Delta Blue Carbon - 1
Second Monitoring Report

Document Prepared By:

Indus Delta Capital
The Government of Sindh
and Silvestrum Climate Associates



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Project Proponent(s)	Government of Sindh Forest Department Barrack-No.10, Block-4A, Sindh Secretariat, Karachi, Pakistan Indus Delta Capital Limited 43 Whitfield Street, Level 2, London, England W1T 4HD, UK Main Contact: Indus Delta Capital – Mr Nadeem Khan +44 208 532 4500 nadeem.khan@deltabluecarbon.com
Prepared By	Indus Delta Capital; see above Silvestrum Climate Associates – Dr Igino Emmer igino.emmer@silvestrum.com
Validation/Verification Body	Icontech Av. Calle 26 No 69 – 76 / Tower 4 / Floor 9 and 10 – Edificio Elemento, Bogotá D.C, Colombia
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GHG Accounting Period	60 years: 19 February 2015 to 18 February 2075
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History of CCB Status	Issuance Date of Validation Statement: 04-October-2021 Issuance Date of First Verification Statement: 29 July 2022 This is the second Monitoring Report for seeking verification under both the Climate, Community and Biodiversity Standard and the Verified Carbon Standard.

Gold Level Criteria	Phase 1 of Delta Blue Carbon (DBC-1) will meet the Gold Level criteria for climate change adaptation, community and biodiversity, as summarised below. **Climate change adaptation benefits for communities and biodiversity** DBC-1 project has generated climate change adaptation benefits for communities and biodiversity during this second monitoring period. It has contributed to climate related disasters risks reduction in three important ways. Firstly, it has contributed to decrease in the frequency and intensity of climate caused disasters. Secondly, it has decreased vulnerability to these disasters. Thirdly, there has been decrease in exposure to disasters. The project has reduced occurrence and intensity of climate related hazards due to the fact that the planted mangroves attenuate the wave energy of storms surges, and thus reduce the damaging effects of floods and slow the progression of saline water into inland areas. It has reduced the vulnerability of both communities and biodiversity to different negative impacts of climate change by providing them with additional and alternative means of livelihood for people and additional and alternative habitat areas for wildlife. DBC-1 has decreased people's and biodiversity exposure to the negative impacts of climate caused hazards by creating awareness and capacities among communities and provision of safe places to migrate to for biodiversity, reduction of fragmentation of wildlife habitat and creation of awareness among communities about the value of wildlife and biodiversity thereby contributing to reduced human-wildlife conflict. Project activities that have contributed to it include restoration of degraded and de-vegetated mangrove lands over an area of 83,034 ha, increased and diversified livelihood sources on account of jobs creation in mangrove restoration work, social organization and mobilization of local communities as well as their institutional strengthening and increased awareness about the impacts of climate change. Biodiversity adaptation benefits have resulted from the restoration of habitat and biodiversity corridors that have led to greater feeding, breeding and nesting places as well as increased protection due to provision of migration opportunities. **Community** More than 42,000 people live in 60 coastal villages within the Project Zone. They meet the definition of smallholder/marginal groups as defined by international and national standards of deprivation, poverty and marginality. More than 70% of the people in the Project Zone live below the poverty line and survive on less than US$ 1.25 a day (2005 purchasing power parity, PPP). Most communities lack access to safe and affordable drinking water and are deprived of basic education and health and hygiene facilities.

They also lack proper housing and shelter facilities and are highly vulnerable to various types of disasters, including cyclones, floods and droughts.

During the second monitoring period the project implemented various community development activities which have generated both short-term and long-term benefits for communities for all community groups including women and vulnerable/marginalized groups. Implemented activities include trainings in alternatives livelihoods earning for both male and female community members, creation of employment opportunities in mangrove restoration and conservation works, provision of health facilities as well as improved access to different health facilities, provision of safe drinking water facilities, provision of civic facilities, and doing foundational work for increasing access to educational and cultural and recreational/historical facilities. In addition, it has organized both male and female community members into village level organizations in the form of village development committees (VDCs) and women organizations (WOs).

Biodiversity

DBC-1 is being implemented in the coastal portion of the Indus eco-region, which is one of the 40 most biologically rich ecoregions in the world. The Project Zone meets the Key Biodiversity Area (KBA) definition on account of both vulnerability and irreversibility criteria. It is characterised by the presence of threatened biodiversity, geographically restricted biodiversity, ecological integrity, biological processes and irreplaceability in a threatened arid zone mangrove ecosystem.

The region is home to 11 globally threatened species (according to the IUCN Red List), including the Indus River dolphin (*Platanista gangetica* ssp. minor; EN), the Indian Ocean humpback dolphin (*Sousa plumbea*; EN), the Indian pangolin (*Manis crassicaudata*; EN) and the fishing cat (*Prionailurus viverrinus*; VU). Compared to baseline situation, there is increase in and improved species diversity (both floral and faunal) as well as increase in the area of different biodiversity related HCVs (HCV1,2 and 3) areas.

Project activities which have contributed to biodiversity and HCVs conservation include restoration and sustainable management of degraded areas, identification and mapping of HCVs areas, increased and effective law enforcement, awareness raising and training and capacity building activities, and mobilization of human, technical, material and financial resources for biodiversity and HCVs conservation.

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1 SUMMARY OF PROJECT BENEFITS

1.1 Unique Project Benefits

Outcome or Impact	Achievements during the Monitoring Period	Section Ref	Achievements during the Project Lifetime
1) Improved protection from storm surges and other coastal hazards for communities and coastal infrastructure	(HCV4) Number of community members benefiting: 2,755 Plantations to date during M-2 period have helped to protect the infrastructure of 16 villages in the Project Zone.	4.1.4 and 4.4.1	(HCV4) People benefiting: 24,099 Communities and infrastructure protected: 51 villages
2) A significant increase in spawning places for fisheries, shrimps and other marine life. This impact is estimated to boost income from fishing	(HCV5) 35 % of 35,797 fishing community members reporting benefiting: 12,529 There are 49 villages in the Project Zone where the primary activity is fishing, benefiting from DBC-1 restoration activities.	4.1.4 and 4.4.1	(HCV5) 60 % of 35,797 fishing community members reporting benefiting: 21,478 (HCV5) Number of fishing Villages benefiting: 49
3) Conservation of Historical and Cultural Heritage Sites and Cultural Artefacts	(HCV6) Community members benefiting: 1,994 6 villages near the area of historical significance, the Jhaki Bandar Fort, benefitting from DBC-1 intervention and survey for conservation and protection of this ancient monument,	4.1.4 and 4.4.1	(HCV6) People benefiting: 3,831 No. of Villages benefiting: 6
4) Inspiration, knowledge and information services. Many artists, musicians, academicians and researchers get inspiration, knowledge and information from mangrove forests and their ecosystems	(HCV6) Community members benefiting: 2,134 Areas with high potential for eco-tourism are conserved and protected near 6 villages.	4.1.4	(HCV6) People benefiting: 7,596 No. of Villages where people are benefiting: 6
5) Aesthetic values and iconic spaces. Tidal wetlands areas are iconic landscapes and seascapes with immense aesthetic values and opportunities for spiritualism and places for	(HCV6) Community members benefiting: 1,421 Sites of special significance were identified and conserved near 6 villages.	4.1.4	(HCV6) People benefiting: 3,256 No. of Villages where people are benefiting: 6

recreation and being part of the nature			

1.2 Standardised Benefit Metrics

Category	Metric	Achievements during Monitoring Period	Section Ref	Achievements during the Project Lifetime
GHG emission reductions & removals	Net estimated emission removals in the project area, measured against the without-project scenario	1,939,872.30 tCO_2e	3.1.2 and 3.2.4	5,437,031.84 tCO_2e
	Net estimated emission reductions in the project area, measured against the without-project scenario	Not Applicable		
Forest[1] cover	For REDD[2] projects: Number of hectares of reduced forest loss in the project area measured against the without-project scenario	Not Applicable		
	For ARR[3] projects: The number of hectares of forest cover increased in the project area measured against the without-project scenario	9,909 ha	3.1.2 and 3.1.3.5	83,034 ha
Improved land management	Number of hectares of existing production forest land in which IFM[4] practices have occurred as a result of the project's activities, measured	Not Applicable		

[1] Land with woody vegetation that meets an internationally accepted definition (e.g., UNFCCC, FAO or IPCC) of what constitutes a forest, which includes threshold parameters, such as minimum forest area, tree height and level of crown cover, and may include mature, secondary, degraded and wetland forests (VCS Program Definitions)

[2] Reduced emissions from deforestation and forest degradation (REDD) - Activities that reduce GHG emissions by slowing or stopping conversion of forests to non-forest land and/or reduce the degradation of forest land where forest biomass is lost (*VCS Program Definitions*)

[3] Afforestation, reforestation and revegetation (ARR) - Activities that increase carbon stocks in woody biomass (and in some cases soils) by establishing, increasing and/or restoring vegetative cover through the planting, sowing and/or human-assisted natural regeneration of woody vegetation (*VCS Program Definitions*)

[4] Improved Forest Management (IFM) - Activities that change forest management practices and increase carbon stock on forest lands managed for wood products such as saw timber, pulpwood and fuelwood (*VCS Program Definitions*)

Category	Metric	Achievements during Monitoring Period	Section Ref	Achievements during the Project Lifetime
	against the without-project scenario			
	Number of hectares of non-forest land in which improved land management has occurred as a result of the project's activities, measured against the without-project scenario	Not Applicable		
Training	Total number of community members who have improved skills and/or knowledge resulting from training provided as part of project activities	The total number of community members who have improved skills is 378.	2.1.10 and 4.1.1	The total number of community members who have improved skills is 812
	Number of female community members who have improved skills and/or knowledge resulting from training provided as part of project activities of project activities	Total number of female community members who have improved skills and/or knowledge resulting from awareness raising-cum-training activities: 215	2.1.10 and 4.1.1	Total number of female community members who have improved skills and/or knowledge resulting from awareness raising-cum-training activities: 425
Employment	Total number of people employed in of project activities[5] expressed as the number of full-time employees[6]	Total employment: 1,246 Detail is as under: Employment in ARR activities: 1,096 Employment in Mangrove Stewardship Agreements: 150 households	2.1.10 and 4.1.1	Total employment: 11,656 Detail is as under: Employment in ARR activities: 11,370 Employment in Mangrove Stewardship

[5] Employed in project activities means people directly working on project activities in return for compensation (financial or otherwise), including employees, contracted workers, sub-contracted workers and community members that are paid to carry out project-related work.

[6] Full time equivalency is calculated as the total number of hours worked (by full-time, part-time, temporary and/or seasonal staff) divided by the average number of hours worked in full-time jobs within the country, region or economic territory (adapted from UN System of National Accounts (1993) paragraphs 17.14[15.102];[17.28])

Category	Metric	Achievements during Monitoring Period	Section Ref	Achievements during the Project Lifetime
				Agreements: 286 households
	The number of women employed in project activities expressed as the number of full-time employees	Total employment: 128 Detail is given below: Employment in ARR activities: 125 Employment in Mangrove Stewardship Agreements: 3 female-led households	2.1.10 and 4.1.1	Total employment: 1,158 Detail is given below: Employment in ARR activities: 1,152 Employment in Mangrove Stewardship Agreements: 6 female-led households
Livelihoods	Total number of people with improved livelihoods[7] or income generated as a result of project activities	ARR + MSAs: 2,446 Number of families benefiting from Mangrove Stewardship Agreements (MSAs): 150 households@9 persons per household is 1,350 persons	2.1.10 and 4.1.1	ARR + MSAs: 14,230 No. benefiting from Mangrove Stewardship Agreements (MSAs): 286 HH@2,574 persons
	Number of women with improved livelihoods or income generated as a result of project activities	ARR + MSAs: 140 (125+15) Number of community members benefiting from Mangrove Stewardship Agreements: 3 households @ 5	2.1.10 and 4.1.1	ARR + MSAs: 1,188 (1,158+30) No. benefiting from Mangrove Stewardship Agreements: 6 households @ 5 females per

[7] Livelihoods are the capabilities, assets (including material and social resources) and activities required for a means of living (Krantz, Lasse, 2001. *The Sustainable Livelihood Approach to Poverty Reduction*. SIDA). Livelihood benefits may include benefits reported in the Employment metrics of this table.

Category	Metric	Achievements during Monitoring Period	Section Ref	Achievements during the Project Lifetime
		females per household is 15 females		household is 30 females
Health	Total number of people for whom health services were improved as a result of project activities, measured against the without-project scenario	Total beneficiaries: 8,300	2.1.10 and 4.1.1	Total beneficiaries: 23,424 Detail is as follows: Mobile health dispensary beneficiaries: 5,494 Community members benefiting from improved health access through a rural health centre and ambulance services: 17,263 Beneficiaries of Covid vaccinations: 667
	Number of women for whom health services were improved as a result of project activities, measured against the without-project scenario	Total women beneficiaries: 3,600	2.1.10 and 4.1.1	Total women beneficiaries: 11,262 Detail is given below: Mobile health dispensary beneficiaries: 2,792 Beneficiaries of improved health access through rural health centre and ambulance services: 8,083 Number of women receiving COVID vaccination: 387

Category	Metric	Achievements during Monitoring Period	Section Ref	Achievements during the Project Lifetime
Education	Total number of people for whom access to, or quality of, education was improved as a result of project activities, measured against the without-project scenario	Total: 387 (225 boys and 161 girls)	2.1.10 and 4.1.1	Total: 773 (451 boys and 322 girls)
	Number of women and girls for whom access to, or quality of, education was improved as a result of project activities, measured against the without-project scenario	Preliminary foundational and needs assessment work done in girl schools having student enrolment of 161	2.1.10 and 4.1.1	Preliminary foundational and needs assessment work done in girl schools having student enrolment of 322
Water	Total number of people who experienced increased water quality and/or improved access to drinking water as a result of project activities, measured against the without-project scenario	Number of community members with improved access to safe and affordable drinking water facilities: 400	2.1.10 and 4.1.1	No. of community members/ people with improved access to safe and affordable drinking water facilities: 800
	Number of women who experienced increased water quality and/or improved access to drinking water as a result of project activities, measured against the without-project scenario	Number of women with improved access to safe and affordable drinking water facilities: 150	2.1.10 and 4.1.1	No. of women with improved access to safe and affordable drinking water facilities: 300
Well-being	Total number of community members whose well-being[8] was improved as a result of project activities	Number of community members/ people whose well-being was improved as a result of project activities (Livelihoods+ Trainings+ Health+ Education +Water): 12,061	2.1.10 and 4.1.1	No. of community members/ people whose well-being was improved as a result of project activities (Employment+ Trainings+ Health+ Education + Water): 38,815

[8] Well-being is people's experience of the quality of their lives. Well-being benefits may include benefits reported in other metrics of this table (e.g.,Training, Employment, Health, Education, Water, etc.), but could also include other benefits such as empowerment of community groups, strengthened legal rights to resources, conservation of access to areas of cultural significance, etc.

Category	Metric	Achievements during Monitoring Period	Section Ref	Achievements during the Project Lifetime
	Number of women whose well-being was improved as a result of project activities	Number of women whose well-being was improved as a result of project activities (Livelihoods+ Trainings+ Health+ Education +Water): 4,266	2.1.10 4.1.1 and 4.4.3	No. of women whose well-being was improved as a result of project activities (Livelihoods+ Trainings+ Health+ Education +Water): 13,479
Biodiversity conservation	Change in the number of hectares significantly better managed by the project for biodiversity conservation,[9] measured against the without-project scenario	Restored degraded biodiversity habitat: 9,909 ha Conserved and protected biodiversity related HCV-1,2 and 3 areas Conserved and enhanced habitat conditions for a number of species of special concern. These include Indian Ocean Humpback Dolphin (vulnerable), Egyptian Vulture (endangered), Fishing Cat (vulnerable), Dalmatian Pelican (near threatened).	5.1.1	Restored degraded biodiversity habitat: 83,034 ha Conserved and protected biodiversity related HCV-1,2 and 3 areas Conserved and enhanced habitat conditions for a number of species of special concern. These include Indian Ocean Humpback Dolphin (vulnerable), Egyptian Vulture (endangered), Fishing Cat (vulnerable), Dalmatian Pelican (near threatened).
	Number of globally Critically Endangered or Endangered species[10] benefiting from reduced threats as a result of project activities,[11] measured against the without-project scenario	Species include: Indus River dolphin; Indian Ocean humpback dolphin; Dalmatian Pelican and Egyptian vulture as well as Fishing Cat which is a vulnerable species.	5.1.1 5.1.4 and 5.4.1	Species include: Indus River dolphin; Indian Ocean humpback dolphin; Dalmatian Pelican and Egyptian vulture as well as Fishing Cat which is a vulnerable species.

[9] Biodiversity conservation in this context means areas where specific management measures are being implemented as a part of project activities with an objective of enhancing biodiversity conservation.

[10] Per IUCN's Red List of Threatened Species

[11] In the absence of direct population or occupancy measures, measurement of reduced threats may be used as evidence of benefit

Category	Metric	Achievements during Monitoring Period	Section Ref	Achievements during the Project Lifetime

2 GENERAL

2.1 Project Description

2.1.1 Implementation Description

Project activities that have been implemented during this second monitoring period of 01 November 2021 to 31 March 2023 (M-2) are highlighted below (see section 4.3.1 for more details about each project activity):

- Mangrove restoration of degraded and de-vegetated lands over an area of 9,909 ha under the planting cohort 2021.
- Maintenance and sustainable management of the already restored mangrove lands of 83,034 ha under the planting cohorts of 2015 to 2021 during the M-2 period
- Providing jobs and income-earning opportunities for both male and female populations in the Project Zone
- Local communities' engagement in mangroves, biodiversity and fisheries conservation and sustainable management through measures like Mangroves Stewardship Agreements
- Participatory land-use planning over an area of 224,997 hectares
- Ensuring greater access to health facilities for local communities through the provision of a mobile health unit, facilitation of an existing rural health centre, provision of ambulance, medicines and medical supplies and equipment
- Rehabilitation of one non-functional Reverse Osmosis (RO) plant and operationalisation of another five RO plants for provision of safe drinking water and improving hygiene facilities
- Provision of civic facilities through the construction of a community centre
- Conducting foundational activities for improved access to education through surveying schools, students enrolled in these schools and assessing needs for increasing enrolment, students' attendance and improving the learning environment in these educational facilities
- Awareness-raising, training and capacity building through a number of Social and Biodiversity Impact Assessment Surveys, PRAs, household surveys and other meetings and talks
- The organisation of local communities into village development committees (VDCs) and Women Organisations (WOs)




Figure 1. DBC-1 has undertaken large scale restoration work in the delta through a plantation programme

- Improved implementation of natural resources and biodiversity conservation-related laws, rules and regulations
- Holding sensitisation sessions about biodiversity and High Conservation Values Areas and sustainable management
- Surveying and assessment of cultural and recreational facilities in the Project Zone

To date, until the end of February 2023, the project has restored, protected, conserved and sustainably managed the restored de-vegetated and degraded mangrove lands of 83,034 ha until and including the year 2021. The ARR/RWE activities of DBC-1 planting cohorts of 2015 to 2021 have so far (from February 2015 to February 2023) sequestered 5,437,031.84 tCO2e. During First Monitoring period (M-1) from February 2015 to 31 October 2021 the restored/planted areas had sequestered 3,497,159.54 tCO2e in planting cohorts 2015 to 2020. During this M-2 period (01 November 2021 to 28 February 2023) the total carbon removals are 1,939,872.30 tCO2e. All project activities related to climate change mitigation and adaptation, biodiversity and HCVs conservation and community development implemented have demonstrated a high degree of success in terms of their impacts, sustainability, replicability and all-around engagement of communities.

Non-permanence risk factors from various sources have been closely monitored using the project's climate monitoring and disturbance monitoring procedures for all internal and external risk factors, including risk resulting from natural factors, as described in section 3.1.3. No events, either in the internal environment or external context, or activities have happened during the period that have affected or could have affected the GHG removals of the project. In line with PD provisions, coastal erosion is monitored at 5-year intervals and was done during the first monitoring campaign. During MR-1, coastal erosion of 340.90 ha had happened. Next, coastal erosion estimation will be done in the year 2025. Potential leakage from the project was monitored through the project's leakage procedures. Potential activity-shifting and market leakage have been dealt with as per procedures provided and laid out in the methodology and described in section 3.2.3.1. Potential ecological leakage was determined using the procedures in the PD section 3.2.3.2

There have been no changes to project proponents or other entities.

2.1.2 Project Category and Activity Type

The DBC-1 project falls under the VCS sectoral scope 14: – Agriculture, Forestry, and Other Land Uses (AFOLU). Specifically, the project falls under the tidal wetlands restoration ARR/RWE category of wetlands restoration and conservation (WRC). The project is eligible under these categories by the definitions provided in the VCS AFOLU Requirements as given in section 3.2 of the VCS Standard version 4.4 issued on 17 January 2023 by virtue of the fact that it removes atmospheric carbon dioxide on account of mangroves restoration on de-vegetated and degraded wetlands. Eligible WRC activities include: (1) Restoring Wetland Ecosystems (RWE) and (2) Conservation of Intact Wetlands (CIW). This project falls under the RWE category which includes activities that reduce GHG emissions or increase carbon sequestration in a degraded wetland through restoration activities. Such activities include enhancing, creating and/or managing hydrological conditions, sediment supply, salinity characteristics, water quality and/or native plant communities.

DBC-1 is not a grouped project type under the VCS standard and the CCB Programmatic approach.

2.1.3 Project Proponent(s)

Organisation name	Indus Delta Capital (IDC) Limited
Contact person	Mr. Nadeem Raza Khan
Title	CEO
Address	43 Whitefield Street, Level 2, London, England, W1T 4HD, UK

Telephone	+44 20 85324500
Email	Nadeem.khan@deltabluecarbon.com

Organisation name	Government of Sindh, Forest and Wildlife Department
Contact person	Mr. Riaz Wagan
Title	Chief Conservator of Forests, Sindh (Mangroves and Rangelands)
Address	Secretary Forests and Wildlife Department, Barrack No. 10, Block- 4A, Sindh Secretariat, Karachi, Pakistan.
Telephone	+92 21 99203105 or +92 3002391663
Email	riazwagan@yahoo.com

2.1.4 Other Entities Involved in the Project

Organisation name	Silvestrum Climate Associates
Role in the project	Wetlands Methodology and Forest Carbon Project Development
Contact person	Dr. Igino Emmer
Title	Principal, Carbon Project Development
Address	25 Taylor Street, San Francisco, CA 94102, USA
Telephone	+31 653699610
Email	Igino.emmer@silvestrum.com

Organisation name	Blue Ventures
Role in the project	Sustainable Fisheries and Communities Development
Contact person	Ms. Leah Glass
Title	Technical Advisor, Mangroves and Blue Carbon
Address	Mezzanine, The Old Library, Trinity Road, St. Jude's, Bristol, BS2 0NW, UK
Telephone	+44 20 76978598
Email	leah@blueventures.org

Organisation name	Pollination
Role in the project	Due Diligence, Carbon Marketing and Financial Resources Mobilization
Contact person	Mr. Martijn Wilder

Title	Founding Partner
Address	Level 4 346 Kent Street, Sydney NSW Australia 2000
Telephone	+61 2 8313 7109
Email	martijn.wilder@pollinationgroup.com

Organisation name	Pakistan Forest Institute
Role in the project	Research and Development and Biomass and Soil Carbon Assessment
Contact person	Dr. Anwar Ali
Title	Director, Forestry Research
Address	Pakistan Forest Institute, University of Peshawar, Pakistan
Telephone	+92 333 5068176
Email	anwerforester@gmail.com

2.1.5 Project Start Date (G1.9)

The project start date for DBC-1 is 19 February 2015, when the public-private partnership agreement between Sindh Forest Department and Indus Delta Capital Ltd was executed.

2.1.6 Project Crediting Period (G1.9)

The project lifetime is 60 years, commencing from the project start date of 19 February 2015 and culminating on the project end date of 18 February 2075. The crediting (GHG accounting) period is the same 60-year period as the project lifetime.

2.1.7 Project Location

Project area is located in Thatta and Sujawal districts in Sindh Province, Pakistan. The project area comprises of degraded and de-vegetated mangrove lands which are under the management responsibility of Sindh Forest Department and are declared as Protected Forest lands. The over-all project zone extends over an area of 350,000 ha. Area that has been tackled under ARR so far is 83,034 ha. Total Area that will be tackled under ARR activities under this project during the lifetime of the project is 224,997 ha. The project boundary includes deforested mangrove habitats and future wetlands due to sea-level rise.

Project Area Extent Boundaries are given in the following table:

Table 1. Project Area Extent Boundaries

Extent Boundary	Location (Easting, Northing UTM Zone 42N)
Northern Extent GPS Point	399845.43m E, 2687145.84m N
Eastern Extent GPS Point	425833.82m E, 2675297.60m N
Southern Extent GPS Point	337553.67m E, 2656048.05m N
Western Extent GPS Point	317896.66m E, 2734708.54m N

Maps containing the VM0033 Methodology Monitoring Report Requirements (MRR) are given below. Planted areas for the period 2015 to 2021 have been reported in the validated PD. Ground truthing of these planted areas was undertaken during this monitoring campaign as well as the first monitoring campaign. The ground-truthing field measurements collected during the first monitoring campaign had revealed some minor anomalies. A few planted areas polygons were found to be lying outside or partially outside the project area map compiled for the PD. The required rectification therefore was completed, as is detailed below. During this monitoring campaign no anomalies have been observed at the time of ground-truthing.

Table 2. Polygons whose area, prior to rectification, was lying either wholly or partially outside the Project Area boundary

Stratum	Polygon ID	Area of the polygon that was partially outside the initial project area map (ha)	Area of the polygon that was completely outside the initial project area map (ha)	Corrective action taken
2015	A-09		85.54	The area has been added to the project area and map boundaries rectified accordingly.
	A-10		2.17	The area has been added to the project area and laid out map boundaries rectified accordingly.
	A-11	86.68		Total area of the polygon is 94.86 ha. Out of this total area, 8.18 ha was lying inside laid out map while 86.68 was lying outside. The outside lying area has now been added and map boundaries corrected accordingly.
	A-41		42.76	The area has been added to the project area and map boundaries rectified accordingly.
	A-42	0.37		Total area of the polygon is 58.64 ha. Out of this total area, 58.27 ha was lying inside laid out map while 0.37 was lying outside. The outside lying area has now been added and map boundaries corrected accordingly.
	A-96		8.91	The area has been added to the project area and laid out map boundaries rectified accordingly.
2016	B-10	4.01		Total area of the polygon is 245.14 ha. Out of this total area, 241.13 ha was lying inside laid out map while 4.01 was lying outside.

Stratum	Polygon ID	Area of the polygon that was partially outside the initial project area map (ha)	Area of the polygon that was completely outside the initial project area map (ha)	Corrective action taken
				The outside lying area has now been added and map boundaries corrected accordingly.
	B-24	1.52		Total area of the polygon is 3.27 ha. Out of this total area, 1.75 ha was lying inside laid out map while 1.52 was lying outside. The outside lying area has now been added and map boundaries corrected accordingly.
2017	C-05	2.90		Total area of the polygon is 164.27 ha. Out of this total area, 161.37 ha was lying inside laid out map while 2.90 was lying outside. The outside lying area has now been added and map boundaries corrected accordingly.
	C-41	8.79		Total area of the polygon is 574.49 ha. Out of this total area, 565.70 ha was lying inside laid out map while 8.79 was lying outside. The outside lying area has now been added and map boundaries corrected accordingly.
2019	E-09	18.52		Total area of the polygon is 94.10 ha. Out of this total area, 75.58 ha was lying inside laid out map while 18.52 was lying outside. The outside lying area has now been added and map boundaries corrected accordingly.
	E-12	0.42		Total area of the polygon is 44.43 ha. Out of this total area, 44.01 ha was lying inside laid out map while 0.42 was lying outside. The outside lying area has now been added and map boundaries corrected accordingly.
	E-13	1.65		Total area of the polygon is 1.92 ha. Out of this total area, 0.27 ha was lying inside laid out map while 1.65 was lying outside. The outside lying area has now been added and map boundaries corrected accordingly.

Stratum	Polygon ID	Area of the polygon that was partially outside the initial project area map (ha)	Area of the polygon that was completely outside the initial project area map (ha)	Corrective action taken
2020	F-09		134.90	The area has been added to the project area and map boundaries rectified accordingly.
	F-10	12.58		Total area of the polygon is 215.50 ha. Out of this total area, 202.92 ha was lying inside laid out map while 12.58 was lying outside. The outside lying area has now been added and map boundaries corrected accordingly.
	F-19	9.13		Total area of the polygon is 258.04 ha. Out of this total area, 248.91 ha was lying inside laid out map while 9.13 was lying outside. The outside lying has now been added and map boundaries corrected map accordingly.

There has been no change in the total project area on account of these adjustments. As a result of this monitoring activity the project area and precise geographic boundaries have been accurately mapped and presented in this document. The Project Area map in 2022 is given below:

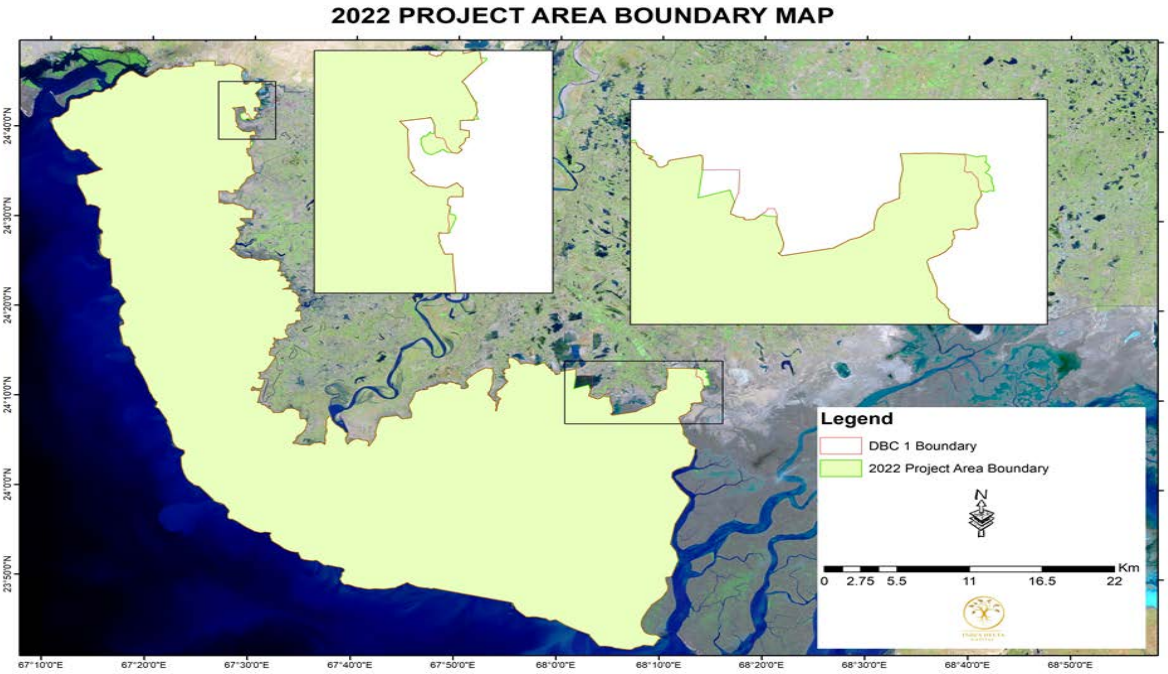


Figure 2. 2022 map of the DBC-1 project area following first monitoring campaign

2.1.8 Title and Reference of Methodology

VCS methodologies and modules

Available at: https://verra.org/methodologies/

VM0033 Methodology for Tidal Wetland and Seagrass Restoration, v2.0

VCS module VMD0019 Methods to Project Future Conditions, v1.0

VMD0052 Demonstration of Additionality of Tidal Wetland Restoration and Conservation Project Activities (ADD-AM), v1.0

CDM methodologies and tools

Available at: https://cdm.unfccc.int/methodologies/ARmethodologies/approved and https://cdm.unfccc.int/methodologies/ARmethodologies/tools/

CDM AR Tool for testing significance of GHG emissions in A/R CDM project activities, v1.0

CDM AR Tool 2 Combined tool to identify the baseline scenario and demonstrate additionality for A/R CDM project activities, v1.0

CDM AR Tool 3 Calculation of the number of sample plots for measurements within A/R CDM project activities, v2.1

CDM AR Tool 5 Estimation of GHG emissions related to fossil fuel combustion in A/R CDM project activities, v1.0

CDM AR Tool 14 Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities, v4.2

2.1.9 Other Programmes (G5.9)

DBC-1 has been validated under the VCS standard as well as the Climate, Community, and Biodiversity (CCB) standard, Third Edition, for triple gold level.

The project seeks to generate carbon credits under the VCS Standard, under which it is validated and will not seek additional environmental or social credits.

The project is not participating in any other emission trading programmes and other binding limits, nor does it intend to participate in any other programme. Since the project has neither received nor sought another form of GHG-related environmental credit, including renewable energy certificates, during this monitoring period; therefore, the question of providing relevant information and list of all and any other programs under which the project is eligible to create another form of GHG-related environment credit is not applicable.

The project is not registered under any other GHG programs.

2.1.10 Sustainable Development

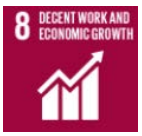
DBC-1 project has contributed to the achievement of the SDGs. Details of these SDG contributions are given in Appendix 4 and 5. A summary is included below.

No poverty, decent work and economic growth (*SDG 1, 8*)

Beneficiaries: MR-2 Period: 2,446; Cumulative: 12, 856



Stakeholders have benefited from and will continue to benefit from direct employment in the project and its livelihood enhancement measures. The project has a 60-year lifetime and employs many local community members across multiple capacities. It is also working with the most vulnerable and impoverished communities, focusing on providing livelihood support to the neediest members and contributing to the achievement of SDG 1 and 8.



Project stakeholders have benefited from employment in the project and from livelihood enhancement activities. These activities have improved local incomes and laid down the foundations for a low-carbon economy. The project will last for another 53 years and will continue to employ local stakeholders in a variety of ways, including forest protection, degraded wetlands restoration, supporting the implementation of various other project activities, as well as livelihood enhancement from increased business opportunities in the Project Zone.

No hunger and reduced inequalities (*(SDG 2, 10)*

No Hunger beneficiaries: MR-2 Period: 1,246; Cumulative: 10,195

Reduced inequalities beneficiaries: MR-2 Period: 355; Cumulative; 3,983



One of the goals of Pakistan Sustainable Development Agenda is to reduce hunger, inequalities and lower poverty levels in rural and poverty-stricken areas like the Indus Delta area. DBC-1 supports these objectives by reducing living costs by providing access to various services at a local level and generating employment, and supporting an increase in household incomes for all socio-economic groups, particularly women and other vulnerable groups.



Several other project interventions contribute to the achievement of these goals in the Project Zone. These include the development of plans for sustainable fishing and improvements in agriculture and livestock production.

Good health and well-being, clean water and sanitation (*SDG 3, 6*)

Health beneficiaries: MR-2 Period: 8,300; Cumulative: 23,424

Clean water and sanitation beneficiaries: MR-2 Period: 400; Cumulative: 800



A core goal of DBC-1 is the improved well-being of communities in the Project Zone. This is achieved by providing community members with access to affordable and quality health care facilities within easy reach.



The project also has specific provisions for ensuring community access to safe and clean drinking water throughout the Project Zone and is also working on improving sanitation and hygiene facilities in the most isolated areas within the delta.

Quality education (*SDG 4*)

SDG 4 beneficiaries: MR-2 Period: 387; Cumulative: 773



A critical component of creating economic development and stopping poverty is improving education. During the SBIAs, two types of educational support were requested by local leaders: primary and secondary education, as well as support, to improve adult literacy, particularly amongst women. The project has laid the foundation for achieving these educational objectives by carrying surveys of primary and secondary education facilities in the Project Zone and identifying reasons for low enrolment and low attendance by students.

The DBC-1 project also plans to support primary and secondary education by improving the existing infrastructure and supplementing teacher salaries. With carbon finance bursaries to offset the cost of education to marginalised families will be provided.

Life below water (*SDG 14*)



Conservation of Endangered Species: Monitoring surveys have shown a healthy increase in the Indian Ocean humpback dolphin population within the Project Zone.

The region has also seen an increase in the numbers of certain fish species whose population had fallen below 1% of the total population. Earlier, 12 fish species had a population of less than 1%. Now, this number has fallen to nine species.

The project has worked with and will continue to work with fishing communities in the delta area in pursuit/support of sustainable fishing practices and through its advocacy push for the declaration and proper management of marine and coastal regions of the Indus Delta in selected creeks. It has also chalked out plans to support small-scale artisanal fishing communities within the framework of Fish Stewardship Committees, besides working with relevant partners in the provincial government to implement and enforce applicable national and international sea laws.

Life on land (*SDG 15*)

Restoration of degraded mangrove lands = MR-2 Period: 9,909 ha; Cumulative: 83,034 ha for increased biodiversity conservation



The project has worked on and taken a number of actions that contribute to the conservation, restoration and sustainable use of mangroves forests, coastal biodiversity and their ecosystem services. DBC-1 has restored 83,034 ha of degraded and de-vegetated mangrove lands through plantations and promotion of assisted natural regeneration (ANR). It has also implemented measures to increase the awareness and capacity of local communities and other stakeholders in a bid to end poaching and trafficking of protected species of fauna through several SBIA workshops and effective enforcement of forestry, wildlife, environmental and other natural resources protection laws. Moreover, the proponents are also working on integrating ecosystem and biodiversity values into local, provincial and national planning development processes.

Gender equality (*SDG 5, 16*)

Women employment opportunities created in ARR activities = MR-2 Period: 128; Cumulative: 1,158

Women employment opportunities creation through MSAs **=** 3

Women Organisations formed and consulted = 13





The project is implementing various gender development interventions that contribute to the economic and social empowerment of women at the household and community level. These interventions include the establishment of women organisations, initiation of income generating activities for women in mangroves propagules collection, storage and nurseries raising, and provision of clean drinking water and health and hygiene improvements. *(SDG 5, 10).*

Affordable and clean energy (*SDG 7*)



DBC-1 is promoting the use of renewable and sustainable energy sources through various interventions such as awareness creation about farm forestry for biomass energy. It also contemplates implementing solar energy to selected communities, especially those living in the creeks with carbon finance.

Climate action (*SDG 13*)

HCV-4: Improved protection from storm surges and other coastal hazards for communities and coastal infrastructure. MR-2 Period: 2,755; Cumulative: 24,099

Beneficiary villages: MR-2 Period: 16; Cumulative: 51

HCV-5: Increase in spawning places for fishes, shrimps and crabs. MR-2 Period: 12,529; Cumulative: 21,478

Beneficiary villages: MR-2 Period: 49; Cumulative: 49

HCV-6. Conservation of Historical and Cultural Heritage Sites and Cultural Artefacts. MR-2 Period: 1,994; Cumulative: 3,831

Beneficiary villages: MR-Period: 6; Cumulative: 6

HCV-6. Inspiration, Knowledge and Information Services. MR-2 Period: 2,134; Cumulative: 7,596

Beneficiary villages: MR-2 Period: 6; Cumulative: 6

HCV-6: Aesthetic Values and Iconic landscapes and seascapes. MR-2 Period: 1,421; Cumulative: 3,256

Beneficiary villages: MR-2 Period: 6; Cumulative: 6



DBC-1 is a climate change mitigation project that has directly contributed to GHG emissions reductions and removals by conserving existing mangrove forests and restoring degraded and de-vegetated mangrove lands. It also contributes to mainstreaming environmental and climate change-related concerns into overall development planning at the local, district, provincial and national levels. Furthermore, DBC-1 has strengthened the resilience of communities living within the Project Zone and has supported their adaptation to climate-related hazards and natural disasters through its HCV-4 Areas conservation and sustainable management.

All of Pakistan's sustainable development themes mentioned above, including economic growth and development, poverty and equity, education, life on land including sustainable forest and land-use, life below water, climate change, and health and safe drinking water, will be monitored and reported through the VCS and CCB monitoring, reporting and verification system every year.

2.2 Project Implementation Status

2.2.1 Implementation Schedule (G1.9)

Activities implemented in the period 2013 to 2022 and milestones achieved during the first monitoring period (19 February 2015 to 31 October 2021) and second monitoring period (1 November 2021 to 28 February 2023) are tabulated below. Details are given in Appendix 3.4., which gives description of strategic areas and focal issues addressed as per project theory of change.

Date	Milestone(s) in the project's development and implementation
18 February 2013	Signing of MoU between Government of Sindh and IDC. Preparatory work completed to lay out the foundation for improved coastal resources governance and therefore increased socio-economic well-being of local communities and environmental improvement.
January-December, 2014	Planning of Project with the Government of Sindh and discussions between the parties on main design features of the partnership agreement and the project. Agreement on main elements of collaborative and Improved governance arrangements for mangroves restoration and conservation.
19 February, 2015	Signing of project agreement between Government of Sindh and IDC. Strengthened partnership with government for realization of climate, community and biodiversity objectives of the project.
February 2015 to 31 December 2018	Free, prior and informed consent (FPIC) meetings with local communities for enhanced community participation and role in mangroves restoration, conservation and sustainable management.
19 February 2015 to 31 December 2020	Restoration of 73,125 hectares of degraded mangrove lands.
February 2015-October 2021	Mangrove Stewardship Agreements (MSAs) agreed and executed with local communities. Improved mangrove and other coastal and marine resources protection and law enforcement through institutionalized and strengthened partnerships with coastal communities for improved mangroves protection and conservation and greater availability of mangrove ecosystem goods and services to local communities and other stakeholders.
February 2015-October 2021	Design, development and implementation of training and capacity building activities so as to enhance capacities of communities and stakeholders for coastal resources restoration, conservation and sustainable management as well as increased income earning opportunities and diversified income sources.
September, 2019	Project area boundary demarcation so as to have coordinates and data available for preparation of maps for PD document.
September-October, 2020	Carried out RTK surveys for elevation and real time tide data collection so as to have data available for modelling and estimation of coastal erosion.

February 2015 to October 2021	Enhanced and expanded access to health facilities through provision of new health facilities and strengthening of existing facilitate for improved and expanded access to health facilities.
February 2015 to October 2021	Restored non-functional Reverse Osmosis (RO) plants for ensuring access to safe and affordable drinking water and improved hygiene.
February 2015 to October 2021	Undertook surveys of schools in the project zone to assess their restoration and facilitation requirement for improved access to education by children.
February 2015 to October 2021	Provided civic and community meetings facility fir improved social interactions and opportunities for participatory decision making thereby promoting peace and justice at the community level and greater engagement with project proponents.
February 2015 to October 2021	Undertook site assessment visits to Jhaki Bandar Island Fort and Bhanbore Fort to see the feasibility of preparing conservation plans by the concerned entities for the conservation and restoration of historical, cultural artefacts and heritage sites.
February 2015 to October 2021	Organized men and women into broad-based village development committees and women organizations respectively for local level institutions building, social capital development and social empowerment including reduced inequalities, less marginalization and increased justice and peace.
February 2015 to October 2021	Organized and implemented awareness raising and capacity building meetings, workshops and other events for poverty reduction and reduced inequalities; human capital development and increased opportunities for income earning as well as participation in decision making; and greater appreciation and awareness of wildlife and biodiversity benefits as well as reduced human-wildlife conflicts.
February 2015 to October 2021	Conducted baseline socio-economic studies to collect data for and prepare socio-economic profile of local communities and different community groups.
February 2015 to October 2021	Conducted baseline biodiversity study to collect data for and prepare status of wildlife and biodiversity at the time of the survey.
February 2015 to October 2021	Undertook preliminary carbon stock assessment study for the preparation of growth model for mangrove forests in the Indus Delta Area.
February 2015 to October 2021	Carried out forest patrols on a regular basis for effective law enforcement and conservation of biodiversity and HCVs areas.
February 2015 to October 2021	Conservation of existing mangrove forests and restoration of degraded mangrove lands for the following ecosystem goods and services for local communities and other stakeholder groups as well as realization of community and biodiversity related climate change adaptation benefits: ▪ Provision of employment and income earning opportunities for the different community groups including coastal fishing communities, coastal communities engaged in agriculture and crop husbandry, coastal communities engaged in livestock raising, coastal communities engaged in daily wage paid labour, women and youth, and landless people and other marginalized groups; ▪ Biodiversity conservation through habitat restoration, prevention of habitat fragmentation and conservation of HCV-1,2 and 3 areas; ▪ Conservation of HCV-4,5, and 6 areas for community benefits; and ▪ Realization of community and biodiversity related climate change adaptation benefits.

January-December, 2021	PD preparation and submission to VERRA.
January 2021. Maintenance is on-going activity	Development of project web portal for information dissemination to communities and other stakeholders.
March 2021	Sharing of PD and preparation of relevant PD summary documents in Urdu and Sindhi language for dissemination to local communities and other stakeholders
June 2021	Established co-operation mechanisms with other relevant conservation organizations like IUCN for linkages development in support of biodiversity conservation and community development.
September-October, 2021	Field work and surveys for biomass carbon estimation for first monitoring report preparation
September-October, 2021	Field surveys for biodiversity impact assessment for first monitoring report preparation
September-October, 2021	Field surveys for community and socio-economic impact assessment for first monitoring report preparation
January, 2022	PD validation and project registration by VERRA
February-March, 2022	Monitoring report preparation and submission to VERRA
March, 2022	Monitoring Report and its information dissemination
January 2021 to December 2021	Carrying out restoration of additional degraded and de-vegetated lands over an area of 9,909 ha
1 November 2021 to 28 February 2023	Engagement of additional 14 community households as Mangrove Stewards
1 November 2021 to 28 February 2023	Continuation of existing 136 MSA including the 3 women Household MSAs
1 November 2021 to 28 February 2023	Continued and expanded provision of health services to local communities
1 November 2021 to 28 February 2023	Continued provision of safe and affordable drinking water supplies to local communities
1 November 2021 to 28 February 2023	Continued support for educational facilities improvement to the project zone communities
1 November 2021 to 28 February 2023	Discussion and finalization of MoU with Department of Archaeology, Culture and Tourism for continued conservation of Bhanbore Fort and other archaeological and cultural heritage sites in the project areas
1 November 2021 to 28 February 2023	Continued support to existing VDCs and WOs in the project zone
1 November 2021 to 28 February 2023	Implementation of -----number of training and awareness sessions on hygiene and safe drinking water
1 November 2021 to 28 February 2023	Implementation of ------number of training and awareness sessions on narcotic and substance abuse
1 November 2021 to 28 February 2023	Food aid and other support to floods and rains affected people in the Project Zone communities

1 November 2021 to 28 February 2023	Continued and expanded patrols for forest protection
1 November 2021 to 28 February 2023	Continued and expanded patrols for wildlife and biodiversity conservation
1 November 2021 to 28 February 2023	Linkages development for partnerships development with academic and research institutions
June 2021	Established co-operation mechanisms with other service providing organizations like SHINE Humanity for provision of health services to communities including women and other marginalized groups. linkages development in support of biodiversity conservation and community development.
1 November 2021 to 28 February 2023	Established co-operation arrangements with the Lasbela University of Agriculture, Water and Marine Sciences (LUAWMS) for supporting biodiversity component of DBC-1 project including monitoring of CCB Biodiversity Monitoring Plan of the Project.
September-October, 2021 to February 2023	Field work and surveys for biomass carbon estimation for second monitoring report preparation
September-October, 2021 to February 2023	Field surveys for biodiversity impact assessment for second monitoring report preparation
September-October, 2021 to February 2023	Field surveys for community and socio-economic impact assessment for second monitoring report preparation
January, 2022	Marketing and sale of issued VCUs
September-October, 2021 to February 2023	Working with Government of Sindh for preparation of plan for spending carbon revenues on upscaling community development and other project related interventions
March 2023	Preparation and dissemination of English Summary of Second Monitoring Report
March, 2023	Preparation of Second Monitoring report and sharing of its findings to the local communities and other stakeholders
March 2023	Preparation and dissemination of Urdu and Sindhi Summary of Second Monitoring Report to communities and other stakeholders
June 2023	Submission of the Second Monitoring Report to VERRA for public comment period on their website
July, 2023	Engagement of VERRA approved Verification Body for carrying out Monitoring Report and its information dissemination

Details about the socio-economic surveys carried out for this second monitoring report are given in Appendix 6 as well as in a separate file folder maintained for the purpose.

All the key dates and milestones in the project's development and implementation (e.g., dates of construction, commissioning, start of project activities, legal/community agreements and continued operation periods) have been completed as per the implementation schedule, and there have been no changes since the project validation.

2.2.2 Methodology Deviations

There have been no methodology deviations or the criteria and procedures for monitoring that affect the applicability of the methodology, additionality, or the baseline scenario's appropriateness. Therefore, the project remains in compliance with the applied methodology, VM0033.

2.2.3 Minor Changes to Project Description (*Rules* 3.5.6)

There have been no community or biodiversity changes to project design that would either require or not require a project description deviation that occurred during the monitoring period compared with the validated project description. Project implementation and monitoring have been done in conformance with the Climate, Community & Biodiversity Standards criteria and indicators.

2.2.4 Project Description Deviations (*Rules* 3.5.7 – 3.5.10)

Three project description deviations from the validated PD have been applied during the first monitoring period. These relate to the rectification of the area of the strata since the validation, the use of more appropriate allometric equations than the ones given in the PD for *Avicennia marina*, and reasons for not validating separate allometric equations for *Ceriops tagal* and *Aegiceras corniculatum* in the validated PD and their biomass inclusion in GHG removals estimation. All these Project Description deviations are permissible at verification as per Rule 3.19.1 of the VCS Standard dated 20 January 2022. These deviations do not impact the applicability of the methodology, additionality or the appropriateness of the baseline scenario. Since these deviations do not affect the applicability of the methodology, additionality or appropriateness of the baseline scenario and the project remains in compliance with the methodology; therefore, these neither require a revision of the PD document nor a description and justification in a revised version of the PD.

The applied project description deviations are described and justified as under:

Rectification of the area of strata since validation

Ground truthing of the planted areas from 2015 to 2020 was undertaken at the time of this first monitoring campaign. The ground truthing exercise revealed that there were certain planted areas polygons whose area was either wholly or partially lying outside the project area boundary. Similarly, water bodies equivalent to the excluded area had creeped into the area calculation of planted areas. This situation warranted rectification of the areas of planted polygons, which was accordingly undertaken. Details of all these polygons where area rectifications have been done are given in Table 2 (Polygons whose area, prior to rectification, was lying either wholly or partially outside the Project Area boundary) in section 2.1.7. Year-wise ARR area (ha) as per PD and Rectified Area (ha) are given in Table 11 (ARR areas in ha as per PD, Rectified ARR Areas in ha, LOSS Area in ha, and Persistent Planted Area in ha) in section 3.1.3.5.

As a result of this rectification the planted ARR during the monitoring period has changed from ARR area as per PD from 75,565 ha to Rectified ARR area of 73,465.85 ha. Part of the rectified areas have also been lost due to erosion. The net and Persistent ARR area now is 73,124.95 ha. However, there has been no change in the total project area on account of these adjustments and it still remains 224,997 ha. Due to this rectification activity, the planted ARR area and the precise geographic boundaries of the planted ARR area have been accurately mapped and presented in the monitoring report.

Use of different allometric equations for *Avicennia marina*

The allometric equations used for estimation of aboveground and belowground biomass of *Avicennia marina* species have been changed from the ones detailed in the PD based on additional research and to reflect the actual ground situation concerning the species biomass accumulation rate in the two carbon pools of aboveground biomass and belowground biomass. The PD had proposed the use of Fu and Wu 2011 allometric equation for aboveground biomass estimation ($1.8247 * (C^2 * H)^{1.0202}$). This allometric equation has been replaced with Chatting et al 2020 (Log (AG) = 2.14 x Log (CD) + 0.20).

This latter equation is more appropriate for the Indus Delta region because of the greater similarity of stand characteristics of Arid Zone Qatar Mangroves to Indus Delta Mangroves in terms of tree density

per hectare, tree height, tree trunk diameter, tree crown diameter and other morphological features such as being multi-stemmed. Similarly, the site characteristics are more comparable in the two regions because of similarities in salinity levels and other edaphic characteristics and greater comparability of climatic factors such as temperature, precipitation, humidity, etc. Also, the belowground biomass equation given in the PD for the species is that of Pakistan Forest Institute 2019 (BGB= 0.6648*AGB^$^{0.9437}$), which has been replaced with Comley and McGuiness 2005 (BGB=0.923*AGB). Pakistan Forest Institute BGB allometric equation for Avicennia marina did not use data collected locally from the Indus Delta site; instead, it was derived another source that was based on data used by the source equation. Against this, the Comley and McGuiness allometric equation uses data from a source in an arid region in Australia that is more representative of the site conditions in the Indus Delta area. Hence, it is deemed more appropriate to use Comley and McGuiness allometric equation for BGB estimation till we have sufficient data from the Indus Delta area to develop our own allometric equations.

Use of these changed allometric equations mentioned above more accurately represent the aboveground and belowground biomass of the *Avicennia marina* species in the Indus Delta.

Non-validation of separate allometrict equations for *Ceriops tagal* and *Aegiceras corniculatum* and use of their biomass estimates in GHG removals calculations

Separate allometric equations for *Ceriops tagal* and *Aegiceras corniculatum* were not validated in the PD for the following reasons:

- The proportion of both *Ceriops tagal* and *Aegiceras corniculatum* species in the total species composition is small (in fact, less than 2%) due to their specific site requirements. Therefore, their contribution to the total carbon stock in the delta área is also very small.
- These two species are closely related to the other two major species in the Indus Delta. *Ceriops tagal* is closely related to *Rhizophora mucronata* species in tree morphology and biomass content, whereas *Aegicera corniculatum* is related to *Avicennia marina* in biomass accumulation.
- The validated allometric equation of *Rhizophora mucronata* is suitable for biomass estimation of *Ceriops tagal*. Similarly, the validated allometric equation of *Avicennia marina* quite closely estimates the biomass of *Aegicera corniculatum*. Hence, there is likelihood of nil to only insignificant variation in GHG removals on account of the use of the already validated allometric equations for these two species.
- The variation in biomass estimation and HGH removal being *de minimus* on account of the use of already validated allometrict, it is prudent to use the already validated allometric equations.
- In literature the following two species sepcific allometric equations are available for these species as given below:

  Ceriops tagal: AGB = 0.1885 x DBH$^{2.3379}$

  Aegiceras corninulatum: Log AGB = 1.496 + 0.465 x Log (DBH^2 x H)
- Both the above allometric equations are based on DBH. Our plantations being young have not yet reached the stage where DBH measurements can be taken. Therefore, it is better to use the allometric equations of *Avicennia* and *Rhizophora* which are based on crown diameter and D_{30} (diameter at 30 cm from the last prop root) respectively.
- At a later stage, when DBH measurements can be taken for *Ceriops* and *Aegiceras*, we will have the species specific allometric equations validated for their use in future monitoring reports. But for now and in this first monitoring report, it seems more reasonable to use the already validated allometric equations which do not use DBH for aboveground biomass estimation.

Further, the PD says that all present mangrove trees will be included in the monitoring of the project scenario. Therefore, *Ceriops tagal* and *Aegiceras corniculatum* plants present in the sample plots had to be included in biomass carbon estimation. The inclusion of their biomass carbon in GHG emissions and removals at the time of this first monitoring campaign using allometric equations of related species more accurately reflects the GHG emissions and removals on account of the fact that all GHG sinks and sources gets included in GHG emissions and removals estimation besides meeting the requirement of

PD that all mangrove plants present will be included in the monitoring of the project scenario. Therefore, it is prudent to include these in the estimates at the time of this first monitoring campaign using allometric equations of related species instead of totally excluding this known sink/source of GHG, And as explained above, the use of allometric equations of related species for these two species at this stage has not affected the GHG emissions and removals estimates but in fact has resulted in more accurate estimation and has also complied with PD requirements.

These project description related changes have been done based on the availability of real-time field data collected at the time of taking measurements as part of the preparation of the first monitoring report of the project. As a result of these changes, there has been no negative impact on the conservativeness of the quantification of GHG removals or any other part of the methodology such as leakage, uncertainty or non-permanence risk assessments.

Hence, there have been no changes in project outcomes pertaining to the project's climate, community, or biodiversity benefits on account of these project description changes. Their impact is increased accuracy due to more accurate presentation of planted ARR area and GHG removals estimation. Since this is the first monitoring report; therefore, there have been no project description deviations applied in previous monitoring reports.

No project description deviations have happened during the second monitoring period.

2.2.5 Grouped Projects

DBC-1 is not a grouped project.

2.2.6 Risks to the Project (G1.10)

The VCS requires that a non-permanence risk assessment be carried out in accordance with the most recent AFOLU Non-Permanence Risk Tool (v4.0). By applying this guidance, a risk rating was determined for the project, and a non-permanence risk buffer of 10% was estimated, see Appendix 2 and Additional Appendix-Non-Permanence Risk Report of this second Monitoring Report (MR-2). Like First Monitoring Campaign, this Second Monitoring Campaign risk assessment also included an assessment of the different types of risk factors (internal risk factors, external risk factors and natural risk factors). No change has been identified in the likelihood of occurrence of these risks or their potential impact on any aspect of the project. More specifically, the following risk factors have been analysed:

Internal Risk Factors

The project management team has the requisite technical and management capacities, the two project proponents have financial resources, project financial viability is established, opportunity costs do not affect project financial viability and the project duration ensures project longevity. There has been no change in the project management team, financial viability, opportunity costs and project longevity since the PD validation time. The same team of experts is continuing and working on the project team. The project's financial viability has improved due to increased investment, availability of carbon revenue resulting from first issuance of VCUs and further anticipated increases in the value of VCUs generated by the project. Similarly, there have been no changes in the opportunity costs or project longevity.

Natural Risks

An assessment of the natural risk factors (risk of fire, pest and disease outbreak, extreme weather, geological or other natural risks) as per detail given in Appendix 2 of the PD document has been carried out during this second monitoring report period, and no change has been found either in the probability or intensity of these natural risk factors compared to the PD document or the first monitoring period. The Indus Delta region is not susceptible to severe natural destructive events. The area is subject to very little geological activity, and as a native ecosystem, the risks from disease and pests are minimal. The fire risk is negligible due to regular inundation and high humidity under the forest canopy and in the whole intertidal zone.

The government has standing orders with respect to forest fires prevention, suppression and reporting. In the event of a forest fire, it must be reported on an immediate basis and a fire damage report prepared. This fire damage report, among others, needs to have details with respect to the date and time the fire occurred, how it occurred, specific location of the fire, extent/area affected, and damages caused by the fire. During this monitoring period, no such fire damage incidents in the Indus Delta mangrove forests have been reported.

During the monitoring report period, no geological activity that negatively affects the project has occurred. Since all restoration work has been done with native mangrove species; therefore, no insect pests or disease attacks have been reported during the monitoring period. Seasonal flooding does occur during the annual monsoons, but the mangroves species in the delta are well adapted and resilient to the hydrological cycle. Coastal erosion surveys were undertaken during the first monitoring period as per provisions of the monitoring plan of the PD document, and there has been minimal loss/erosion of planted areas due to sea-level rise see section 3.1.3.5. As per provision of PD, next coastal erosion will be carried out during the monitoring campaign to be undertaken in the year 2025.

Human-induced Risks

The major human-induced risk to the project is the unsustainable and unregulated use of mangrove forests, along with the failure of restoration work. Measures to end destructive practices that can impact the project negatively have been put in place through a participatory approach with forest-dependent communities in the Project Zone (see Section 4.5.2 of the PD).

The main mitigation activity against failure in a plantation is through ongoing protection, replanting of any failed plants, and community-led Mangrove Stewardship Agreements, which ensure that restoration work is protected and allowed to develop and establish over the project's lifetime. The human-induced risks described above have been adequately addressed through the indicated measures and have not impacted the expected climate, community and biodiversity benefits during this second monitoring report period.

External Risks

All the lands and vegetation included in the Project Area of the DBC-1 project are government-owned and belong to the Provincial Government of Sindh. There have been no changes in land tenure. Both the local communities and the provincial government of Sindh continue to remain project partners and support the project and its different interventions. Accordingly, in Appendix 2 and Additional Appendix- Non-Permanence Risk Report of this Monitoring Report (MR), it is clarified that there has been no change in any risk category- Internal Risk Factors, External Risk Factors and Natural Risk Factors- during this second monitoring report period.

In addition to the non-permanence risks assessed through the AFOLU Risk Assessment Tool and those reported in the Non-Permanence Risk Report, the project has also considered and assessed, and where required mitigated, risks related to community and biodiversity at the time of monitoring campaign. The following risks have been assessed and have been found to be adequately addressed at the time of this second monitoring campaign and therefore are insignificant:

Community participation risks

The community participation risks have been addressed by involving them at each and every step from project activities designing, planning, implementing to monitoring and evaluating. Thus, community members have been giving their input at all stages of the project. Moreover, they have been organized into broad-based communities which work as representative bodies from local communities to interact and work with the project. Therefore, there is no community participation related risk.

Marginalized community groups exclusion risks

All the socio-economically marginalized community groups present in the project area are given equal chance to participate in different project activities and therefore have access to and benefit from all project activities implemented including mangrove restoration works, community development activities (drinking water and hygiene facilities, health facilities, etc.), awareness raising and training and capacity building activities. They also have representation in the different village level organizations such as VDCs

and WOs and are included in participatory planning and monitoring processes such as FPIC processes and SBIA workshops and village and household level surveys.

All measures related to avoiding and preventing elite capture of project benefits as described in the PD document are also in place and working.

Therefore, there is no risk related to marginalized communities' exclusion and availing of project benefits.

Women marginalization risks

Women are an integral part of the project activities. They have been organized into women organizations and are involved in and benefit from all activities as discussed above for the marginalized community groups. Similarly, all mechanisms and steps needed with regard to the problem of avoiding and preventing men capture of project benefits as given in the PD document are well established and working.

Therefore, there are no risks related to exclusion of women or their non-accessing project benefits.

Protection of community related HCVs

Different project interventions have contributed to the conservation and enhancement of different community related HCVs which include HCV-4, 5 and 6. Hence, no risk of any harm to community related HCVs during this monitoring period.

Biodiversity related risks prevention

The project has specifically taken measures to ensure that the following biodiversity related risks are avoided and prevented:

Avoidance of monocultures: DBC-1 project undertakes its restoration work following landscape level ecological restoration principles and ensures that there are no monocultures. Hence there is no risk of promoting monocultures under the project.

Avoidance of invasive species: The project has not introduced any invasive species in its restoration activities. Therefore, the risk of introducing invasive species under the project does not exist.

Avoidance of exotic species: The project has used only native species and no exotic species have been introduced into the project area. Therefore, no risk related to inclusion of exotic species in the project zone.

Avoidance of habitat destruction and fragmentation: The project has restored habitat over large stretches of land thereby avoiding habitat fragmentation and destruction. Hence, no risk of biodiversity habitat destruction or fragmentation.

Avoidance of human-wildlife conflict: DBC-1 project has taken steps to control human-wildlife conflict in the project zone; therefore, no risk on this count.

Avoidance of unsustainable and harmful biodiversity exploitation practices: Through its awareness raising and capacity building initiatives as well as rigorous law enforcement, the project has been successful in avoiding and preventing unsustainable and harmful utilization of biodiversity and its products. Hence, this risk of over-exploitation of biodiversity resources is not there.

Prevention of waste products and pollution: None of the project activities have contributed to waste products and pollution, either atmospheric, terrestrial or ocean. Accordingly, no risk of waste products or pollution due to project activities.

Use of harmful agro-chemicals and biological agents: None of the project activities has contributed in any way to use of harmful agro-chemicals or biological agents use. Due to their non-use, there is no risk from use of agro-chemicals or biological agents.

Measures to enhance HCVs: Various project activities have contributed to the conservation of different biodiversity related HCVs-HVC1,2, and 3.

2.2.7 Benefit Permanence (G1.11)

The project ensured the permanence of benefits through the monitoring period by implementing the activities outlined in the Project Description Section 2.1.11 of the PD. Other measures include:

- Quantification, validation and verification of GHG emissions. Carbon credits generated from this second monitoring will be sold and carbon finance re-invested into the project.
- Indus Delta Capital and the Sindh Forest department continued capacity building through forging new strategic alliances and partnerships with industry specialists. Mitigation of financial risk through further investment.
- Regular meetings, consultations and adaptive management with all stakeholders. Dissemination of project information and strengthening of communication channels.

2.3 Stakeholder Engagement

2.3.1 Stakeholder Access to Project Documents (G3.1)

DBC-1 project has used multiple channels and mechanisms for ensuring stakeholder access to Project Documents. Both hard and soft copies of various project documents such as the PD document, validation event, validation report, verification event, monitoring report and their summaries in Urdu and Sindhi language have been made available to stakeholders using different channels. Hard copies of these documents have been placed in the Project Main office as well as the two Project sub-offices (Keti Bandar and Shah Bandar) for easy access by the stakeholders. Notices of validation event and verification events were posted at conspicuous places throughout the project zone before these events took place. Findings of the validation event (validation report) and detailed program of the verification events have been explained to stakeholder in different meetings, which included representatives from different community groups including members of various marginal groups.

Soft copies of the above-mentioned documents have been placed on the project website *deltabluecarbon.com* as well as VERRA website. During discussions with stakeholders', they are encouraged to read various project documents so that fruitful and informative dialogues can take place with them and they are fully informed about the different project activities and their outcomes.

2.3.2 Dissemination of Summary Project Documents (G3.1)

English language version of summary of the monitoring report has been translated into Urdu (national language) and Sindhi (local language). Copies of these translated documents have been kept in and are available in the two regional project offices (Keti Bandar and Shah Bandar) and the main project office in Karachi. Electronic version of this document is available on the VCS database and the project's website.

These summary and other project documents have also been shared, discussed, and explained to communities in various meetings, workshops, and talks in the project zone. Summary information on monitoring results and other documents has been actively disseminated to communities and other stakeholders through participatory workshops (See Appendix 6 and supporting folders for information).

2.3.3 Informational Meetings with Stakeholders (G3.1)



Figure 3. DBC-1 staff conduct informational meetings with communities at a household level during monitoring

Information regarding DBC-1 has been communicated to stakeholders through a series of meetings that have taken place in socially and culturally-appropriate settings for both male and female community members (*pictured above*). These meetings have been held both at the PD preparation stage and for this monitoring report as well as first monitoring report preparation. All meetings were widely publicised and known events. Participants of the sessions also included local elected officials and administration representatives, as members of different community groups including the different marginal groups. These meetings were meant to establish a closer liaison with these community members and key stakeholders.

They were held in the Sindhi language to ensure that the information was communicated to and understood by all participants. Similarly, informational meetings were held during the preparation of this monitoring report and upon completion. SOPs were developed and implemented to conduct these informational and monitoring meetings for the different stages of data collection, analysis, summarization, sharing and dissemination, storage and archiving. During these meetings, the participatory monitoring process was explained, and the process was conducted with their full participation. Appendix 6 gives details of village-level meetings/SBIA workshops and household surveys meeting details.

2.3.4 Community Costs, Risks, and Benefits (G3.2)

DBC-1 is a participatory project that uses participatory planning, monitoring and evaluation approaches in planning, implementing, monitoring and evaluating its different interventions. Following this participatory approach, the project remains engaged with the local communities on a continual basis. During its project designing, planning, implementing and monitoring meetings with the communities which the project has undertaken on a regular basis from time to time, it has shared relevant and adequate information about potential costs, risks and benefits to communities in an understandable and local language. The communities are encouraged all along to raise any of their potential concerns about the costs, risks and benefits arising for them from project implementation. These discussions take place

in an open and interactive mode and at places convenient to communities. Details of meetings and discussions held with the communities have been documented and are available for review by VVB.

Sindh Forest Department has been working with these communities since early 1970s. As a result of this long association there is mutual trust and understanding between the communities and the project proponents. The communities are therefore familiar with the project proponents and there exist open channels of communications between the communities and the project proponents. For the last many years, the proponents have conducted a number of dialogues, meetings, workshops, surveys and studies pertaining to different aspects of the project including obtaining free, prior and informed consent of the local communities. These consultative meetings and dialogues have also served as and provided the basis for communicating and discussing the project's costs, risks and benefits with the communities.

In addition, the project maintains two sub-offices at central locations in the project area, one each at Keti Bandar and Shah Bandar Areas. These project offices serve as information and meetings hubs of DBC-1 project and are open to all community members and stakeholders for having access to any information about the project that has an impact on communities and other stakeholders in any way.

2.3.5 Information to Stakeholder on Verification Process (G3.3)

For details, see sections 2.3.1 and 2.3.2. Salient features are described below:

The project's executive summary, including project information and project benefits, has been translated into Urdu and Sindhi languages and is posted in the project's regional offices and other public places in communities throughout the Project Zone. The validation/verification process was described during community meetings held by project staff as part of the project outreach processes.

A poster/notice in Urdu and Sindhi languages advertising the project's public comment period and the timing, activities, process and channels for validation/verification through the remote process (in case of validation) and on-ground field visits for the two verifications was posted in communities throughout the Project Zone.

It includes details on how a comment to the CCB can be made. In addition to the executive summary and the public comment period advertisement, a poster/flyer in Urdu and Sindhi language advertising the project and providing a contact email address has been posted in locations in the Project Zone.

The complete monitoring report and the executive summary of the PD and monitoring report in English and Urdu version are available on the Project webpage (http://www.deltabluecarbon.com).

2.3.6 Site Visit Information and Opportunities to Communicate with Auditor (G3.3)

Communities and other stakeholders have been informed of the verification body's site visit in a timely manner before the site visit occurred. During the first monitoring campaign (October 2021 to February 2022) as well as this second monitoring period (1 November 2021 to 28 February 2023) the communities and stakeholders were informed that the monitoring results will be compiled and the monitoring report will be shared with them, which was then done. While sharing the results with the communities and stakeholders, they were informed that the monitoring report will be placed on the VERRA website for public comment for a period of one month during June-July 2023. As soon as the public comment period is over in end-July 2023, there will be site visits by the VVB during August-September 2023 according to a sampling plan developed by the verification body (VB). This sampling plan, among others, will have the following elements:

- Project activities implemented by the proponents during the period from 19 February 2015 to 31 October 2021 as well as those implemented during this second monitoring period 1 November 2021 to 28 February 2023 in particular forest restoration and protection of the restored areas, various community development activities (health facilities, drinking water facilities, civic facilities, access to education, conservation and restoration of historical and cultural sites, community climate change adaptation benefits, and conservation of community related high conservation values areas), and biodiversity conservation activities including conservation of biodiversity related high conservation values areas and climate change adaptation benefits for biodiversity.

- Community costs, risks and benefits.
- Stakeholders' identification and consultation, training, benefits and satisfaction
- Stakeholders' rights.
- Project conflicts, barriers or difficulties, grievances and complaints
- Project communication and engagement with the communities and stakeholders
- Benefits permanence (mid and long term) and non-permanence risks

The project proponents have facilitated the direct and independent communication between communities and other stakeholders or their representatives and VB which took place during the period from 14 May 2022 to 25 May 2022 for first monitoring period and were scheduled during August-September 2023 for the second monitoring campaign. During this field visit the VB was facilitated to hold meetings with the following stakeholders:

- CCB project stakeholders
- Village development committees
- Women organizations representatives and women benefiting from alternative livelihoods
- Village organizations
- Fishermen attending awareness raising sessions and benefited by the project
- Community members employed in mangrove restoration, conservation, and sustainable management related activities
- Mangrove Stewardship Agreements signers
- Traditional/Community leaders
- Beneficiaries of training in alternative livelihoods
- SBIA workshops participants
- Project employees

During these meetings, the VB was able to directly and independently ask any and all questions related to the project.

2.3.7 Stakeholder Consultation (G3.4)



Figure 4. Participatory workshops were conducted during the monitoring campaign for stakeholder input

Communities, including all community groups and other stakeholders, have influenced project design and implementation in a number of ways. As a result of stakeholders' input areas to be planted under ARR have been identified, demarcated and effectively conserved through the mechanism of Mangrove Stewardship Agreements (MSAs). Terms and conditions of the MSAs have been developed in a consultative manner and have been finalized with the input of the stakeholders.

Fishing community members have given their recommendations for mangrove species to be planted in particular areas so as to increase fish and shrimp spawning sites and to increase crab population which are a source of income (particularly for women and youth) and on which their livelihoods depend.

Also, grazing areas have been identified after consultation with and input from stakeholders. These areas have been left for grazing of livestock by local communities. Input for these grazing lands came from the whole community including livestock owning communities.

Areas close to settlements have also been not planted and left for community use based on input and suggestions from community members.

Communities have given their input for the establishment of village level organizations and the project proponents have constituted village development committees and women organizations based on the recommendations of local communities. They have also helped identify the community members who are to participate in awareness raising sessions and training and capacity building programs. Moreover, these programs have been designed and implemented in consultation with and after the input of communities.

Similarly, community development activities such as the location for civic facility, the reverse osmosis plant and mobile health facility was based on discussions with local communities in the area.

Fishing community members have also given their suggestions for increasing fish and marine biodiversity.

During the SBIA workshops community members were satisfied with the consultative processes adopted by the project and have indicated that their input has been well-received and considered by the project proponents in project design and implementation.

The SBIA workshops and village level and household level monitoring surveys were held in strategic locations in the Project Zone at the time of monitoring campaign with key representatives of community groups, which represented more than 50 percent of households living within the project area and who are reliant on the project area and more than 20 percent of households living within 20 km of the project boundary outside the project area and who are reliant on the project, have been consulted during the monitoring campaign. Participants consisted of representatives from all stakeholder groups including local administration, village elders, local community leaders, indigenous women and youth representatives.

Details of the consultations mentioned above have been documented and are available for review by the VVB.

2.3.8 Continued Consultation and Adaptive Management (G3.4)

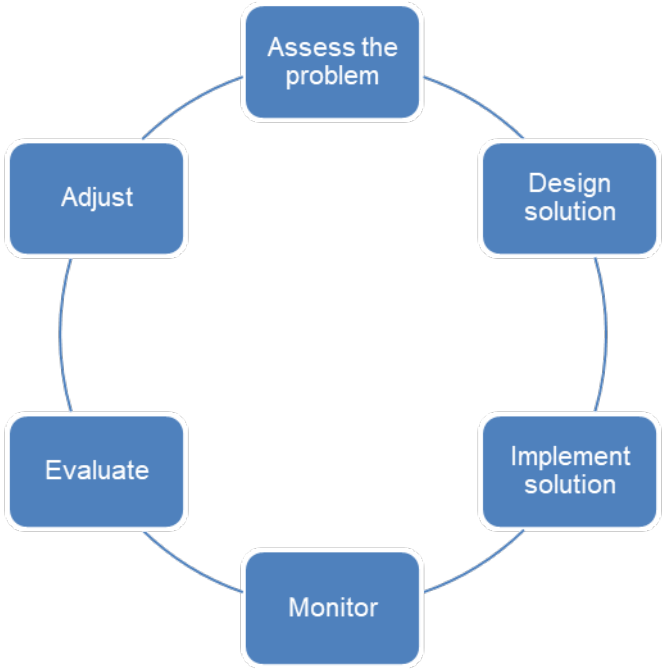
Communication and consultation about the project have continued between the project proponent(s) and communities and other stakeholders ever since the inception and start of project in early 2015. Inputs and feedback from communities and other stakeholders has been sought and used at each stage of the project design, planning, implementation, monitoring and evaluation. Project proponents have used multiple processes and channels to receive, consider and make use of the input received from communities and other stakeholders. The input received has been, is being and will be used continually to influence and have used it for adaptative management.

The project has sub-offices in Keti Bandar and Shah Bandar areas. These sub-offices are used for regular contacts with communities and stakeholders. The project has been interacting with and maintaining a regular dialogue with communities and stakeholders. Through socio-economic surveys at the start of the project, community groups have been identified and their socio-economic profiles developed. They have been consulted at the time of obtaining free, prior and informed consent; identification and design of

different project interventions; and planning, implementation and monitoring and evaluating the impacts of those interventions through SBIA workshops. Keeping in view the wants and wishes of communities, project interventions are collaboratively planned and implemented with communities. These communication and consultation sessions happen as a continual process and not as a particular event.

The project proponents have an information collection, communication and consultation plan about the implementation of various project interventions. Using this plan, the project regularly collects information about the outcomes of implemented decisions in a participatory manner through surveys, focus group discussions, workshops, thematic studies, etc. Using the collected information, any potential problems and barriers hampering the achievement of objectives are identified and assessed in Climate, Social and Biodiversity Impact Assessment Workshops.

Using these workshops and in consultation with communities and other stakeholders, solutions to those problems are designed. These solutions are then implemented, monitored and evaluated. Any further adjustments are made again, if there is a need for such adjustments. This adaptive management process happens in a cyclic, systematic and iterative manner as diagrammatically depicted below:



2.3.9 Stakeholder Consultation Channels (G3.5)

Keeping in view the various constraints (language and literacy-related constraints; mobility, access and time-related constraints; socio-cultural and low confidence levels related constraints) faced by local communities in the Project Zone to effectively participate in planning and decision making, DBC-1 has developed a Project Communication Strategy which makes use of a number of stakeholder consultation channels and mechanisms to share information with and get feedback from the various stakeholder groups.

These include the formation of stakeholder roundtables and forums, establishment of village development committees (10 no.) and women groups (13 no.) , Mangrove and Biodiversity Conservation Stewardship Committees (150 no. out of which 147 are males and 3 are females), and formation of dedicated stakeholders virtual groups (for sharing voice and text messages in Sindhi and Urdu for sharing information about the project and getting community members and other stakeholders feedback), community motivators and activists. These channels provided an avenue for project feedback and the grievance redress mechanism of the project.

Using these various stakeholder consultation channels, the project has used a number of consultation methods such as awareness-raising and training sessions on a number of themes and topics (participatory planning, monitoring and evaluation; socio-economic surveys and assessments and community development related MRV; biodiversity surveys and assessments and biodiversity-related MRV; participatory carbon MRVs; etc.), meetings, workshops (including SIA workshops), focus group discussions, surveys and organised special events (Guinness World Records setting, etc.) and days (Mangroves and Wetlands Day, Forest Day, Biodiversity Day, Environment Day, Plantation Day, etc.) for continued consultation with stakeholders.

Through these different stakeholder consultation channels, relevant information about various aspects of the project, including its design, implementation, outcomes and the monitoring approach, has been shared with communities and other stakeholders.

A complete report of the various meetings and workshops, including pictures, video and meeting results, are available and will be provided to the VVB.

2.3.10 Stakeholder Participation in Decision-Making and Implementation (G3.6)

To ensure effective participation, as appropriate, of all communities, the project has implemented a number of activities and processes. Different community groups have been identified and their socio-economic profiles have been developed. Broadly, these community groups include fishing communities, agriculturists and livestock raising communities, daily wage paid labour, youth and women, business people and middlemen, etc. The activities implemented include their organization, awareness raising, sensitization, training and capacity building and a host of other activities. Multistakeholder and broad-based village level organizations in the form of village development committees and women organizations have been established, wherein representation have been given to these different socio-economic groups. The project interacts and communicates with these different community groups through these platforms and focus group discussions.

A number of other activities that have been implemented include sensitization and mobilization through awareness raising and training programs, engagement in surveys and discussions, participation in SBIA workshops, and having key informant interviews and focus group discussions with them.

They are also involved in implementing various project activities such as propagules collection, nurseries raising and planting as well as engagement through the mechanism of Mangrove Stewardship Agreements.

Also, to ensure effective participation of DBC-1 communities in the monitoring campaign, dissemination of information about the monitoring event program was done to them, and meetings and consultations have been held with them at places and during periods where stakeholders could attend in a culturally appropriate and gender-sensitive manner.



Figure 5. Findings were discussed and disseminated during structured SBIA workshops with communities

Consultation agendas were extended to communities beforehand and in a timely manner, using all the methods of communication available to the project proponents. All meetings and communications were conducted in Sindhi or Urdu languages so that every participant could effectively understand and fully participate in the structured discussion. Participants were also given sufficient time to do subsequent consultations at the community level before formal decision making.

Details of the meetings held with local communities (village, household and participant level) and the findings of those meetings and discussions have been compiled and are given in Appendix 6 of the Monitoring Report and the Socio-economic Survey Report. These include supporting data collection sheets uploaded to the project's virtual library and is available for review by the VVB in both hard and soft forms.

2.3.11 Anti-Discrimination Assurance (G3.7)

The project is committed to fair treatment and equal opportunity for all stakeholders, community members and employees. Neither the project, nor any agent of the project, has discriminated against or will discriminate against any person for any reason, including – but not limited to – gender, religion, nationality, tribe, or sexual identity. DBC-1 is committed to providing a workplace and programmes that are safe and free from all kinds of harassment. The project has developed an anti-discrimination and non-harassment assurance document outlining its full policy. This document is available for viewing by the VVB.

During this monitoring period, no instance of discrimination has been reported by any stakeholder, community group or project employees.

2.3.12 Grievances (G3.8)

The project employs a grievance redress procedure using a structured process, details of which can be found in the Project Document (Section. 2.3.12).

During this monitoring period the project did not receive any grievance that had to be resolved at the project level using the project’s grievance redress procedure.

2.3.13 Worker Training (G3.9)




Figure 6. Training and capacity building events held with community groups and VDCs

DBC-1 is committed to investing in the training and capacity building of all concerned people and organisations. Therefore, this commitment to training and capacity building extends from project staff to project-area communities and local collaborators (NGOs and government). This training and capacity building initiative has taken many forms, from classroom lectures to field-based hands-on exercises and learning by doing sessions. Table 3 gives details of the main thematic areas on which training has been imparted to communities, stakeholders, Project staff and staff of the Sindh Forest Department during the monitoring period.

Table 3. Training and capacity building during the first and second monitoring periods

Year	Topic	Target	Description	Outcome	Duration
2015	Mangrove conservation, restoration and sustainable management, including propagules collection, storage, transportation, nurseries raising, and mangrove planting and maintenance	Project Zone communities, employees	Field-based training on propagules collection, nursery establishment and mangroves planting and maintenance	Propagules collected, transported, stored, nurseries raised, and mangroves planted maintained	Two-day training and hands-on experience
2015	MSAs for mangroves protection and controlled grazing	Community stewards engaged through MSAs	Training on the provisions of MSAs and their effective implementation	MSAs understood and effectively implemented	One-day training
2016	Mangrove conservation, restoration and sustainable management, community development and biodiversity	Project Zone communities, Sindh Forest Department staff	Training on mangroves conservation, restoration and sustainable management, boundaries establishment,	Propagules collected, transported, stored, nurseries raised, and mangroves	Two-day training and hands-on experience

Year	Topic	Target	Description	Outcome	Duration
	conservation, project boundaries establishment, use of GPS, data collection and management		use of GPS, data collection and management	planted maintained	
2016	MSAs for mangroves protection and controlled grazing	Community stewards engaged through MSAs	Training on the provisions of MSAs and their effective implementation	MSAs understood and effectively implemented	One-day training
2017	Participatory planning, monitoring and evaluation	Project Zone communities, Sindh Forest Department staff	Training on participatory land-use mapping and village planning, monitoring and evaluation	Community and Forest Department staff trained in participatory planning, monitoring and evaluation	Three-day training and hands-on experience
2017	MSAs for mangroves protection and controlled grazing	Community stewards engaged through MSAs	Training on the provisions of MSAs and their effective implementation	MSAs understood and effectively implemented	One-day training
2018	Socio-economic survey methods, community-related baseline survey and MRV data collection and analysis, and conflict management and resolution	Project Zone communities, Sindh Forest Department staff	Field-based training on socio-economic surveys, survey instruments development, instruments administration, data recording and analysis and report preparation and conflict management	Socio-economic survey team established, and activities run and conflict resolution approaches understood	One-week training and hands-on experiences
2018	MSAs for mangroves protection and controlled grazing	Community stewards engaged through MSAs	Training on the provisions of MSAs and their effective implementation	MSAs understood and effectively implemented	One-day training
2019	Biodiversity survey methods and Biodiversity MRV	Sindh Forest Department staff, Project staff and Project Zone communities	Field-based training on flora and fauna survey, survey instruments survey development, stations	Participants trained in biodiversity survey methods, biodiversity MRV, and biodiversity	One-week training and hands-on experiences

Year	Topic	Target	Description	Outcome	Duration
			establishment, and data recording and analysis and report preparation	survey team established, and activities run	
2019	MSAs for mangroves protection and controlled grazing	Community stewards engaged through MSAs	Training on the provisions of MSAs and their effective implementation	MSAs understood and effectively implemented	One-day training
2020	SBIA workshops, SOPs for biomass and coastal erosion estimation and carbon MRV	Sindh Forest Department staff, Project staff and Project Zone communities	Field and classroom-based. Provide training on CCB Guidance for the conduct of SBIA workshops carbon MRV, including use of equipment for the measurement, monitoring and reporting of biomass and soil organic carbon	Participants trained in the conduct of SBIA workshops and carbon MRV	One-week training and hands-on experience

Year	Topic	Target	Description	Outcome	Duration
2020	MSAs for mangroves protection and controlled grazing	Community stewards engaged through MSAs	Training on the provisions of MSAs and their effective implementation	MSAs understood and effectively implemented	One-day training
2021	MSAs for mangroves protection and controlled grazing	Community stewards engaged through MSAs	Training on the provisions of MSAs and their effective implementation	MSAs understood and effectively implemented	One-day training
2022	Mangroves seed collection, proper storage and transportation and nursery raising training	Community members engaged in mangroves propagules collection, storage, transportation and nurseries raising	The training is given in local Sindhi language. The training includes a combination of theoretical sessions, practical demonstrations, and hands-on exercises. Participants have the opportunity to practice seed collection, nursery management, and seed storage techniques under the guidance of experienced trainers the program also encourage discussions, sharing of experiences, and networking among participants to foster a collaborative learning environment	Participants are expected to gain a thorough understanding of propagules that are ripe and ready for collection, their proper handling, storage and transportation techniques. They also learn mangrove nursery raising techniques.	One-day training

Year	Topic	Target	Description	Outcome	Duration
2022	Effective Implementation of MSAs by Stewards and SFD staff training	Community stewards and Sindh Forest Department staff	This training is imparted in local language. Topics covered include various provisions of MSA, roles and responsibilities of SFD staff, mangrove steward and general community. Also, measures needed for effective implementation of MSA are also discussed and explained.	Mangrove stewards, general community members and SFD staff understand the provisions of MSA and how to effectively implement the MSAs.	One-day training
2022	SBIA workshops, SOPs for biomass and coastal erosion estimation and carbon MRV	Sindh Forest Department staff, Project staff and Project Zone communities	Field and classroom-based. Provide training on CCB Guidance for the conduct of SBIA workshops carbon MRV, including use of equipment for the measurement, monitoring and reporting of biomass and soil organic carbon	Participants trained in the conduct of SBIA workshops and carbon MRV	One-week training and hands-on experience
2022	Socio-economic survey methods, community related surveys and MRV data collection and analysis, and conflict management and resolution	Project Zone communities, Sindh Forest Department staff	Field-based training on socio-economic surveys, survey instruments development, instruments administration, data recording and analysis and report preparation and conflict management	Socio-economic survey team established, and activities run and conflict resolution approaches understood	One-week training and hands-on experiences

Year	Topic	Target	Description	Outcome	Duration
2022	Biodiversity survey methods and Biodiversity MRV as per newly developed SOP for biodiversity impact assessment	Sindh Forest Department staff, Project staff, Project Zone communities and relevant staff of LUAWMS	Field-based training on flora and fauna survey, survey instruments survey development, stations establishment, and data recording and analysis and report preparation	Participants trained in biodiversity survey methods, biodiversity MRV, and biodiversity survey team established, and activities run	One-week training and hands-on experiences
2022	Safe drinking water and personal hygiene	Local communities	Lectures as well as practical demonstration	Hands on training how to treat water to make it safe for drinking and how to observe personal hygiene	One-day trainings at three Project Locations in the Project Zone.
2022	Training and awareness raising about substance abuse and use of narcotics	Local communities	Lectures and sharing of case studies	Lectures and demonstration through case studies	One-day trainings at three Project Locations in the Project Zone.
2022	MSAs for mangroves protection and controlled grazing	Community stewards engaged through MSAs	Training on the provisions of MSAs and their effective implementation	MSAs understood and effectively implemented	One-day training

Year	Topic	Target	Description	Outcome	Duration
2022	Effective Implementation of MSAs by Stewards and SFD staff training	Community stewards and Sindh Forest Department staff	This training is imparted in local language. Topics covered include various provisions of MSA, roles and responsibilities of SFD staff, mangrove steward and general community. Also, measures needed for effective implementation of MSA are also discussed and explained.	Mangrove stewards, general community members and SFD staff understand the provisions of MSA and how to effectively implement the MSAs.	One-day training
2023	Training and awareness session on safe drinking water at Keti Bandar, Shah Bandar and Bhanbore Areas	Project zone communities	This session provides valuable information on the potential risks associated with contaminated water sources and highlights effective measures to ensure water safety and prevent waterborne diseases. By raising awareness and providing practical knowledge, participants can make informed decisions to protect themselves and their communities	Increased understanding of the value of clean drinking water and its effects on human health among participants.	One-day session

Both in-house resources, various government departments – and external and outsourced individuals and organisations – are used to implement the training and capacity building. The above describes the activities and/or processes implemented to provide orientation and training for the project's workers and a wide range of people from the communities. Also, it is ensured that local capacity is not lost once it is built. For this purpose, regular contact is kept with people who have received training and additional information is collected about the community members who have received the training as to how they are using and keeping up the knowledge that they have gained and the skills they have built.

2.3.14 Community Employment Opportunities (G3.10)




Figure 7. DBC-1 provides ongoing work for community members. 11,656 have benefitted to date

The project is committed to employing Project Zone residents and contractors to implement the large scale ARR activities in the Project Area. Detailed description of how local employment generation is a priority of DBC-1 has been provided in PD Section 2.3.15 (Community Employment Opportunities). The project has implemented a number of activities and processes to ensure community members, including women and vulnerable and/or marginalized people, are given a fair chance to fill positions for which they can be trained. Community members and marginalized groups members such as women, youth and vulnerable groups have been trained in and engaged for mangroves propagules collection, proper sorting, storage and transportation. They have also been trained and employed in nursery raising activities. Members of vulnerable and marginalized groups are engaged in mangrove restoration work too as well as protection of planted mangrove areas through the mechanism of Mangrove Stewardship Agreements.

When the project undertakes other community development and biodiversity conservation related activities, the local people are engaged for these activities. In addition, local people belonging to various groups are engaged for field activities and data collection too.

Due to the scale of the restoration, during this monitoring period, the project has already created 1,246 full time employment opportunities and a total of 11,656 job opportunities for the local people since the start of the project. These employment opportunities have been in various restoration and protection activities-11,370 jobs including 1,158 for women in ARR and 150 through engaging in MSAs, of which 3 are with women. Details of these employment creation opportunities are available in the Community Monitoring Survey Report which is given as Additional Appendix-Community Monitoring Survey Report of Second Monitoring Report of MR, is given in the Dropbox Folder and is available for review by the VVB.

Once carbon revenues allow the proponents to scale up activities significantly, thousands more will find employment.

2.3.15 Relevant Laws and Regulations Related to Worker's Rights (G3.11)

A number of Constitutional, legal and policy provisions safeguard workers' rights. The Constitution of Pakistan contains a range of provisions with regards to labour rights. These are found in Part II:

Fundamental Rights and Principles of Policy. Specific Articles of the Constitution dealing with labour rights include the following:

- Article 11 of the Constitution prohibits all forms of slavery, forced labour and child labour
- Article 17 provides for a fundamental right to exercise the freedom of association and the right to form unions
- Article 18 proscribes the right of its citizens to enter upon any lawful profession or occupation and to conduct any lawful trade or business
- Article 25 lays down the right to equality before the law and prohibition of discrimination on the grounds of sex alone
- Article 37(e) makes provision for securing just and humane conditions of work, ensuring that children and women are not employed in vocations unsuited to their age or sex, and for maternity benefits for women in employment

All Constitutional Provisions with regard to Fundamental Rights and Principles of Policy have been followed in their letter and spirit.

Pakistan also has a suite of laws and regulations related to workers' rights. Labour laws of the country fall into the following core legal categories:

- Laws relating to industrial relations;
- Laws relating to employment and service conditions;
- Laws relating to occupational safety and health;
- Laws relating to human resource development;
- Laws relating to labour welfare and social security.

Key elements of these labour laws have been embodied in the employment contracts of workers and workers are informed about their rights at the point of their employment during the employee orientation.

Applicable Labour Policies in the country include Government of Pakistan Labour Policy 2010 and Sindh Government Labour Policy 2018. These Labour Policies are also custodians of labour rights. At the national level there is the full-fledged Ministry of Labour, Manpower and Overseas Pakistanis dealing with labour issues in the country. At the provincial level, Sindh Province also has a Labour Department. These Ministries and Labour Department ensure implementation of the country and province's labour laws, regulations and policies and protect labour rights.

Pakistan joined the ILO (International Labour Organisation) in 1947. The country has ratified 34 ILO Conventions. Of these, 33 are already in force in the country. The project proponents being a governmental organisation and a socially responsible private sector company ensures that any relevant international conventions or government laws and regulations (provincial and national) are fully followed and undertakes workers trainings in this regard.

2.3.16 Occupational Safety Assessment (G3.12)

DBC-1 project designs, plans and implements its different activities in a manner so that there is no increase in risks to worker safety. Potential risks associated with different activities implemented by the project have been identified and workers are informed about those risks and how to minimize such risks. Measures taken by the project for minimizing the risks include their proper identification and documentation; awareness raising of workers about the potential risks; development of protocols to undertake different project activities in a safe manner; imparting training to workers in safe work environment and safety practices; provision of needed protective equipment and use of appropriate tools and methods; awareness creation about worker rights and responsibilities as well as organizational responsibilities and liabilities to do work under safe conditions and create safe working environment; etc.

DBC-1 abides by all relevant Pakistani and Sindh Province worker's rights laws and regulations as set out in Pakistan Labour Policy 2010 and Sindh Government Policy (Sindh Labour Policy 2018). These policies address different aspects of labour issues in the province and in the country, including occupational safety, fair wages and compensation, training and human resource development, labour relations, and protection of labour rights.

Keeping in view the provisions of the National and Provincial Labour Policy, a mechanism for ensuring occupational safety has been developed and is being implemented as given above and also elaborated in PD Section 2.3.17 (Occupational Safety Assessment). In addition, for the safety of field workers, Field Safety SOP has been developed which is given as Appendix 7.4- Field Safety SOP.

During this monitoring period, people who were engaged in project activities were fully briefed and trained on the different safety precautions to follow while undertaking various project activities and were provided with the needed safety equipment. Possible risks that were discussed with them and for which needed mitigation measures were taken included taking proper safety measures while collecting, transporting and storing mangrove propagules; proper safety measures in raising nursery plants and doing planting work; safety measures and vaccines against snakes bites and other aquatic organisms bites; safety measures against heat waves and dehydration in the field work; boats capsizing and the provision and use of safety jackets; protection against injuries to various body parts including feet, hands, eyes, ears, head etc.; and provision of medicines against different diseases in the area such as malaria, diarrhoea, etc. First Aid Box is always provided at the work place site. Similarly, office workers have been sensitized to occupational safety related risks and the required mitigations as part of ergonomic in the work environment.

As a result of our elaborate procedures and safety measures, no accident or incident has happened during this monitoring period which was hazardous to the health and safety of project staff and workers.

2.4 Management Capacity

Full details of management capacity are given in the PD, section 2.4.

2.4.1 Required Technical Skills (G4.2)

Design, development, implementation, monitoring, validation, and verification of wetlands restoration projects and marketing and sale of verified carbon credits requires a suite of vital technical skills besides those related to community engagement, biodiversity assessment and carbon measurement. Therefore, professional staff of an ARR project organization need to have these skills for successful implementation of the project.

DBC-1 project has a corps of professional and technical staff who have these needed knowledge, skills and competencies. The project team members, among others, have skills in the following important areas:

- Ecological restoration of mangroves including ARR and ANR techniques
- Community and other stakeholders' consultation, engagement and implementation of community development activities
- Design, development and implementation of coastal and marine biodiversity conservation and sustainable management
- GIS and mapping skills
- VCS and CCB Standards and their Program Rules for credible carbon accounting
- AFOLU Projects Requirements including AFOLU Non-Permanence Risk Assessment
- VM0033 and its associated modules for assessing applicability conditions, project boundary setting, determination of baseline scenario and additionality, quantification of GHG emission reductions and removals, etc.
- Social and environmental skills including implementation of Social and Biodiversity Impact Assessments
- Caring on and facilitating project validation and verification processes
- Legal and contractual aspects of forest carbon projects
- Marketing, finance and business aspects of forest carbon projects

Memorandum of Understanding (MoU)/Memorandum of Cooperation (MoC) have either been signed or in the final stages of signing. These include MoU/MoC with IUCN to support various project activities in which IUCN has a comparative advantage, such as coastal and marine biodiversity conservation; MoU

with SHINE HUMANITY for providing health services to the local communities; MoU with Lasbela University of Agriculture, Water and Marine Sciences (LUAWMS) for supporting the coastal and marine biodiversity component of the project. A MoU is in the final stages of execution with the Department of Archaeology, Culture and Tourism Government of Sindh to support the HCV-6 related activities of DBC-1 project.

2.4.2 Management Team Experience (G4.2)

Successful implementation of DBC-1 Project requires knowledge and skills related to conduct of socio-economic surveys, community engagement and implementation of community development activities; ecological restoration of mangrove lands and their effective conservation and sustainable management; biomass and soil carbon measurement, carbon and GHG accounting including the use and application of wetlands methodology; general aspects of ARR project implementation and management; and conduct of biodiversity surveys and conduct of social and biodiversity impact assessment.

To further supplement our capacity in biodiversity conservation and sustainable management, the project proponents have signed a memorandum of co-operation with IUCN and LUAWMS for collaboratively undertaking biodiversity related activities.

2.4.3 Project Management Partnerships/Team Development (G4.2)

See PD sections 2.4.1 and 2.4.3 for details.

2.4.4 Financial Health of Implementing Organisation(s) (G4.3)

IDC and Sindh Forest Department are the two project proponents. Both organizations have the requisite financial resources at their disposal to meet the capital expenditure, operating expenditure and transactions costs associated with implementing the ARR project. The two project entities have already invested sufficient financial resources and have met the initial project implementation costs for restoration and sustainable management of de-vegetated mangrove lands to the extent of 83,034 ha, implementation of various community development and biodiversity conservation activities; and transactions costs incurred on project description development, PD validation, and implementation of the first and second monitoring campaigns, etc. Both project partners are meeting their contractual obligations for developing and implementing this mangrove restoration projects without any constraints.

IDC has mobilized enough financial resources from the private sector and has now obtained carbon revenue from the sale of VCUs. The company has at its disposal the needed financial resources to meet its obligations. Similarly, Sindh Forest Department is a government agency and gets regular budgetary allocations from the Provincial Government of Sindh from Regular and Development budget portfolios of the Provincial Government to meet the financial requirements of the project. In addition, it has also received its share of carbon revenue which it intends to spend on upscaling various socio-economic development activities in the Project Zone and adjacent areas.

Both project proponents have sufficient funds to pay their staff salaries, pay for various operating costs and carbon assets development related costs, make payments to specialists, consultants, labourers, and other work contractors and ensure that they have the needed financial resources to meet all their financial obligations. Project proponents have secured 100% of funding needed to cover the total cash out flow before the project reaches breakeven.

Company financial statement analysis is one of the surest ways to assess the financial health of a company. Therefore, IDC regularly analyses its balance sheet, prepares its income statement, does cash flow analysis, and undertakes financial ratios analysis of various types such as gross profit margin, net profit margin, coverage ratio, current ratio, quick ratio, etc. Based on these financial statements analyses, the company is able to assess how liquid the business is in the short term (less than one year) as well as in the long-term, the company sources of cash, the free cash flow the company generates to invest in operations and carbon assets creation, and what is happening to the over-all financial resources of the company. It is further able to compare its performance against periods over time. The company neither carries any financial liabilities nor has ever defaulted in meeting its financial obligations.

Similarly, Sindh Forest Department prepares its annual budget for meeting its operating and forest resources protection, conservation, development and sustainable management related costs and submits this budget to the provincial government for allocation of needed financial resources. The government of Sindh allocates and releases the requisite budget to the Forest Department. The Department does not have any financial liabilities to meet. It has at its disposal carbon revenue from the sale of VCUs from the first monitoring campaign.

The proponents have also designed and developed a detailed financial model to cater to the resource needs of the project and their appropriate management. Predicted revenue from the sale of carbon credits and budgetary allocations by the project proponents demonstrate the availability of required financial resources to implement and sustain the project from its start till its successful completion until the end of crediting period.

2.4.5 Avoidance of Corruption and Other Unethical Behaviour (G4.3)

The project has put in place internal and external control mechanisms to avoid corruption and unethical behaviour. These include the development of a comprehensive policy framework and SOPs for ensuring effective implementation of the policy framework so that there is no instance of corruption and unethical behaviour. Other steps taken include the establishment of a UK Private Limited Company, the opening and management of a joint bank account for project funds management, development of transparent financial transactions mechanisms, periodic and regular internal and external monitoring of physical and financial aspects of the project and its assets, rigorous auditing of funds and other project operations, and the inculcation and promotion of a culture of transparency and ethical behaviour. Commitment of the top leadership of the project to this culture of transparency and accountability and zero tolerance for corruption and unethical practices ensures that there are no deviant and unacceptable behaviour and practices.

Anti-bribery/anti-corruption/anti-unethical behaviour policy and SOPs, gifts and hospitality policy, donations policy and whistle blowing policies of IDC have been provided in the Dropbox and are available for review by the VVB.

The Government of Sindh also has a rigorous anti-corruption and accountability mechanisms in place for all sectors including the forestry sector so that there is transparent spending of financial resources. The Government of Sindh has an Anti-Corruption Establishment which is responsible for curbing any corrupt and unethical practices under the Sindh Enquiries and Anti-Corruption Act 1991. In addition, there is a Provincial National Accountability Bureau which also investigates and tries anti-corruption cases under the Pakistan National Accountability Ordinance 1991, which is applicable to the whole of Pakistan, including Sindh Province. Moreover, there are financial auditing institutions and mechanisms in the province which investigate cases of financial irregularities in the province.

As a result of the internal and external control mechanisms regarding avoidance of corruption and other unethical behaviour, no instance of corruption or unethical behaviour has occurred either during the first monitoring period or this second monitoring period.

2.4.6 Commercially Sensitive Information (*Rules* 3.5.13 – 3.5.14)

No commercially sensitive information is presented in this document.

2.5 Legal Status and Property Rights

2.5.1 Recognition of Property Rights (G5.1)

DBC-1 Project recognises, respects and supports all property rights, whether statutory or customary, of local communities and other stakeholders' groups. Detailed information can be found in the PD section 2.5.2. There is a 60-year legally binding agreement, extendable up to 100 years, signed between IDC and Sindh Government wherein the Government of Sindh being the holder of statutory property right holder in the land, vegetation and conservational and management processes that generate GHG emission reductions or removals which vests project ownership rights in project proponents. The

agreement and due diligence of the contract and relevant laws in this regard has been prepared by the proponent's lawyers.

2.5.2 Free, Prior and Informed Consent (G 5.2)

The project is being implemented on Government owned Protected Forests which are under the management responsibility of Sindh Forest Department and where community members have no rights as per statutory and customary laws. Under such situation, VERRA does not require for obtaining free, prior and informed consent from local communities. Despite this exemption by VERRA, the project proponents have undertaken detailed activity for obtaining free, prior and informed consent of the local communities.

The project has taken steps for ensuring a well-informed and comprehensive understanding of all communities and community groups in the Project Zone and have obtained their FPIC for project activities through a series of meetings with local communities. In total for the FPIC process and other project related activities, more than 330 meetings have been held since 2013 which have been attended by hundreds of community members belonging to various groups from the Project Zone. Details of these PRAs and FPIC meetings is given in Appendix 3 of the PD, Appendix 6 of MR and supporting folders containing information about these meetings.

2.5.3 Property Rights Protection (G5.3)

The project does not encroach on private, community, or government property uninvited. It is implementing its different interventions in the areas allotted to the Project by the Government of Sindh as per agreement signed between the Government of Sindh and IDC. The Project Area is legally state-owned property and has been declared as Protected Forests under Section 29 and 30 of the Forest Act.

Furthermore, the Project has prepared maps and demarcated the boundaries of the Project Area. This mapping and demarcation of the Project Area allows the project area communities and other stakeholders to understand their spatial position in relation to the Project Area. Accordingly, they plan their future land use within the Project Zone as per boundaries de-limitations and without encroachment by the different parties.

The project also does not lead to or require involuntary removal or relocation of communities or of any activities which are important for the livelihoods of these communities or which in any way impact the rights of local people. As a result, there is no need for agreements in this regard, nor is there a need to pay compensation.

Appendix 3 in the PD document gives details of all the meetings that have been held with local communities on social safeguards and on obtaining their FPIC.

Details of consultations held by the project with communities and the Mangrove Stewardship Agreements that the project has executed with the communities are provided as Additional Appendix on Property Rights Protection in the Dropbox Folder and are available for review by the VVB.

2.5.4 Identification of Illegal Activity (G5.4)

Section 33 of the Sindh Forest Act defines and gives details of activities which if undertaken without the permission of Sindh Forest Department are considered illegal activities. Details of the acts identified as an illegal activity are detailed in the PD Sections 2.5.5.

No illegal activity was reported during the first monitoring period or this second monitoring period.

2.5.5 Ongoing Disputes (G5.5)

Activities implemented by the Project during this monitoring period include mangrove restoration and sustainable management, various community development activities (such as the provision of safe drinking water facilities, the provision of and improved access to health facilities, the provision of civic facilities, etc.)

and biodiversity conservation through habitat restoration and improved protection. None of the activities implemented by the project so far have contributed to or have prejudiced the outcome of an unresolved dispute relevant to the project.

The Project Area is free of land grabbing, territorial displacement, or deprivation from access to resources. There have been only a few minor disputes amongst the communities of various villages or within communities of a village over land, territory or resources in the Project Zone during the last 20 years. Most of their disputes have been migrant herders bringing camels for grazing into the delta area during the flood season.

During this monitoring period, there have been no ongoing disputes identified which have been prejudiced by the implementation or project activities and hence there was no need to implement activities and/or processes to resolve conflicts or disputes.

2.5.6 National and Local Laws (G5.6)

There have been no laws or regulations at the national, provincial or local level which have gone into effect, changed, or been eliminated since the project's last validation or verification that are relevant to project activities and the project needs to comply with the provisions of those laws and regulations. A list of all relevant laws and regulations, both national and local, is given in the PD section 2.5.7. The project is already in compliance with the provisions of all those existing policies, laws and regulations and will continue to do so in future too.

If there is any change in future policies and laws which would necessitate compliance by the project, the project will ensure compliance with those policies, laws and regulations. During this monitoring period, no such change has happened.



Figure 8. DBC-1 and Sindh Forest department teams in the field



Figure 9. DBC-1 team collecting field data for biomass estimation

3 CLIMATE

3.1 Monitoring GHG Emission Reductions and Removals

3.1.1 Data and Parameters Available at Validation

Data / Parameter	$A_{BSL,i}$
Data unit	Ha
Description	Area of baseline stratum *i* (in year *t*)
Source of data	See Section 3.1.3.2 of PD (Geographic Boundaries)
Value applied	See Table 15 and 16 in the PD
Justification of choice of data or description of measurement methods and procedures applied	See Section 3.1.3 of PD-Project Boundaries-for justification, description of measurement methods and procedures applied.
Purpose of the data	Determination of baseline scenario
Comments	N/A

Data / Parameter	$\Delta C_{TREE\_BSL,i}$
Data unit	$tCO_2e\ yr^{-1}$
Description	Changes in carbon stock in baseline tree biomass within the project area in year *t*
Source of data	See Section 3.2.1.4 of PD
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	See Section 3.2.1.4 of PD-Net carbon stock change in biomass carbon pools in the baseline scenario.
Purpose of the data	Determination of baseline scenario
Comments	N/A

Data / Parameter	CF_i
Data unit	t C t-1 d.m.
Description	Carbon fraction of dry matter in tCt^{-1}d.m. for species *j*
Source of data	Kauffman, J.B. and D.C. Donato. 2012 Protocols for the measurement, monitoring and reporting of structure, biomass and carbon stocks in mangrove forests. Working Paper 86. CIFOR, Bogor, Indonesia.
Value applied	0.48 t C t-1 d.m. for aboveground biomass 0.39 t C t-1 d.m. for belowground biomass
Justification of choice of data or description of measurement methods and procedures applied	These values are deemed to be defensible default values for carbon fraction.
Purpose of the data	Calculation of project emissions
Comments	N/A

Data / Parameter	$C_{BSL\text{-}soil,,i,t}$
Data unit	t C ha^{-1}
Description	Soil organic carbon stock in the baseline scenario in stratum *i* in year *t*
Source of data	See Section 3.2.1.5 of PD
Value applied	163.6 t C ha^{-1}
Justification of choice of data or description of measurement methods and procedures applied	See Section 3.2.1.5 of PD-Net GHG emissions from soil in the baseline scenario
Purpose of the data	Determination of baseline scenario
Comments	N/A

Data / Parameter	$GHG_{BSL\text{-}insitu\text{-}CO2,,i,t}$
Data unit	t CO_2e ha^{-1} yr^{-1}
Description	CO_2 emissions from the SOC pool in-situ soils in the baseline scenario in stratum *i* in year *t*
Source of data	See Section 3.2.1.5.2 of PD
Value applied	–
Justification of choice of data or description of measurement methods and procedures applied	See Section 3.2.1.5.2 of PD-CO_2 emissions from soil-*in situ*.
Purpose of the data	Determination of baseline scenario
Comments	N/A

Data / Parameter	$GHG_{WPS\text{-}soil\text{-}CO2,i,t}$
Data unit	t CO_2e ha^{-1} yr^{-1}
Description	CO_2 emissions from the SOC pool in the project scenario in stratum *i* in year *t*
Source of data	See Section 3.2.2.5.1.2 of PD
Value applied	-5.35
Soure of data	See Section 3.2.2.5.1.2 of PD-CO_2 emissions from soil-*in situ*.
Purpose of the data	Determination of project emissions
Comments	N/A

Data / Parameter	%C
Data unit	%
Description	Percentage of soil organic C
Source of data	See Section 3.2.2.5.1.2 of PD
Value applied	2.02

Justification of choice of data or description of measurement methods and procedures applied	See Section 3.2.2.5.1.2 of PD-CO_2 emissions from soil *in-situ*.
Purpose of the data	Calculation of project emissions
Comments	This value is used to calculate the deduction from allochthonous carbon.

Data / Parameter	$Deduction_{alloch}$
Data unit	t CO_2e ha^{-1} yr^{-1}
Description	Deduction from CO_2 emissions from the SOC pool to account for the percentage of the carbon stock that is derived from allochthonous soil organic carbon
Source of data	See Section 3.2.2.5.1.2 of PD
Value applied	4.95
Justification of choice of data or description of measurement methods and procedures applied	See Section 3.2.2.5.1.2 of PD-CO_2 emissions from soil-*in situ*.
Purpose of the data	Calculation of project emissions
Comments	N/A

Data / Parameter	$GHG_{WPS\text{-}fuel,i,t}$
Data unit	t CO_2e ha^{-1} yr^{-1}
Description	GHG emissions from fossil fuel use in the project scenario in stratum *i* in year *t*
Source of data	See Section 3.2.2.6 of PD
Value applied	482
Justification of choice of data or description of measurement methods and procedures applied	See Section 3.2.2.6 of PD

Purpose of the data	Calculation of project emissions
Comments	N/A

Data / Parameter	Allowable_uncert
Data unit	%
Description	Allowable uncertainty; 20% or 30% at a 90% or 95% confidence level, respectively
Source of data	See Section 3.2.2.6 of PD
Value applied	20%
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of the data	Calculation of net GHG emissions reductions
Comments	N/A

3.1.2 Data and Parameters Monitored

Data / Parameter	$\Delta C_{TREE\_PRO,i,t}$
Data unit	t CO_2e yr^{-1}
Description	Change in carbon stock in trees in stratum *i* during the period between two points of time t_1 and t_2.
Source of data	Field data were collected from sample plots during the monitoring campaign for the M-2 monitoring period 1 November 2021 to 28 February 2023. Equations used for calculations are derived from the application of AR Tool 14.
Description of measurement methods and procedures to be applied	See Section 3.3.3.4 of PD-Estimation of tree carbon stocks and SOP to measure carbon stocks and changes in carbon stock in trees in Appendix 7 of this document.
Frequency of monitoring/recording	Each monitoring period.

<table>
<tr><td>Value monitored</td><td>Based on field measurements, the following have been the changes in carbon stock in different strata/planting year cohorts during the M-2 monitoring period (1 November 2021 to 28 February 2023):

Change in carbon stock in the stratum (t CO_2e)

<table>
<tr><th>Plantation Year Stratum – i</th><th>Plantation /Year Stratum – i</th><th>Ctree,i,t</th><th>Soil Organic Carbon Removals (tCO2e)</th><th>Net Ctree,i,t</th></tr>
<tr><td>2015</td><td>10,249.35</td><td>1,552,259.34</td><td>20,026.89</td><td>1,572,286.23</td></tr>
<tr><td>2016</td><td>18,438.45</td><td>1,875,663.78</td><td>28,822.49</td><td>1,904,486.27</td></tr>
<tr><td>2017</td><td>15,332.16</td><td>1,230,828.10</td><td>17,975.12</td><td>1,248,803.22</td></tr>
<tr><td>2018</td><td>10,434.45</td><td>395,818.94</td><td>8,155.43</td><td>403,974.37</td></tr>
<tr><td>2019</td><td>9,339.43</td><td>164,539.13</td><td>3,649.79</td><td>168,188.92</td></tr>
<tr><td>2020</td><td>9,331.11</td><td>103,559.12</td><td>–</td><td>103,559.12</td></tr>
<tr><td>2021</td><td>9,909.00</td><td>35,733.71</td><td>–</td><td>35,733.71</td></tr>
<tr><td>Total</td><td>83,033.95</td><td>5,358,402.12</td><td>78,629.71</td><td>5,437,031.84</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>See Section 3.3.3.4 of PD and SOP for measurement of biomass carbon stocks and changes in carbon stocks in Appendix 7 of this document.</td></tr>
<tr><td>QA/QC procedures to be applied</td><td>See Section 3.3.3.7 of PD and SOP for measurement of biomass carbon stocks and changes in carbon stocks in Appendix 7 of this document.</td></tr>
<tr><td>Purpose of the data</td><td>Calculation of project emissions.</td></tr>
<tr><td>Calculation method</td><td>See Section 3.3.3.4 of PD and Monitoring Protocol for Carbon Measurements in Appendix 7 of this document.</td></tr>
<tr><td>Comments</td><td>N/A</td></tr>
</table>

Data / Parameter	Crown or vegetation cover$_t$
Data unit	%
Description	Proportion of an area covered by the crowns of live trees

Source of data	Field collected data from sample plots in different strata for the monitoring period 1 November 2021 to 28 February 2023. See also SOP for carbon stock measurements in Appendix 7.1 and 7.2 in the MR and See Section 3.3.3.4 of PD-Estimation of tree carbon stocks
Description of measurement methods and procedures to be applied	See SOP for carbon stock measurement in Appendix 7 in the MR as well as Section 3.3.3.4 of PD-Estimation of tree carbon stocks.
Frequency of monitoring/recording	Each monitoring period
Value monitored	Monitoring period (1 November 2021 to 28 February 2023): Stratum — Crown cover % in the stratum 2015 — 80.76 2016 — 63.44 2017 — 41.83 2018 — 25.57 2019 — 15.00 2020 — 8.34 2021 — 5.01
Monitoring equipment	See SOP for carbon stock measurement in Appendix 7 in the MR and Section 3.3.3.4 of PD-Estimation of tree carbon stocks.
QA/QC procedures to be applied	See SOP for carbon stock measurement in Appendix 7 and 7.2 in the MR and Section 3.3.3.7of PD-Estimation of tree carbon stocks.
Purpose of the data	Calculation of project emissions.
Calculation method	See SOP for carbon stock measurement in Appendix 7 in the MR as well as Section 3.3.3.4 of PD-Estimation of tree carbon stocks
Comments	N/A

Data / Parameter	$A_{t,i}$
Data unit	Ha
Description	Area of project stratum *i* in year *t*
Source of data	Delineation of strata using Geographic Information System (GIS), integrating GPS data collected in the field.
Description of measurement	See SOP for carbon stock measurement in Appendix 7 in the MR and Section 3.3.3.3 of PD-Delineation of strata in the Project Area.

methods and procedures to be applied	
Frequency of monitoring/recording	Each monitoring period
Value monitored	M-2 Monitoring period: 1 November 2021 to 31 March 2023 For *ex post*, See Table 11 (part of which is reproduced below) and Table 12 in Section 3.1.3.5 of MR Stratum Area in hectares 2015 10,249.35 2016 18,438.45 2017 15,332.16 2018 10,434.45 2019 9,339.43 2020 9,331.11 2021 9,909.00 **Total= 83,033.95**
Monitoring equipment	See SOP for carbon stock measurement in Appendix 7 in the MR and Section 3.3.3.3 of PD-Delineation of strata in the Project Area.
QA/QC procedures to be applied	See SOP for carbon stock measurement in Appendix 7 in the MR and Section 3.3.3.3 of PD-Delineation of strata in the Project Area.
Purpose of the data	Calculation of project emissions.
Calculation method	Area measurement of polygons using GIS software. See Section 3.3.3.3 in the PD-Delineation of strata in the Project Area.
Comments	N/A

Data / Parameter	N
Data unit	Dimensionless
Description	Number of sample plots required for estimation of biomass stocks within the project boundary
Source of data	Derived from the application of AR Tool 14 using data collected in the field in the project area. Equation 2 from CDM AR Tool 3 (Calculation of the number of sample plots for measurements within A/R CDM project activities) has been used to calculate the number of sample plots per stratum.

<table>
<tr><td>Description of measurement methods and procedures to be applied</td><td>See SOP for carbon stock measurement in Appendix 7 in the MR and Section 3.3.3.4 of PD-Estimation of tree carbon stocks.</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>Each monitoring period.</td></tr>
<tr><td>Value monitored</td><td>M-2 Monitoring period: 1 November 2021 to 28 February 2023
Using Equation 2 from CDM AR Tool 3 (Calculation of the number of sample plots for measured below.
<table>
<tr><th>Year</th><th>Area (ha)</th><th>Wi</th><th>Wi*Si</th><th>No. of sample plots as per PD Data</th><th>No. of sample plots as per MR Data</th><th>Actual No. of sample plots used for MR</th></tr>
<tr><td>2015</td><td>10,287.76</td><td>0.015</td><td>0.1050</td><td>7</td><td>7</td><td>7</td></tr>
<tr><td>2016</td><td>18,543.98</td><td>0.049</td><td>0.3869</td><td>14</td><td>13</td><td>14</td></tr>
<tr><td>2017</td><td>15,407.08</td><td>0.034</td><td>0.0632</td><td>11</td><td>11</td><td>11</td></tr>
<tr><td>2018</td><td>10,473.74</td><td>0.016</td><td>0.0638</td><td>8</td><td>8</td><td>8</td></tr>
<tr><td>2019</td><td>9,368.46</td><td>0.013</td><td>0.0024</td><td>7</td><td>7</td><td>7</td></tr>
<tr><td>2020</td><td>9,384.86</td><td>0.013</td><td>0.0047</td><td>7</td><td>7</td><td>7</td></tr>
<tr><td>2021</td><td>9,909.00</td><td>0.014</td><td>0.0003</td><td>8</td><td>8</td><td>8</td></tr>
<tr><td>Total</td><td>83,033.95</td><td></td><td>0.63</td><td>62</td><td>61</td><td>62</td></tr>
</table></td></tr>
<tr><td>Monitoring equipment</td><td>N/A</td></tr>
<tr><td>QA/QC procedures to be applied</td><td>See SOP for carbon stock measurement in Appendix 7 in the MR and Section 3.3.3.7 of PD-Estimation of tree carbon stocks.</td></tr>
<tr><td>Purpose of the data</td><td>Calculation of project emissions.</td></tr>
<tr><td>Calculation method</td><td>Equation 2 from CDM AR Tool 3 (Calculation of the number of sample plots for measurements within A/R CDM project activities)</td></tr>
<tr><td>Comments</td><td>N/A</td></tr>
</table>

Data / Parameter	$C_{WPS,soil,,i,t}$
Data unit	t C ha^{-1}
Description	Carbon stock in the project scenario in stratum *i* in year *t*
Source of data	Equation 99 from VM0033 using data collected in the field in the project area. For this monitoring period, default value as provided in the methodology has been used instead of the field-collected data.
Description of measurement methods and procedures to be applied	See Section 3.3.3.5 of PD-Estimation of soil carbon stocks and SOP for measurement of soil organic carbon stocks given in Appendix 7 in the MR.
Frequency of monitoring/recording	Each monitoring period.
Value monitored	Default soil organic carbon value has been used during this monitoring period, which is given below. -1.46 t C ha-1 yr-1 × 44/12
Monitoring equipment	See Appendix 7of MR and Section 3.3.3.5 of PD.
QA/QC procedures to be applied	See Section 3.3.3.7 of PD and QA/QC procedures provided in the Monitoring Protocol, Appendix 7 in the MR.
Purpose of the data	Calculation of project emissions.
Calculation method	Equation 99 of VM0033
Comments	N/A

Data / Parameter	%OM
Data unit	%
Description	Percentage of soil that is organic matter
Source of data	Calculated from the combustion of soil collected at various depths in a given stratum in a given year.
Description of measurement methods and procedures to be applied	See Section 3.3.3.5 of PD-Estimation of soil carbon stocks. During this monitoring period, default values as provided for in the methodology has been used.

Frequency of monitoring/recording	Each monitoring period.
Value monitored	The default soil organic carbon value has been used for the current monitoring campaign and is given below. 2.528 %
Monitoring equipment	See Section 3.3.3.5 of PD and equipment provided for in the Monitoring Protocol, Appendix 7 in the MR.
QA/QC procedures to be applied	See Section 3.3.3.7 of PD and QA/QC procedures provided in the Monitoring Protocol, Appendix 7 in the MR.
Purpose of the data	Calculation of project emissions.
Calculation method	See Section 3.3.3.5 of PD. See provisions of VM0033 Methodology regarding the use of default value for soil organic carbon.
Comments	N/A

Data / Parameter	$\%C_{soil}$
Data unit	%
Description	Percentage of soil organic C
Source of data	The default values given in the PD and VM0033 Methodology have been used for the current monitoring campaign. It will be calculated from %OM derived from soil cores collected from the project area for future monitoring campaigns.
Description of measurement methods and procedures to be applied	See Section 3.3.3.5 of PD-Estimation of soil carbon stocks.
Frequency of monitoring/recording	Each monitoring period.
Value monitored	1.6 %
Monitoring equipment	See Section 3.3.3.5 of PD and equipment provided for in the Monitoring Protocol, Appendix 7 in the MR.
QA/QC procedures to be applied	See Section 3.3.3.7 of PD. See Section 3.3.3.7 of PD and QA/QC procedures provided in the Monitoring Protocol, Appendix 7 in the MR.
Purpose of the data	Calculation of project emissions.
Calculation method	See Section 3.3.3.5 of PD.

Comments	N/A

Data / Parameter	BD
Data unit	gcm^{-3}
Description	Dry bulk density
Source of data	Bulk density has not been calculated for the current monitoring campaign, and default soil organic carbon values have been used. See PD Section 3.3.3.5-Estimation of soil carbon stocks. They were calculated from soil samples collected in the field in the project area.
Description of measurement methods and procedures to be applied	See Section 3.3.3.5 of PD-Estimation of soil carbon stocks.
Frequency of monitoring/recording	Each monitoring period.
Value monitored	The default soil organic carbon value has been used for the current monitoring campaign.
Monitoring equipment	See SOP-2 for Soil Organic Carbon Measurements in Appendix 7 in MR and Section 3.3.3.5 of PD.
QA/QC procedures to be applied	See Section 3.3.3.7 of PD and QA/QC procedures provided in the Monitoring Protocol, Appendix 7 in the MR.
Purpose of the data	Calculation of project emissions.
Calculation method	The default value for soil organic carbon has been used during this monitoring. For the future, see SOP-2 for Soil Organic Carbon Measurements in Appendix 7 in MR and Section 3.3.3.5 of PD.
Comments	N/A

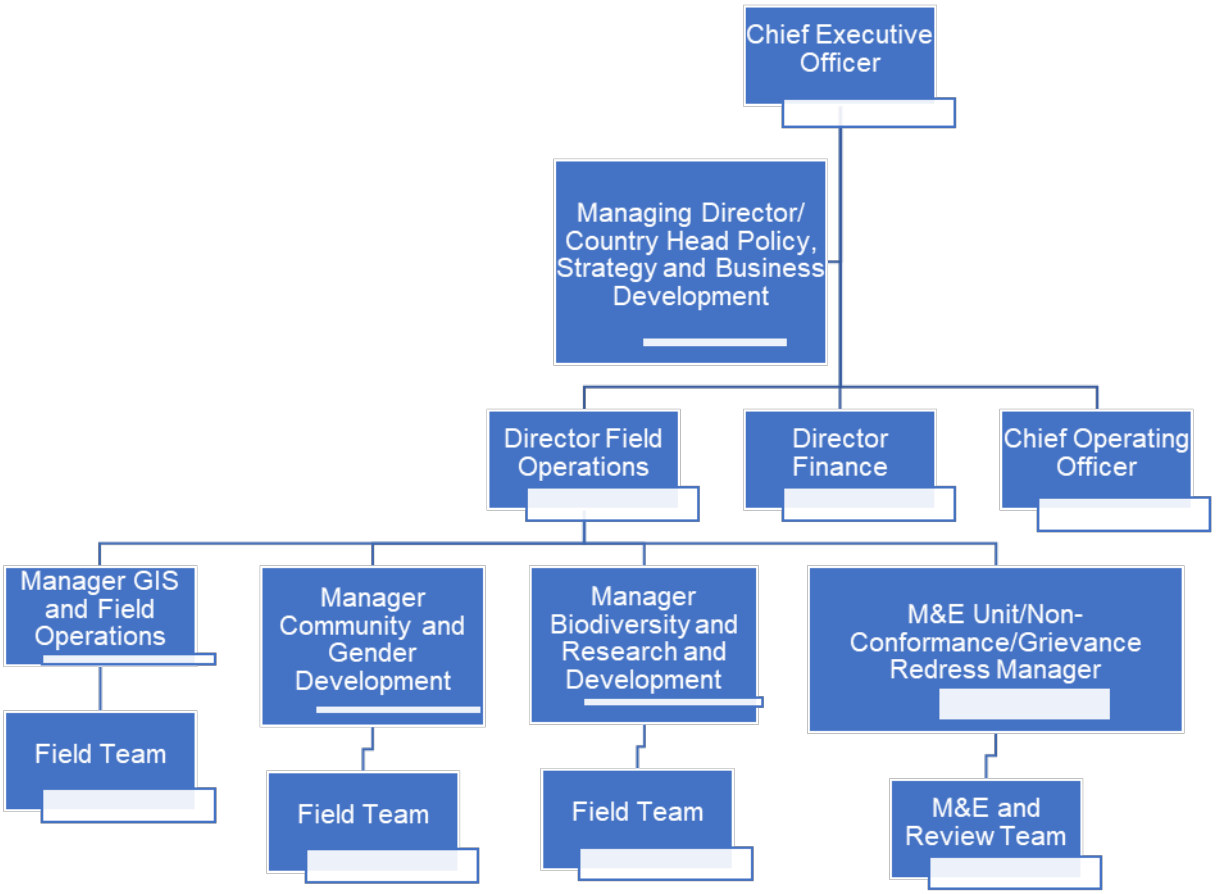
Data / Parameter	NER_{ERROR}
Data unit	%
Description	Total uncertainty for project activity
Source of data	GIS mapping of planted years, eroded areas, and data collected from the field for these area measurements and biomass measurements in sample plots.

Description of measurement methods and procedures to be applied	See PD Sections 3.3.3.3 (Delineation of strata in the Project Area), 3.3.3.4 (Estimation of tree carbon stocks), section 3.3.3.5 (Estimation of soil carbon stocks), and 3.3.3.6 (Estimation of coastal erosion).
Frequency of monitoring/recording	Each monitoring period.
Value monitored	0.03
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of the data	Calculation of net GHG emission reductions
Calculation method	N/A
Comments	N/A

3.1.3 Monitoring Plan

IDC has organizational structures and qualified staff members in the different units in its organizational set-up. These professionally trained and qualified staff members are responsible for implementing the climate monitoring plan of the project and undertaking monitoring activities and collecting data on monitoring parameters variables given in section 3.1.2 above. They have the knowledge, skills and competencies to accurately estimate carbon stocks and emissions removals of the project resulting from implementation of the project activities.

The organizational structure of IDC is given below:



Following monitoring activities are implemented under the monitoring plan and noted against each are required knowledge, skills and competencies and their availability in the project.

Monitoring Activity	Required Knowledge, Skills and Competencies	Organizational Unit where needed staff is based
Delimitation and estimation of Project Area	GIS and field surveys and their associated procedures, use of equipment and calculation methods	GIS and Field Operations Unit
Preparation of accurate land cover maps and estimation of the accuracy of land cover maps	GIS analysis skills	GIS and Field Operations Unit
Biomass plots layout and biomass carbon estimation	Measurement, Monitoring, Verification and Reporting (MMRV)	Managing Director and GIS and Field Operations Unit
Soil Organic Carbon estimation	Measurement, Monitoring, Verification and Reporting (MMRV)	Managing Director and GIS and Field Operations Unit
Estimation of Coastal Erosion	GIS and field surveys and their associated procedures, use of equipment and calculation methods	GIS and Field Operations Unit
Identification of Significant Disturbances	GIS and field surveys and their associated procedures, use of equipment and calculation methods	GIS and Field Operations Unit
QC/QA and Internal Auditing	Measurement, Monitoring, Verification and Reporting (MMRV)	Managing Director and GIS and Field Operations Unit
Forest Patrols and Perimeters Observations	Forest Offences prevention, detection, suppression, prosecution and adjudication	Managing Director and GIS and Field Operations Unit; and M&E Unit
Climate Change Adaptation Benefits MRV	High Conservation Values (HCVs) areas identification, assessment, monitoring, documentation and reporting	Managing Director and GIS and Field Operations Unit; and M&E Unit

3.1.3.1 Monitoring activities

A climate monitoring plan has been developed by the DBC-1 Project to monitor its impact on its climate change objectives, which include GHG removal and community and biodiversity-related climate change adaptation benefits. The primary objective of the monitoring plan is to ensure accurate estimates of carbon stocks and emissions removals from DBC-1 Project restoration activities over the crediting period of the Project. The climate monitoring plan includes four primary monitoring activities that will be performed throughout the lifetime of the DBC-1 Project. These activities and their frequency are shown in the below-given table.

Table 4. The four primary monitoring activities, the frequency they will be performed, and the method used.

Activity	Frequency	Method
Forest Patrols and Perimeter Observations	The first monitoring assessment took place 6 years after the project inception, at the time of M-1 period (19 February 2015 to October 2021). Second Monitoring Period (M-2) was from 01 November 2021 to 28 February 2023. Subsequently, monitoring will occur on an annual basis.	Project patrol teams inspect the perimeter of Project Area
Plot Measurements	The first monitoring assessment took place 6 years after the project inception, at the time of M-1 period (19 February 2015 to October 2021). Second Monitoring Period (M-2) was from 01 November 2021 to 28 February 2023. Subsequently, monitoring will occur on an annual basis.	Sampling teams visit the required number of sample plots at each monitoring event and take biomass carbon estimation related measurements (such as diameter at the base, diameter at 30 centimetres above the last/top prop root, diameter at breast height, tree height, crown circumference/diameter) and collect soil samples from the sample plots for estimation of soil organic carbon in the laboratory as per SOPs developed for the purpose.
Coastal erosion and inter-tidal lands migration-related measurements	The first monitoring assessment took place 6 years after the project inception, at the time of M-1 period (19 February 2015 to October 2021). Second Monitoring Period (M-2) was from 01 November 2021 to 28 February 2023. Subsequently, monitoring will occur on an annual basis.	The amount of area eroded within the Project Area will be assessed every five years, beginning with the first assessment in 2021, which will examine erosion since 2015. At a minimum, Landsat satellite imagery (30 m resolution) will be procured over the Project Area. If higher resolution imagery is available, it will be used to enable finer-scale erosion delineation. The shoreline within Project Area will be manually delineated using GIS every five-year increment. The delineation will be done by one GIS specialist and confirmed by another. The manual delineation will be checked on the ground for plantations closest to the coastline. In conjunction with soil biomass and soil sampling, a GIS team member will walk portions of the coastline within the plantations dispersed across the Project Area, with the tracking feature enabled. The data will be recorded in the laboratory, uploaded to the GIS and compared to the manually delineated shoreline. The amount of erosion that occurred between image dates will be assessed using GIS.

Activity	Frequency	Method
Identification of Significant Disturbances	The first monitoring assessment took place 6 years after the project inception, at the time of M-1 period (19 February 2015 to October 2021). Second Monitoring Period (M-2) was from 01 November 2021 to 28 February 2023. Subsequently, monitoring will occur on an annual basis.	Periodic inspection of aerial imagery, drone images or videography, with ground inspection, when necessary

Description of these monitoring activities is given in section 3.3.3 of PD and the Monitoring Protocol and SOPs for field safety, SOPs for biomass carbon measurement and SOPs for soil organic carbon measurements. These are given as Appendices 3.2, 7, 9 to this monitoring report. In addition to these primary Project monitoring activities, several additional monitoring activities will happen at informal frequencies during the Project Proponents general operations. This includes regular field staff patrols throughout the Project Area, floral and faunal biodiversity assessments, assessments of HCVs areas, and outreaches to the communities. These additional monitoring activities serve to identify any instances of animals grazing, tree cutting, or carrying out any other prohibited activities in the Project Area.

3.1.3.2 Monitoring protocol (see Appendix 7)

A monitoring protocol has been prepared to implement the monitoring plan and is meant as a guide to maintaining consistency during monitoring and includes training and internal audit procedures for quality control. It is intended as a working document to be revised as needed during the course of the Project. When revisions are necessary, they would be noted as monitoring protocol deviations in the subsequent monitoring report prepared for a VCS and CCB verification event.

Following are the salient features of the DBC-1 Project Monitoring Plan and Protocol.

- Data and parameters to be monitored
- Organisational structure for monitoring
- Monitoring teams' constitution, composition and training
- Roles and responsibilities of different team members
- List of equipment, materials and supplies for monitoring
- Data management flow chart and processes
- SOPs for field safety
- SOPs for biomass measurements in the field, including calculation of the number of sample plots and allometric equations to be used for aboveground and belowground biomass carbon estimation
- SOPs for taking soil samples in the field and soil organic carbon measurement
- SOPs for soil/coastal erosion measurement
- QA/QC about different aspects of the data management process

3.1.3.3 Allometric equations for aboveground and belowground biomass estimation

Above- and belowground mangrove biomass has been determined following CDM AR Tool 14 (Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities) using the approach of differencing two independent stock estimations. Aboveground biomass has been determined using species-specific allometric equations as given in Table 5 and Table 6 below separately for aboveground biomass and belowground biomass estimation.

Table 5. Allometric equations for aboveground biomass for mangrove species found within the Indus Delta.

Species	Equation	Source
Avicennia marina	Log (*AG*) = 2.14 x Log (*CD*) + 0.20	Mark Chatting, Lewis LeVay, Mark Walton, Martin W. Skov, Hilary Kennedy, Simon Wilson, and Ibrahim Al-Maslamani, 2020[12]
Rhizophora mucronata	0.8069 * $DBH^{2.5154}$ 0.8069* $D^{2.5154}$	Kirui et al. 2006[13]

Where *CD* = canopy diameter in metres, *H* = tree height in metres, *DBH* = diameter at breast height, *D* = diameter at base (30 cm from ground)/30 cm above last prop root, *AG* = Aboveground biomass, and Log = Log to the base 10.

Justification for the use of Chatting et al. 2020 allometric equation for *Avicennia marina* species has been furnished under Project Description Deviations in Section 2.2.4.

The allometric equation developed by Kirui et al. 2006 permits the use of both DBH and D (diameter at 30 cm above last prop root/diameter at 30 cm from ground) for aboveground biomass estimation in *Rhizophora mucronata* species. Therefore, for trees which are large enough and for which DBH measurements can be taken, DBH is measured and used in the allometric equation. For young small trees, D is measured and used in biomass estimation.

Table 6. Allometric equations for belowground biomass for mangrove species found within the Indus Delta.

Species	Equation	Source
Avicennia marina	*BGB* = 0.923 × *AGB*	Comley and McGuinness (2005)[14]
Rhizophora mucronata	0.6648 * $AGB^{0.9437}$	Pakistan Forest Institute

Where *BGB* = belowground biomass, and *AGB* = aboveground biomass.

Justification for the use of Comely and McGuiness (2005) allometric equation for estimation of belowground biomass of *Avicennia marina* has been furnished in Section 2.2.4 (Project Description Deviations).

[12] Chatting Mark, Lewis LeVay, Mark Walton, Martin W. Skov, Hilary Kennedy, Simon Wilson, and Ibrahim Al-Maslamani. 2020. Mangrove carbon stocks and biomass partitioning in an extreme environment. *Estuarine, Coastal and Shelf Science 244*.

[13] Kirui, B, J. G. Kairo, and M. Karachi. 2006. Allometric equations for estimating above ground biomass of *Rhizophora mucronata* Lamk. (Rhizopheraceae) Mangroves at Gazi Bay, Kenya. *Western Indian Ocean Journal of Marine Science* 5(1):27-34.

[14] Comley, B.W.T., McGuinness, K.A., 2005. Above- and below-ground biomass, and allometry, of four common northern Australian mangroves. *Aust. J. Bot. 53, 431–436. https://doi.org/10.1071/BT04162*.

Justification fo not giving separate allometric equations for *Ceriops tagal* and *Aegiceras corniculatum* in the validated PD and reasons for their biomass inclusión at the time of monitoring report have been furnished in Section 2.2.4 (Project Description Deviations).

3.1.3.4 Estimation of tree biomass carbon stocks

A. Random plot location

Sample plot locations for biomass measurements during the current monitoring campaign for the 2021 and 2022 planting cohorts were determined using the random method, as set out in Appendix 7 (See Appendix 7.5).

For the sample plots of planting cohorts 2015 to 2020, repeat measurements had to be taken from the already existing sample plots. At the time of first monitoring, modifications to operating procedures were made necessary because the project faced multiple challenges during the process. These included limitations on movements due to the ongoing Covid pandemic and financial constraints, leading to accessibility issues and time restrictions. Working in tough conditions in the field – as well within tidal regimes – the project's aim was to maximise efficiency in collection of field data whilst ensuring a random approach was followed. Logistical considerations led to what can be seen as 'clumping' of some sample biomass plots of multiple strata in certain areas (see Figure 10. Biomass Plot locations). However, field measurements within these areas were taken following a systematic regime as outlined in Appendix 7.5.

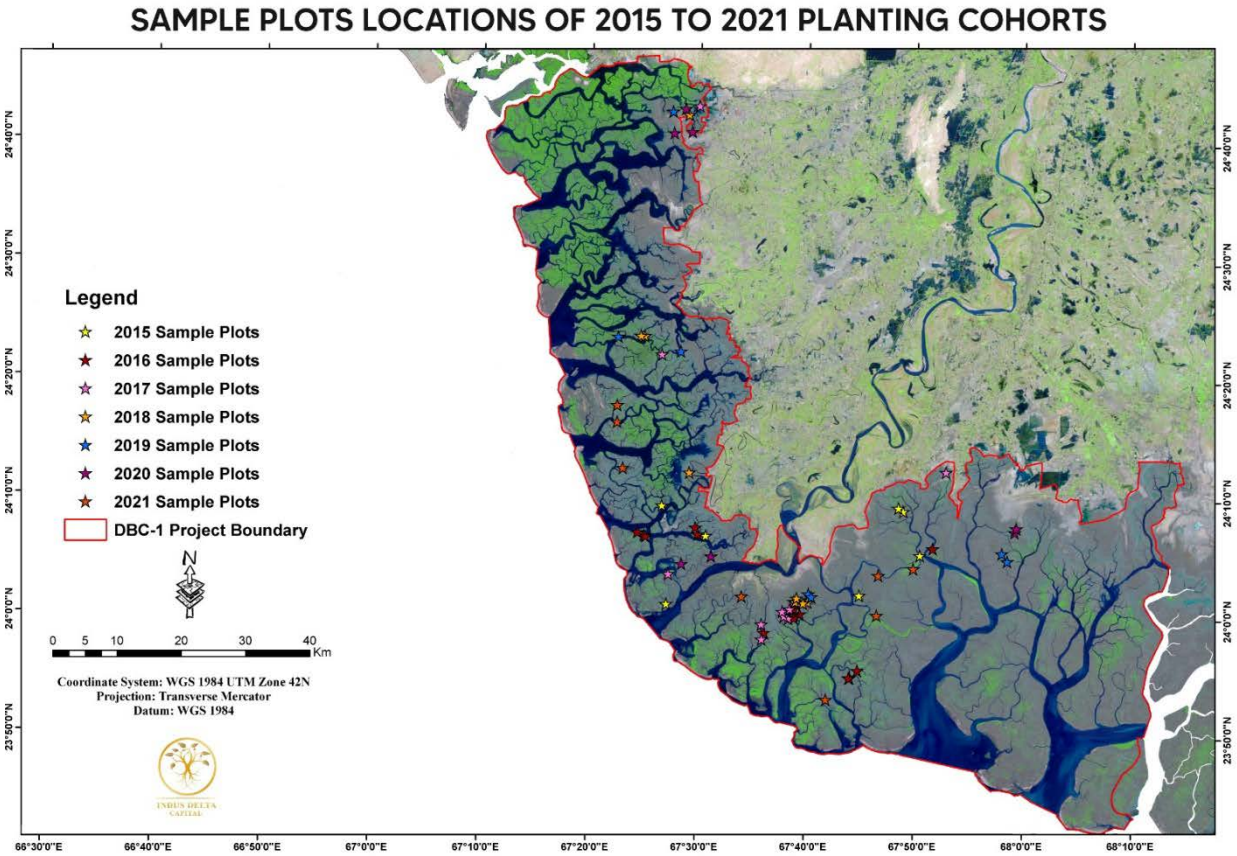


Figure 10. Sample Plots Locations of 2015 to 2021 Planting Cohorts

Due to conditions in the field, a proportion of biomass plots are located nearer to the edge of plantation polygons. An NDVI analysis to demonstrate biomass levels in sample plots located closer to the plantation edge (0-500 m) are representative of the entire plantation area has been conducted (Appendix 7.6). Also, a series of drone videos were taken at sampling locations to obtain visual conformation of the analysis.

Stratification was based on the assumption that the project area is homogeneous in growing conditions and that plantation age is the dominant factor determining biomass stock differences (see Section 3.2.2.1 in PD). From this analysis, the project concludes that there is no evidence of bias in the location of sample plots due to edge proximity and a transparent and systematic approach has been applied to fieldwork to negate the challenges outlined above. Moreover, access to carbon finance will ensure that future monitoring campaigns can be conducted on a periodic basis with full remedies to all issues faced in the first campaign.

B. Plot Biomass Estimation

The plot biomass is estimated according to equations 1 through 3 in appendix 1 of CDM AR Tool 14 (Methods of plot biomass measurement: measurement of fixed area plots):

$$b_{TREE,p,i} = \frac{B_{TREE,p,i}}{A_{PLOT,i}}$$

$$B_{TREE,p,i} = \sum_{j} B_{TREE,j,p,i}$$

$$B_{TREE,j,p,i} = \sum_{l} B_{TREE,l,j,p,i}$$

Where:

$b_{TREE,p,i}$	Tree biomass per hectare in plot *p* of stratum *i*; t d.m. ha^{-1}
$B_{TREE,p,i}$	Tree biomass in sample plot *p* of stratum *i*; t d.m.
$A_{PLOT,i}$	Size of sample plot in stratum *i*; ha
$B_{TREE,j,p,i}$	Biomass of trees of species *j* in sample plot *p* of stratum *i*; t d.m.
$B_{TREE,l,j,p,i}$	Biomass of tree *l* of species *j* in sample plot *p* of stratum *i*; t d.m.

Using the above equations, plot biomass estimations are provided in Table 7.

Table 7. Plot Biomass Estimation

Plantation Year Stratum – i	Plot – p	Btree,p,i (kg)	Aplot,i (ha)	btree,p,i (t/ha)	Total C (t/ha)	Cover %	# of Tree
2015	2015 Sample Plot # 01	2,333.37	0.025	93.33	41.46	81.13	142
2015	2015 Sample Plot # 02	2,361.93	0.025	94.48	42.05	75.98	136
2015	2015 Sample Plot # 03	2,203.85	0.025	88.15	39.09	96.86	185
2015	2015 Sample Plot # 04	2,688.60	0.025	107.54	47.97	81.73	159
2015	2015 Sample Plot # 05	2,219.55	0.025	88.78	39.51	70.52	107
2015	2015 Sample Plot # 06	2,218.76	0.025	88.75	39.46	78.80	123
2015	2015 Sample Plot # 07	2,224.01	0.025	88.96	39.59	80.28	97
2016	2016 Sample Plot # 01	1,865.65	0.025	74.63	33.21	61.97	104
2016	2016 Sample Plot # 02	1,713.34	0.025	68.53	30.42	68.76	95
2016	2016 Sample Plot # 03	1,537.89	0.025	61.52	27.34	54.81	102
2016	2016 Sample Plot # 04	1,795.44	0.025	71.82	31.93	58.78	91
2016	2016 Sample Plot # 05	1,549.18	0.025	61.97	27.57	47.47	84
2016	2016 Sample Plot # 06	1,000.59	0.025	40.02	17.48	90.92	72

Plantation Year Stratum – i	Plot – p	Btree,p,i (kg)	Aplot,i (ha)	btree,p,i (t/ha)	Total C (t/ha)	Cover %	# of Tree
2016	2016 Sample Plot # 07	1,572.35	0.025	62.89	27.94	59.25	123
2016	2016 Sample Plot # 08	1,569.87	0.025	62.79	27.90	55.84	156
2016	2016 Sample Plot # 09	1,514.43	0.025	60.58	26.90	55.09	129
2016	2016 Sample Plot # 10	1,708.04	0.025	68.32	30.33	67.94	119
2016	2016 Sample Plot # 11	1,758.29	0.025	70.33	31.25	61.22	108
2016	2016 Sample Plot # 12	1,020.64	0.025	40.83	17.83	94.06	95
2016	2016 Sample Plot # 13	1,780.73	0.025	71.23	31.65	60.72	130
2016	2016 Sample Plot # 14	1,500.58	0.025	60.02	26.67	51.31	101
2017	2017 Sample Plot # 01	1,352.83	0.025	54.11	23.99	50.96	129
2017	2017 Sample Plot # 02	1,285.62	0.025	51.42	22.92	25.67	78
2017	2017 Sample Plot # 03	1,142.56	0.025	45.70	20.31	35.82	147
2017	2017 Sample Plot # 04	1,110.36	0.025	44.41	19.71	44.82	115
2017	2017 Sample Plot # 05	1,365.62	0.025	54.62	24.32	38.24	161
2017	2017 Sample Plot # 06	1,310.59	0.025	52.42	23.36	27.24	96
2017	2017 Sample Plot # 07	1,123.88	0.025	44.96	19.86	55.73	98
2017	2017 Sample Plot # 08	1,408.86	0.025	56.35	25.05	47.92	80
2017	2017 Sample Plot # 09	1,175.87	0.025	47.03	20.79	57.75	118
2017	2017 Sample Plot # 10	1,127.46	0.025	45.10	20.04	33.48	89
2017	2017 Sample Plot # 11	1,154.61	0.025	46.18	20.48	42.50	113
2018	2018 Sample Plot # 01	518.63	0.025	20.75	9.15	30.24	80
2018	2018 Sample Plot # 02	602.06	0.025	24.08	10.59	39.95	101
2018	2018 Sample Plot # 03	510.76	0.025	20.43	9.06	17.59	72
2018	2018 Sample Plot # 04	927.64	0.025	37.11	16.32	65.79	141
2018	2018 Sample Plot # 05	536.88	0.025	21.48	9.55	12.21	67
2018	2018 Sample Plot # 06	551.80	0.025	22.07	9.75	26.73	69
2018	2018 Sample Plot # 07	528.48	0.025	21.14	9.42	9.21	100
2018	2018 Sample Plot # 08	500.23	0.025	20.01	8.93	2.83	58

Plantation Year Stratum – i	Plot – p	Btree,p,i (kg)	Aplot,i (ha)	btree,p,i (t/ha)	Total C (t/ha)	Cover %	# of Tree
2019	2019 Sample Plot # 01	251.46	0.025	10.06	4.43	14.65	72
2019	2019 Sample Plot # 02	332.14	0.025	13.29	5.85	20.35	119
2019	2019 Sample Plot # 03	266.11	0.025	10.64	4.71	10.92	80
2019	2019 Sample Plot # 04	273.75	0.025	10.95	4.83	14.20	70
2019	2019 Sample Plot # 05	248.61	0.025	9.94	4.39	12.61	93
2019	2019 Sample Plot # 06	281.24	0.025	11.25	4.96	15.34	98
2019	2019 Sample Plot # 07	254.13	0.025	10.17	4.47	16.91	91
2020	2020 Sample Plot # 01	139.60	0.025	5.58	2.47	4.61	67
2020	2020 Sample Plot # 02	144.32	0.025	5.77	2.55	5.10	71
2020	2020 Sample Plot # 03	161.79	0.025	6.47	2.86	7.14	66
2020	2020 Sample Plot # 04	159.69	0.025	6.39	2.82	7.00	63
2020	2020 Sample Plot # 05	145.09	0.025	5.80	2.56	11.54	71
2020	2020 Sample Plot # 06	196.48	0.025	7.86	3.46	12.43	100
2020	2020 Sample Plot # 07	252.48	0.025	10.10	4.46	10.58	109
2021	2021 Sample Plot # 01	67.05	0.025	2.68	1.17	5.87	46
2021	2021 Sample Plot # 02	50.30	0.025	2.01	0.88	4.31	67
2021	2021 Sample Plot # 03	62.87	0.025	2.51	1.10	6.80	68
2021	2021 Sample Plot # 04	52.58	0.025	2.10	0.92	4.74	45
2021	2021 Sample Plot # 05	37.15	0.025	1.49	0.65	2.61	47
2021	2021 Sample Plot # 06	53.38	0.025	2.14	0.94	4.65	69
2021	2021 Sample Plot # 07	61.81	0.025	2.47	1.08	5.37	64
2021	2021 Sample Plot # 08	64.31	0.025	2.57	1.13	5.73	62
	TOTAL	**59,928.17**			**1,063.82**		**6,008**

C. Tree Biomass Estimation

Biomass of a tree in a sample plot is estimated by using Equation 4:

$$B_{TREE,l,j,p,i} = f_j(x_{1,l}, x_{2,l}, x_{3,l}, \dots) * (1 + R_j)$$

Where:

$B_{TREE,l,j,p,i}$	Biomass of tree *l* of species *j* in sample plot *p* of stratum *i;* t d.m.
$f_j(x_{1,l}, x_{2,l}, x_{3,l}, \dots)$	Aboveground biomass of the tree returned by the allometric equation for species *j* relating the measurements of tree *l* to the aboveground biomass of the tree; t d.m.
R_j	Root to shoot ratio for tree species *j*; dimensionless[15]

Mean carbon stock in trees within the tree biomass estimation strata and the associated uncertainty are estimated by using equations 12 through 17 of CDM AR Tool 14:

$$b_{TREE,i} = \frac{\sum_{p=1}^{n_i} b_{TREE,p,i}}{n_i}$$

$$b_{TREE} = \sum_{i=1}^{M} w_i * b_{TREE,i}$$

$$B_{TREE} = A * b_{TREE}$$

Using the above equations, tree biomass estimations are provided in in Table 8.

Table 8. Tree Biomass Estimation

# of sample plots	Plantation Year Stratum - i	Plantation/ Year Stratum - i	∑ btree,p,i (t/ha)	btree,i	btree	Btree
7	2015	10,249	650.00	92.86	11.46	951,729.27
14	2016	18,438	875.48	62.53	13.89	1,153,036.25
11	2017	15,332	542.33	49.30	9.10	755,918.18
8	2018	10,434	187.06	23.38	2.94	243,982.39
7	2019	9,339	76.30	10.90	1.23	101,797.19
7	2020	9,331	47.98	6.85	0.77	63,955.08
8	2021	9,909	17.98	2.25	0.27	22,267.75
62		**83,033.95**			**39.65**	**3,292,686.10**

[15] The description of R_j in CDM AR Tool 14 says that "$R_j = \frac{e^{(-1.085+0.9256 x \ln b}}{b}$ where *b* is the aboveground biomass tree biomass per hectare (in t. d.m. ha^{-1}), unless transparent and verifiable information can be provided to justify a different value." Our method uses results from allometric equations that are added to the results for aboveground biomass, which gives the same result without the additional step of calculating R_j.

D. Tree Carbon Estimation and their Uncertainty Estimation

The following equation have been used for tree carbon estimation along with uncertainty estimation.

$$C_{TREE} = \frac{44}{12} * CF_{TREE} * B_{TREE}$$

$$u_c = \frac{t_{VAL} * \sqrt{\sum_{i=1}^{M} w_i{}^2 * \frac{s_i{}^2}{n_i}}}{b_{tree}}$$

$$s_i^2 = \frac{n_i * \sum_{p=1}^{n_i} b_{TREE,p,i}^2 - (\sum_{p=1}^{n_i} b_{TREE,p,i})^{\ 2}}{n_i * (n_i - 1)}$$

Where:

$b_{TREE,i}$	Mean tree biomass per hectare in stratum *i*; t d.m. ha^{-1}
$b_{TREE,p,i}$	Tree biomass per hectare in plot *p* of stratum *i*; t d.m. ha^{-1}
B_{TREE}	Tree biomass in the tree biomass estimation strata; t d.m.
A	Sum of areas of the tree biomass estimation strata, ha
b_{TREE}	Mean tree biomass per hectare in the tree biomass estimation strata; t d.m. ha^{-1}
C_{TREE}	Carbon stock in trees in the tree biomass estimation strata; t CO_2e
44/12	Ratio of molecular weight of CO_2 to carbon
CF_{TREE}	Carbon fraction of tree biomass; t C (t d.m.)$^{-1}$
w_i	Ratio of the area of stratum *i* to the sum of areas of tree biomass estimation strata (i.e. $w_i = A_i / A$); dimensionless
u_c	Uncertainty in C_{TREE}
t_{VAL}	Two-sided Student's *t-value* for a confidence level of 90% and degrees of freedom equal to *n – M*, where *n* is total number of sample plots within the tree biomass estimation strata and *M* is the total number of tree biomass estimation strata
$s_i{}^2$	Variance of tree biomass per hectare across all sample plots in stratum *i*; (t d.m. ha^{-1})^2
n_i	Number of sample plots in stratum *i*

Using the above equations, tree carbon estimations and uncertainty estimations are provided in Table 9.

Table 9. Tree Carbon Estimation

# of sample plots	Plantation Year Stratum - i	Plantation/ Year Stratum - i	Total C (t/ha)	Mean Total C (t/ha)		Ctree,i,t
7	2015	10,249	289.13	41.30	423,343.46	1,552,259.34
14	2016	18,438	388.41	27.74	511,544.67	1,875,663.78
11	2017	15,332	240.83	21.89	335,680.39	1,230,828.10
8	2018	10,434	82.76	10.35	107,950.62	395,818.94
7	2019	9,339	33.63	4.80	44,874.31	164,539.13
7	2020	9,331	21.19	3.03	28,243.40	103,559.12
8	2021	9,909	7.87	0.98	9,745.56	35,733.71
62		**83,033.95**			**1,461,382.40**	**5,358,402.12**

Table 10. Tree Carbon Uncertainty Estimation

# of sample plots	Plantation Year Stratum - i	Plantation/ Year Stratum - i	s_i^2 2015	s_i^2 2016	s_i^2 2017	s_i^2 2018	s_i^2 2019	s_i^2 2020	s_i^2 2021
7	2015	10,249	8,711.39	5,569.06	2,928.24	430.36	101.17	31.18	7.19
14	2016	18,438	8,925.97	4,696.85	2,644.51	579.97	176.51	33.33	4.05
11	2017	15,332	7,771.10	3,784.19	2,088.71	417.40	113.30	41.88	6.32
8	2018	10,434	11,565.68	5,157.76	1,972.63	1,376.82	119.91	40.80	4.42
7	2019	9,339	7,882.26	3,839.93	2,983.86	461.19	98.89	33.68	2.21
7	2020	9,331	7,876.65	1,601.88	2,748.25	487.17	126.56	61.76	4.56
8	2021	9,909	7,913.92	3,955.64	2,020.98	446.87	103.33	101.99	6.11
62		**83,033.95**	**60,646.97**	3,943.21	3,175.84	400.37	**839.67**	**344.63**	6.62
			422,503.47	3,669.61	2,212.29	**4,600.14**	5,821.39	2,301.86	**41.49**
			48.22	4,667.85	2,033.85	34,991.12	**1.34**	**2.63**	323.20
			6.94	4,946.52	2,132.99	**32.32**	**1.16**	**1.62**	**0.16**
				1,666.73	**26,942.15**	**5.69**			**0.39**
				5,073.59	294,122.51				
				3,602.76	**20.37**				
				56,175.58	**4.51**				
				766,466.50					
				109.84					
				10.48					

t_{VAL} 1.645

w_i^2

Plantation Year Stratum – i	Plantation/Year Stratum - i	w_i^2
2015	10,249	0.1050
2016	18,438	0.3869
2017	15,332	0.0632
2018	10,434	0.0638
2019	9,339	0.0024
2020	9,331	0.0047
2021	9,909	0.0003
Total	**83,034**	

u_c 0.04 (Uncertainty in Tree C Estimation)

The change in tree biomass carbon stock is determined by (Equation 1 in CDM AR Tool 14):

$$\Delta C_{TREE} = C_{TREE,t_2} - C_{TREE,t_1}$$

$$u_{\Delta C} = \frac{\sqrt{(u_1 * C_{TREE,t_1})^2 + (u_2 * C_{TREE,t_2})^2}}{|\Delta C_{TREE}|}$$

Where:

ΔC_{TREE} Change in carbon stock in trees during the period between two points of time t_1 and t_2; t CO_2e

C_{TREE,t_1} Carbon stock in trees, including both above- and belowground biomass, as estimated at time t_1; t CO_2e

Note 1. At the first verification C_{TREE,t_1} is set equal to the carbon stock in the pre-project tree biomass (i.e., $C_{TREE,t_1} = C_{TREE\_BSL}$).

C_{TREE,t_2} Carbon stock in trees, including both above- and belowground biomass, as estimated at time t_2; t CO_2e

$u_{\Delta C}$ Uncertainty in ΔC_{TREE}

u_1 , u_2 Uncertainty in $C_{TREE,\ 1}$ and C_{TREE,t_2}, respectively

ΔC_{TREE} 3,533,228.46

$u_{\Delta C}$ 0.04

3.1.3.5 Project area and estimation of coastal erosion

Ex-ante area targets set for GHG removals and realized at the time of this monitoring period are given in Table 11 below.

Table 11. ARR areas as per PD, rectified ARR areas, LOSS areas, and Persistent Planted areas

Stratum	ARR area as per PD (ha)	Rectified ARR area (ha)	Area lost to erosion or LOSS area (ha)	Persistent Planted area (ha)
2015	9,685	10,287.74	38.39	10,249.35
2016	18,544	18,543.98	105.53	18,438.45
2017	10,399	15,407.09	74.93	15,332.16
2018	10,472	10,473.74	39.29	10,434.45
2019	15,630	9,368.45	29.02	9,339.43
2020	10,835	9,384.85	53.74	9,331.11
2021	9,909	9,909.00	0	9,909.00
Total	**85,474**	**83,374.85**	**340.90**	**83,033.95**

The difference in the areas reported to be planted in the PD and areas actually planted in the planting year has been because of misplaced showing of polygon boundaries from their actual location in the field, error in recording of the polygon planting year, or inclusion of inside water channel area in the planted area estimation. This necessitated the need for PD polygons rectification.

Accordingly, PD polygons rectification was attempted and has been conducted in the following ways:

- Planted areas were traversed with GPS for proper recording of coordinates of planted areas;
- Correction was done where the planting year was not correctly recorded; and
- Water channels inside the planted polygons were removed using Google Earth Pro images.

Coastal erosion estimation during this monitoring campaign is not needed as per provisions of PD that coastal erosion estimation will be done on a five-year interval. Coastal erosion estimation during the first monitoring campaign has been done as per measurement methods and procedures given in PD Section 3.3.3.6. The estimation was done using GIS analysis as well as ground checking of erosion in the field.

For GIS analysis, low-tide timing Sentinel-2 data of 12th February, 2022 (5:54 GMT corresponding to 11:00 hours Pakistan Standard Time) comprising of three tiles (Tile 1: L1C_T42RUN_A034694_20220212T055948; Tile 2: L1C_T42QVM_A034694_20220212T055948; Tile 3: L1C_T42QUM_A034694_20220212T055948) which covered the whole project area was procured. The imagery procurement timing coincides with low tide timing in the Indus Delta area as shown by the tide timings for 12th February, 2022.

Erosion was estimated using Normalized Difference Water Index (NDWI) from Green band and Near Infra-red (NIR) narrow band. Unsupervised classification system was used to classify the image into two classes-water and land. The raster data from this analysis was then used to draw post-erosion polygons. The land area of the pre-erosion planted polygon which was showing as water constitutes the part that has been eroded till the time of the monitoring campaign. These eroded areas were excluded from the pre-erosion polygons. Only those areas of the polygons which are still classified as land and are existing

on ground have been shown as persistent /still intact vegetated lands. Ground checking in the field was also done to estimate the extent of erosion in certain selected areas.

Using results from the above analysis, out of the total planted "ARR" area of 73,465.85 ha, 340.90 ha got eroded during the period February 2015 to February, 2022 and hence constitute "LOSS". Thus the "LOSS" area is 0.464 percent of the "ARR" or planted area. Summary results of the "ARR" area, "LOSS" areas, and planted areas that are still existing and persistent are given in Table12.

Table 12. ARR Area, LOSS Area, and Persistent planted area

Stratum	ARR Area (ha)	LOSS Area (ha)	Persistent planted area (ha)
2015	10,287.74	38.39	10,249.35
2016	18,543.98	105.53	18,438.45
2017	15,407.09	74.93	15,332.16
2018	10,473.74	39.29	10,434.45
2019	9,368.45	29.02	9,339.43
2020	9,384.85	53.74	9,331.11
2021	9,909.00	0	9,909
Total	**83,374.85**	**340.90**	**83,033.95**

Details of all the polygons in which erosion has taken place and their net area after deduction of the eroded area are given in Appendix 8. Maps of the eroded polygons are provided in the file *Eroded Areas Maps* in the *Shapefiles* Folder in the Dropbox. Pre-erosion map of the planted areas and post-erosion map of the planted areas are given below as Figure 10 and Figure 11 respectively.

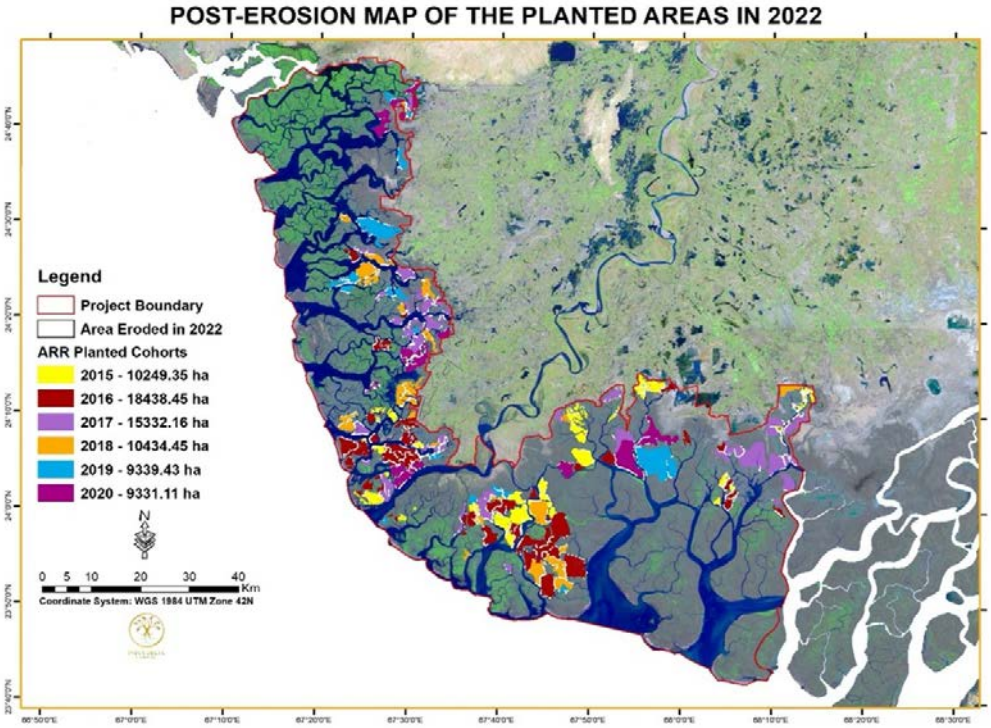


Figure 11. Post-erosion map of the planted areas in 2022

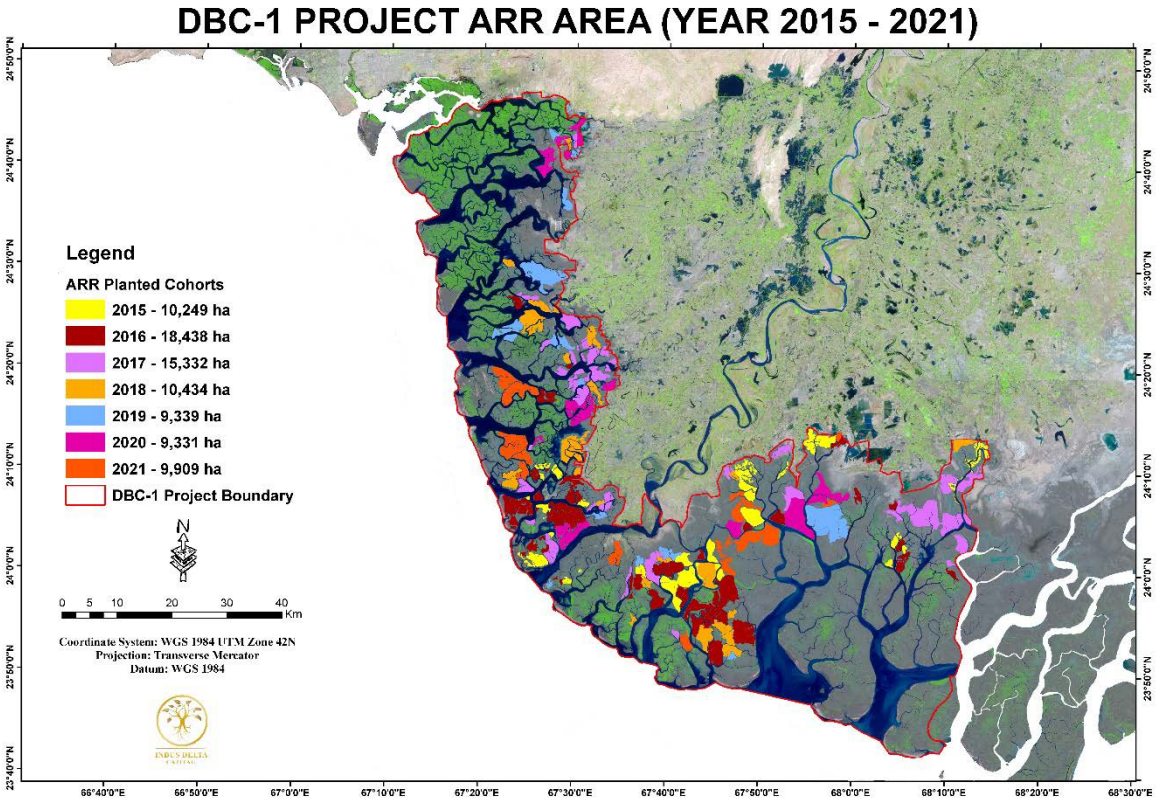


Figure 12. Post-erosion map of the planted areas in 2023

3.1.3.6 Quality Assurance and Quality Control (QA/QC)

To assist field inventory personnel, data analysts, and other individuals involved in evaluating the quality of any aspect of the forest inventory data, Quality Assurance (QA) and Quality Control (QC) are a must. These procedures include specific criteria to evaluate the quality of analytical data gathered, entered into datasheets/spreadsheets and made use of in analysis work. The QA/QC procedures promote the acceptance of analytical data in the marketplace for carbon credits and reduce the need for additional sampling and analysis to support and/or confirm the analytical data and the professional decisions made.

The QA/QC procedures are, therefore, an essential part of the Forest Inventory Program and GHG Removal Estimation of Delta Blue Carbon Project.

Provisions for different aspects of QA/QC have been implemented to ensure that the carbon stocks and carbon credits generated are accurate and reliable and have been estimated following relevant, consistent, transparent, and comparable standards that meet the requirements set for measurement procedures and which result in conservative estimates. These QA/QC provisions are an integral part of the standard operating procedures for the conduct of Forest Inventory under the Delta Blue Carbon Project. They are detailed in the Monitoring Protocol for the conduct of measurements at the time of monitoring. These procedures aim to:

- collect reliable field measurements;
- verify laboratory procedures;
- verify data entry and analysis techniques;
- check data completeness and consistency; and
- maintain and archive data.

3.1.3.7 Training for forest officers and field crews for undertaking field measurement, data management and analysis

Primary and refresher training events have been held for both forest officers and field crews throughout the implementation of the DBC-1 project in 2015-2023. Primary training events for forest officers and field crews were held in 2019, when baseline information was collected for the development of the mangrove growth model in the Indus Delta area and at the time of preparation of the Project Description document. Subsequent refresher training is held regularly on various SOPs, including field safety observation, biomass data collection, soil sample collection for soil organic carbon estimation and QA/QC procedures for field measurements, data collection, storage, and archiving. One of the latest trainings was also held in August 2022 when a detailed training was given on calculation of the number of plots for estimation of biomass and soil organic carbon, laying out of plots in the field, taking of measurements and their recording, as well as doing analysis for biomass and soil organic carbon estimation in the Project Area, beside QA/QC procedures.

Teams comprising of Sindh Forest Department and IDC staff have been carrying out the monitoring activities and collecting data from the field and recording, storing, collating, aggregating it and based on the data gathered and analysed, generating reports.

3.1.3.8 Data management methods and structure

All data generated by the DBC-1 project is centrally managed in an online-based database. Hard copies of all data sheets are archived in Project's head office, with duplicate copies stored in the field offices of the Sindh Forest Department. Field data is uploaded from the datasheets directly into the online database system from the project head office, allowing simultaneous multi-user input through a local server network. After collating the data in the database server, it can be adapted to fulfil all monitoring and reporting needs, using standard and custom-made report formats. Hard and soft copies of all data will be stored for a minimum of two years beyond the end of the project crediting period (31st December 2075). All climate, community and biodiversity monitoring parameters, including raw and processed data, and their frequency are detailed in Appendix 3.1 and Appendix 3.2.

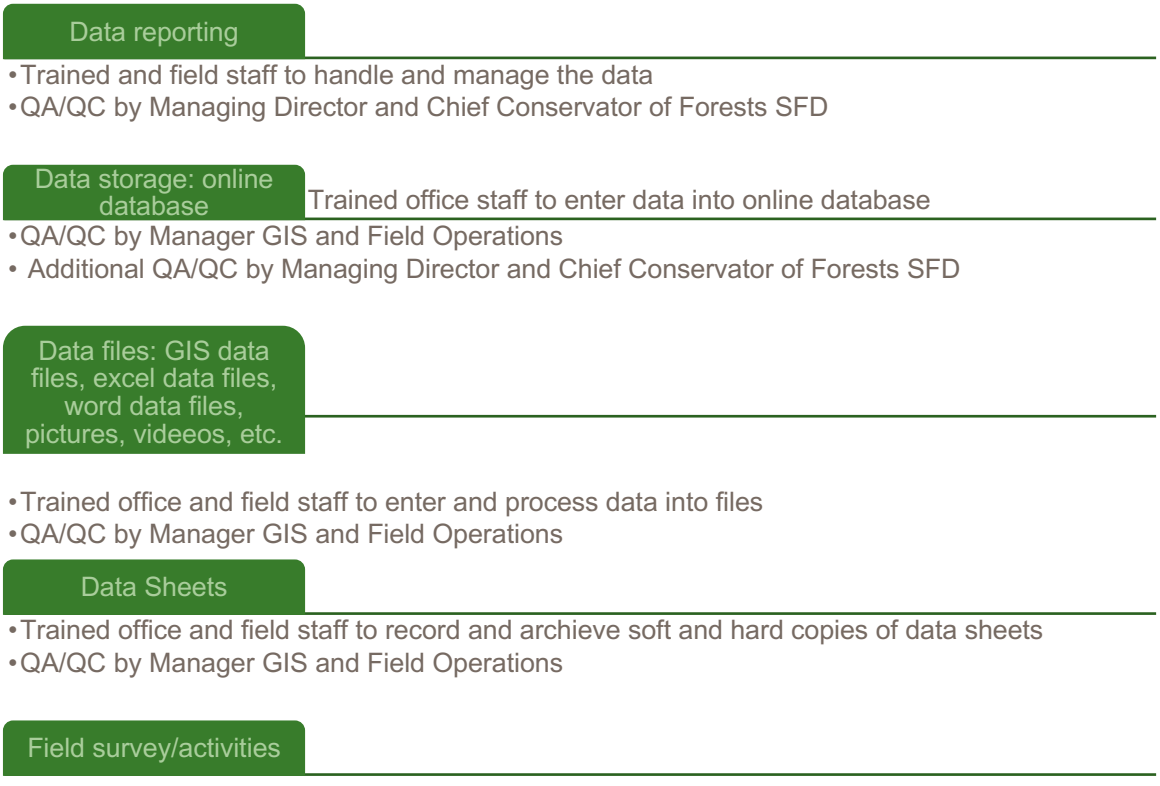
The project's data management structure comprises the following major stages:

1. Data Recording
2. Data Storing
3. Data Collation
4. Data Aggregation
5. Data Generation and
6. Data Reporting

3.1.3.9 Procedures for handling internal auditing and non-conformities

Internal auditing and non-conformities are addressed through standard operating procedures (SOPs) that incorporate multiple quality assurance and quality control (QA/QC) measures. All data collected, recorded, aggregated, summarized, analysed, stored and reported are subject to review and approval by the respective unit heads and/or Managing Director with reference to written SOPs covering each level of data management. In order to ensure the security and traceability of data entry and QA/QC procedures, all users are allocated unique user IDs and passwords to access the database, and in turn, their access and roles can be restricted as appropriate.

Figure 13. Data management QA/QC procedures



3.1.4 Dissemination of Monitoring Plan and Results (CL4.2)

Before the start of the preparation of the monitoring report period, IDC and SFD published in September 2022, the monitoring plan, monitoring protocol/monitoring manual and programme for the implementation of the monitoring campaign on the local bulletin boards for the public and project villages in Keti Bandar and Shah Bandar regional/field offices from 01 August 2022. The objective was to share the monitoring plan, procedures, and programme with the local communities, other stakeholders, and the general public. It invited them to give their comments and feedback on the monitoring plan, monitoring procedures, and

monitoring programme. Copies of the monitoring plan, monitoring procedures, and campaign programme have also been publicly available in the Project Headquarter office at Karachi for any comments and feedback throughout the monitoring process.

Besides, as part of the verification process, the monitoring plan, has been published on the VERRA website (VCS and CCB Standards websites), which stakeholders can easily download. On completion of the monitoring activity, the monitoring results are being published on the project website as well as the VERRA (VCS and CCB) website as part of the draft monitoring report.

Hard copies of the monitoring plan, monitoring manual, campaign, and results have also been placed in the Project Headquarter office at Karachi and the two field/regional offices for review by general public, local communities, and other stakeholders. Monitoring teams of the project have carried out the monitoring process in a participatory manner with the local communities who were closely involved in the monitoring process.

They had full knowledge of the monitoring plan, monitoring procedures and monitoring campaign and monitoring results are also being shared with them. Summaries of the monitoring plan, monitoring manual and monitoring report are being prepared in Urdu and Sindhi languages for sharing with them in hard copies format and for explaining and communicating to the communities and other stakeholders in person by the monitoring team members. For this and any future verification, the monitoring report will summarize all the comments received from communities and stakeholders and corresponding responses regarding the monitoring plan and results, and publish it on the VERRA (VCS and CCB) website along with the monitoring report for this as well as each future monitoring period.

No comments on the monitoring plan and results have been received during this monitoring period.

3.2 Quantification of GHG Emission Reductions and Removals

3.2.1 Baseline Emissions

Quantification of baseline emissions has been done as per procedures laid out in PD Section 3.2.1

Net CO_2e emissions in the baseline scenario are calculated using the following equations.

$$GHG_{BSL} = GHG_{BSL\text{-}biomass} + GHG_{BSL\text{-}soil} + GHG_{BSL\text{-}fuel} \quad (18)^{16}$$

$$GHG_{BSL-biomass} = -\sum_{t=1}^{t^*} \sum_{i=1}^{M_{BSL}} \left(\frac{44}{12} \times \Delta C_{BSL-biomass,i,t} \right) \quad (19)$$

$$GHG_{BSL-soil} = \sum_{t=1}^{t^*} \sum_{i=1}^{M_{BSL}} GHG_{BSL-soil,i,t} \quad (20)$$

$$GHG_{BSL-fuel} = \sum_{t=1}^{t^*} \sum_{i=1}^{M_{BSL}} GHG_{BSL-fuel,i,t} \quad (21)$$

Where:

GHG_{BSL}	Net CO_2e emissions in the baseline scenario up to year t^*; t CO_2e
$GHG_{BSL\text{-}biomass}$	Net CO_2e emissions from biomass carbon pools in the baseline scenario up to year t^*; t CO_2e
$GHG_{BSL\text{-}soil}$	Net CO_2e emissions from the SOC pool in the baseline scenario up to year t^*; t CO_2e
$GHG_{BSL\text{-}fuel}$	Net CO_2e emissions from fossil fuel use in the baseline scenario up to year t^*; t CO_2e

[16] Equation numbers as in VM0033.

$\Delta C_{BSL\text{-}biomass,i,t}$	Net carbon stock changes in biomass carbon pools in the baseline scenario in stratum *i* in year *t*; t C yr^{-1}
$GHG_{BSL\text{-}soil,i,t}$	GHG emissions from the SOC pool in the baseline scenario in stratum *i* in year *t*; t CO_2e yr^{-1}
$GHG_{BSL\text{-}fuel,i,t}$	GHG emissions from fossil fuel use the baseline scenario in stratum *i* in year *t*; t CO_2e yr^{-1}
i	1, 2, 3 …M_{BSL} strata in the baseline scenario
t	1, 2, 3, … *t** years elapsed since the project start date

Fossil fuel combustion in the baseline scenario is not a significant emissions source in this ARR/RWE project activity, as it does not move soil material.

Results are provided in Section 3.2.2.6 in the PD.

3.2.1.1 Net carbon stock change in biomass carbon pools in the baseline scenario

The baseline scenario represents degraded mangrove habitats almost void of any vegetation and without significant natural recovery. GHG removals in this baseline vegetation is considered *de minimis* and therefore need not be deducted from Project emission reductions and carbon removals.

3.2.1.2 Net GHG emissions from soil in the baseline scenario

3.2.1.2.1 Net GHG emissions from soil

Net GHG emissions from soil in the baseline scenario are estimated as:

$$GHG_{BSL\text{-}soil,i,t} = A_{i,t} \times (GHG_{BSL\text{-}soil\text{-}CO2,i,t} - Deduction_{alloch} + GHG_{BSL\text{-}soil\text{-}CH4,i,t} + GHG_{BSL\text{-}soil\text{-}N2O,i,t}) \quad (26)$$

$$GHG_{BSL\text{-}soil\text{-}CO2,i,t} = GHG_{BSL\text{-}insitu\text{-}CO2,i,t} + GHG_{BSL\text{-}eroded\text{-}CO2,i,t} + GHG_{BSL\text{-}excav\text{-}CO2,i,t} \quad (27)$$

Where:

$GHG_{BSL\text{-}soil,i,t}$	GHG emissions from the SOC pool in the baseline scenario in stratum *i* in year *t*; t CO_2e yr^{-1}
$GHG_{BSL\text{-}soil\text{-}CO2,i,t}$	CO_2 emissions from the SOC pool in the baseline scenario in stratum *i* in year *t*; t CO_2e ha^{-1} yr^{-1}
$Deduction_{alloch}$	Deduction from CO_2 emissions from the SOC pool to account for the percentage of the carbon stock that is derived from allochthonous soil organic carbon; t CO_2e ha^{-1} yr^{-1}
$GHG_{BSL\text{-}soil\text{-}CH4,i,t}$	CH_4 emissions from the SOC pool in the baseline scenario in stratum *i* in year *t*; t CO_2e ha^{-1} yr^{-1}
$GHG_{BSL\text{-}soil\text{-}N2O,i,t}$	N_2O emissions from the SOC pool in the baseline scenario in stratum *i* in year *t*; t CO_2e ha^{-1} yr^{-1}
$A_{i,t}$	Area of stratum *i* in year *t*; ha
$GHG_{BSL\text{-}insitu\text{-}CO2,i,t}$	CO_2 emissions from the tidal wetland SOC pool of *in-situ* soils in the baseline scenario in stratum *i* in year *t*; t CO_2e ha^{-1} yr^{-1}
$GHG_{BSL\text{-}eroded\text{-}CO2,i,t}$	CO_2 emissions from the eroded tidal wetland SOC pool in the baseline scenario in stratum *i* in year *t* ; t CO_2e ha^{-1} yr^{-1}
$GHG_{BSL\text{-}excav\text{-}CO2,i,t}$	CO_2 emissions from the tidal wetland SOC pool of soil exposed to an aerobic environment through excavation in the baseline scenario in stratum *i* in year *t*; t CO_2e ha^{-1} yr^{-1}
i	1, 2, 3 … M_{BSL} strata in the baseline scenario
t	1, 2, 3, … *t** years elapsed since the project start date

Areas are provided in Table 15 in the PD and reference to this effect is made in Section 3.2.1.5 in the PD.

Excavation occurred prior to the project start date associated with the establishment of fields for red rice production since the early 19th century[17]. SOC in piled-up soil has been exposed to oxidation for a long period and may have reached a steady state value. Therefore, $GHG_{BSL\text{-}excav\text{-}CO2,i}$ is not accounted for, which is always conservative for the baseline scenario.

3.2.1.2.2 CO_2 emissions from soil – *in situ*

The baseline scenario represents degraded mangrove habitats almost void of any vegetation and without any significant natural recovery. The presence of ground vegetation (*Oryza coarctata* grass) is only seasonal as the grass only grows during the rainy season and is not a permanent cover. Under such circumstances, SOC levels will continue to decline and eventually reach a steady state.

DBC-1 project does not claim avoided emissions (stop loss) from the soil, as a result of the restoration activities.

CO_2 emissions from the *in-situ* soil in the baseline scenario are conservatively not accounted for.

Deduction for allochthonous carbon

A deduction for allochthonous carbon would only apply if $GHG_{BSL\text{-}insitu\text{-}CO2,i,t}$ was negative (sequestration). Since the baseline scenario does not involve accumulation of SOC, a deduction for allochthonous carbon is not necessary.

3.2.1.2.3 CH_4 emissions from soil – *in situ*

CH_4 emissions from soil in the baseline scenario are not accounted for as CH_4 emissions do not increase in the project scenario compared to the baseline scenario.

3.2.1.2.4 N_2O emissions from soil – *in situ*

N_2O emissions from soil in the baseline scenario are not accounted for, as N_2O emissions do not increase in the project scenario compared to the baseline scenario.

3.2.1.2.5 CO_2 emissions from soil – *eroded*

As discussed in Section 3.1.3.2.2 in the PD, sea level rise will over a period of 100 years cause erosion and a loss of wetland area. The predicted loss of wetland area has been calculated in 5-year time steps. However, the soil eroded from one side of the channel is deposited on the opposite side of the channel. Due to this re-sedimentation of the eroded soil there are no CO_2 emissions from eroded soil. Hence, it has been omitted.

3.2.2 Project Emissions and/or removals

3.2.2.1 Stratification

In the project scenario, the planting cohorts – starting in year 2015 and ending in year 2026 – are the dominant factor in ex-post stratification. The stratification procedure is explained in Appendix 7.2 under "Procedures", part of which is given below:

(b) Procedures

Step 1: Key variables for stratification system

[17] Burnes, A. 1837. On Sindh. *Journal of the Royal Geographical Society of London* 7:11-20.

Sub-step 1a: The dominant factor in ex-post stratification is the age of the vegetation or planting year cohorts. Therefore, the project area has been/will be stratified based on the year of planting in 2015 and ending in the year 2026. Project area land within each stratum should be similar with respect to carbon stocks, with different strata having different carbon stocks.

Sub-step 1e: In addition, due to sea level rise some of the planted areas will be washed away while some inland areas will become intertidal and will be gradually colonized by mangrove species because of the nearby presence of mangrove seeds and propagules and planting by DBC-1 project. Such areas will need to be identified, demarcated and mapped and the eroded areas have accordingly been identified, demarcated and mapped.

Sub-step 1f: Thus, additional factors in ex-post stratification include:

- The loss of planted area due to sea level rise, giving rise to a zone actively reforested with mangrove trees but then submerged/eroded and lost. These lands will be classified as “LOSS”.
- The new inland areas which have become intertidal due to sea level rise. These pieces of land will be classified as “GAIN”.

During the first monitoring campaign, using the NDWI analysis procedure given and explained in section 3.1.3.5 (Project area and estimation of coastal erosion), eroded areas (LOSS) were estimated using NDWI from Green Band and Near Infra-red (NIR) narrow band. Using results from the above analysis, out of the total planted ARR area of 73,465.85 ha, 340.90 ha got eroded during the period February 2015 to February 2022, and hence constitute “LOSS”. This LOSS area is 0.464 percent of the “ARR” planted area. Summary results of the “ARR” area, “LOSS” areas, and planted areas that are still existing and intact/persistent are given in the following table:

Year	ARR Area (ha)	LOSS Area (ha)	Persistent Planted Area (ha)
2015	10,287.74	38.39	10,249.35
2016	18,543.98	105.53	18,438.45
2017	15,407.09	74.93	15,332.16
2018	10,473.74	39.29	10,434.45
2019	9,368.45	29.02	9,339.45
2020	9,384.85	53.74	9,331.11
2021	9,909.00	0	9,909.00
Total	**83,374.85**	**340.90**	**83,033.97**

Details of all the polygons in which erosion has taken place and their net area after deduction of the eroded area given in Appendix 8. Maps of the eroded area polygons are provided in the relevant folder in the Dropbox (Folder CL ID-05) for M-1.

Estimation, demarcation and mapping of the “GAIN” areas due to sea level rise has not been undertaken in the first monitoring campaign. These areas will be estimated, demarcated and mapped at future time when these areas will be tackled for planting.

In line with the provisions of PD, coastal erosion estimation is to be done on a 5-year interval. Therefore, during this second monitoring campaign, estimation of coastal erosion has not been done and there are no “LOSS” and “GAIN” areas calculated in this monitoring campaign.

3.2.2.2 Projection of future conditions

As per VM0033 Methodology Section 8.2.1, emissions in the project scenario are attributed to carbon stock changes in biomass carbon pools, soil processes, or a combination of these. In addition, where relevant, emissions from organic soil burns and fossil fuel use may be quantified.

Emissions and removals for biomass carbon pools have been estimated using monitoring results. For soil processes default factors as provided in the VM0033 Methodology and given in the PD have been used due to lack of sufficient and reliable data at the time of this monitoring campaign. There are no organic soils found in the Project area; therefore, emissions from organic soil burns are not relevant. Fossil fuel emissions in the project scenario at the time of monitoring are conservatively not accounted for as these are *de minimis*.

3.2.2.3 Emissions and removals in the project scenario

Net CO_2e emissions in the project scenario are calculated using the following equations from the PD Section 3.2.2.3.

$$GHG_{WPS} = GHG_{WPS\text{-}biomass} + GHG_{WPS\text{-}soil} + GHG_{WPS\text{-}burn} + GHG_{WPS\text{-}fuel} \quad (69)$$

$$GHG_{WPS-biomass} = -\sum_{t=1}^{t^*}\sum_{i=1}^{M_{WPS}}\left(\frac{44}{12}\times\Delta C_{WPS-biomass,i,t}\right) \quad (70)$$

$$GHG_{WPS-soil} = \sum_{t=1}^{t^*}\sum_{i=1}^{M_{WPS}} GHG_{WPS-soil,i,t} \quad (71)$$

$$GHG_{WPS-burn} = \sum_{t=1}^{t^*}\sum_{i=1}^{M_{WPS}} GHG_{WPS-burn,i,t} \quad (72)$$

$$GHG_{WPS-fuel} = \sum_{t=1}^{t^*}\sum_{i=1}^{M_{WPS}} GHG_{WPS-fuel,i,t} \quad (73)$$

Where:

GHG_{WPS}	Net CO_2e emissions in the project scenario up to year t^*; t CO_2e
$GHG_{WPS\text{-}biomass}$	Net CO_2e emissions from biomass carbon pools in the project scenario up to year t^*; t CO_2e
$GHG_{WPS\text{-}soil}$	Net CO_2e emissions from the SOC pool in the project scenario up to year t^*; t CO_2e
$GHG_{WPS\text{-}burn}$	Net CO_2e emissions from prescribed burning in the project scenario up to year t^*; t CO_2e
$GHG_{WPS\text{-}fuel}$	Net CO_2e emissions from fossil fuel use in the project scenario up to year t^*; t CO_2e
$\Delta C_{WPS\text{-}biomass,i,t}$	Net carbon stock change in biomass carbon pools in the project scenario in stratum i in year t; t C yr^{-1}
$GHG_{WPS\text{-}soil,i,t}$	GHG emissions from the SOC pool in the project scenario in stratum i in year t; t CO_2e yr^{-1}
$GHG_{WPS\text{-}burn,i,t}$	GHG emissions from prescribed burning in the project scenario in stratum i in year t; t CO_2e yr^{-1}
$GHG_{WPS\text{-}fuel,i,t}$	GHG emissions from fossil fuel use the project scenario in stratum i in year t; t CO_2e yr^{-1}
i	1, 2, 3 … M_{WPS} strata in the project scenario
t	1, 2, 3, … t^* years elapsed since the project start date

3.2.2.4 Net carbon stock change in biomass carbon pools in the project scenario

Calculations follow the equations provided in VM0033 and CDM AR Tool 14[18], which are given below.

$$\Delta C_{WPS\text{-}biomass,i,t} = \Delta C_{WPS\text{-}tree/shrub,i,t} + \Delta C_{WPS\text{-}herb,i,t} \quad (74)$$

Where:

$\Delta C_{WPS\text{-}biomass,i,t}$	Net carbon stock change in biomass carbon pools in the project scenario in stratum *i* in year *t*; t C yr^{-1}
$\Delta C_{WPS\text{-}tree/shrub,i,t}$	Net carbon stock change in tree and shrub carbon pools in the project scenario in stratum *i* in year *t*; t C yr^{-1}
$\Delta C_{WPS\text{-}herb,i,t}$	Net carbon stock change in herb carbon pools in the project scenario in stratum *i* in year *t*; t C yr^{-1}
i	1, 2, 3 …M_{WPS} strata in the project scenario
t	1, 2, 3, … *t** years elapsed since the project start date

Herbal vegetation development is not significant.

$$\Delta CWPS\text{-}tree/shrub,i,t = 12/44 \times (\Delta CTREE\_PROJ,t + \Delta CSHRUB\_PROJ,t) \quad (75)$$

Where:

$\Delta C_{BSL\text{-}tree/shrub,i,t}$	Net carbon stock change in tree and shrub carbon pools in the project scenario in stratum *i* in year *t*; t C yr^{-1}
$\Delta C_{TREE\_PROJ,t}$	Change in carbon stock in tree biomass in the project scenario in year *t*; t CO_2-e yr^{-1} (derived from application of AR Tool 14; calculations are done for each stratum *i*)
$\Delta C_{SHRUB\_PROJ,t}$	Change in carbon stock in shrub biomass in the project scenario in year *t*; t CO_2-e yr^{-1} (derived from application of AR Tool 14; calculations are done for each stratum *i*)

Change in carbon stock in trees in a year is estimated as follows (Equation 11 from AR Tool 14):

$$\Delta C_{TREE,t} = \frac{C_{TREE,t_2} - C_{TREE,t_1}}{T} \times 1\ year$$

Where:

$\Delta C_{TREE,t}$	Change in carbon stock in trees within the project boundary in year t; t CO_2e
$C_{TREE,t2}$	Carbon stock in trees within the project boundary at time t_2; t CO_2e
$C_{TREE,t1}$	Carbon stock in trees within the project boundary at time t_1; t CO_2e
T	Time elapsed between two successive estimations ($T = t_2 - t_1$;); yr

All present mangrove trees are included in the monitoring of the project scenario. The 1.1 % existing vegetation is considered *de-minimis* and therefore not accounted for.

[18] Applicability conditions included in AR-ACM0003 and associated tools that exclude project activities on wetlands can be disregarded as set out in VM0033.

Ex-post CO_2 emissions or removals by mangrove plantations in the First Monitoring Report have been calculated for:

- Areas actively reforested with mangrove trees ("ARR")
- Areas actively reforested with mangrove trees but then submerged/eroded and lost due to sea-level rise ("LOSS")

Since there were areas that have been actively reforested with mangrove trees but then submerged/eroded and lost due to sea-level rise ("LOSS") during M-1 monitoring period (Section 3.1.3.5), there has been estimation of emissions due to sea-level rise ("LOSS") and deduction on this count has been made from GHG removals under the project scenario in M-1 period GHG quantification and calculations.

The PD says that coastal erosion estimation is to be done at 5-years intervals; therefore, during this M-2 period coastal erosion estimation has not been attempted and will be done in the year 2025 as per provisions of PD document.

Table 13. Cumulative CO_2 removals by mangrove trees per stratum

Stratum	C removals (tCO_2)	Cumulative removals (tCO_2)
2015	1,552,259.34	1,552,259.34
2016	1,875,663.78	3,427,923.12
2017	1,230,828.10	4,658,751.21
2018	395,818.94	5,054,570.16
2019	164,539.13	5,219,109.29
2020	103,559.12	5,322,668.41
2021	35,733.71	**5,358,402.12**
Total	**5,358,402.12**	

3.2.2.5 Net GHG emissions from soil in the project scenario

During this monitoring period, due to the non-availability of suitable local data to estimate net GHG emission from soil in the project scenario, default values as provided in the VM0033 Methodology and given in the PD have been used. See PD section 3.2.2.5.

$$GHG_{WPS\text{-}insitu\text{-}CO2,i,t} = -1.46 \text{ t C ha}^{-1} \text{ yr}^{-1} \times 44/12 \quad (33)^{19}$$

The default value, adjusted for allochthonous carbon as described in VM0033 Methodology and PD under Deduction for allochthonous carbon, is conservatively used for this Monitoring Report. The above default factor may only be applied to areas with a crown or vegetation cover of at least 50%. For areas with a crown or vegetation cover of less than 15%, this value is assumed to be insignificant and accounted for as zero. For areas with a crown or vegetation cover between 15 and 50%, a linear interpolation may be applied and has therefore been used.

[19] Suffixes adjusted for the project scenario

To account for allochthonous carbon, the generalised estimate of the deduction due to allochthonous carbon has been used in the PD from Needelman et al. (2018)[20]:

$\%Deduction_{alloch} = 213.17 \times \%C^{-1.184}$

Where $\%Deduction_{alloch}$ is the percentage of allochthonous carbon deduction from as a percentage of total C, and $\%C$ is the percent of soil C.

The $Deduction_{alloch}$ applied equals 1.35 t C yr^{-1}, or 4.95 t CO_2e yr^{-1}.

Accounting for $Deduction_{alloch}$, the CO_2 emission from the soil is -0.40 t CO_2e yr^{-1} (-0.11 t C yr^{-1}) if the vegetation cover requirement of 50% or more is met.

However, it is noted that the above allochthonous deduction, although used at the time of this monitoring report, is likely to be too high. Therefore, for the next monitoring report, the project may consider empirically assessing the allochthonous deduction and may apply a deduction rate based on field-collected data in the Indus Delta, accurately reflecting the on-ground situation.

Table 14. Average vegetation cover for each stratum

Stratum	Average crown cover % in the stratum	Cumulative removal (t C/ha)
2015	80.76	0.53
2016	63.44	0.43
2017	41.83	0.32
2018	25.57	0.21
2019	15.00	0.11
2020	8.34	0.00
2021	5.01	0.00

Based on the above rules for the application of the default value, CO_2 removals by the tidal wetland SOC pool of *in-situ* soils in the project scenario are as follows.

Table 15. Cumulative CO_2 removals by soil per stratum

Stratum	Cumulative removals (tCO_2)
2015	20,026.89
2016	28,822.49
2017	17,975.12
2018	8,155.43
2019	3,649.79

[20] $y = 213.17x^{-1.184}$ from Needelman, B. A., I. M. Emmer, S. Emmett-Mattox, S. Crooks, J. P. Megonigal, D. Myers, M. P. J. Oreska, and K. McGlathery. 2018. The science and policy of the verified carbon standard methodology for tidal wetland and seagrass restoration. *Estuaries and Coasts* 41(8): 2159-2171.

2020	0
2021	0
Total	**78,629.71**

3.2.2.6 Net GHG emissions from CH_4 and N_2O emissions from soil in situ, CO_2 emissions from eroded soil and fuel use in the project scenario

There are no GHG emissions of CH_4 and N_2O from soil in situ or CO_2 emissions from eroded soil or emissions on account of fossil fuel use in the project scenario at the time of this monitoring report preparation as explained below.

Activities undertaken by the project during the monitoring period pertain to ARR activities, and some community development and biodiversity conservation related activities. No project activity has been undertaken either by the project proponents or other actors during this period that have changed salinity values or increased these values; hence, CH_4 emissions have not increased in the project scenario compared to the baseline scenario. Therefore, methane emissions have not increased and hence have been excluded.

None of the activities of the project proponents or project zone communities who are primarily fishermen have either lowered wáter table or increased nitrogenous fertilizer use in the project área/Project zone or otherwise increased NO_2 emissions in the project scenario compared to the baseline scenario. Therefore, NO_2 emissions have not increased compared to the baseline scenario and therefore have been excluded.

CO_2 emissions from eroded soil material ($GHG_{WPS\text{-}eroded\text{-}CO_2,i,t}$) may be calculated by calculating the area eroded of each stratum, the estimates of the amount of carbon that is eroded ($C_{WPS\text{-}eroded,i,t}$) and the percentage of the eroded carbon that is returned to the atmosphere ($C\%_{WPS\text{-}emitted,i,t}$). The area of each stratum eroded during the first monitoring period has been given above and the total for all strata during the first monitoring period is 340.90 ha over a period of 7 years. For mangrove systems, a default factor ($GHG_{WPS\text{-}insitu\text{-}CO2,i,t}$ = -1.46 t C ha-1 yr-1 × 44/12) for carbon amount may be used in the absence of data suitable for the published value approach or suitable and reliable field collected data. And when the applicable CPDE (carbon preservation depositional environment) is “Normal Marine” or “Deltaic fluidized muds”, which is the case in Indus Delta, then $C\%_{WPS\text{-}emitted,i,t}$ then 80% of this carbon amount value is assumed to return to the atmosphere in the project scenario.

Keeping in view PD provisions regarding coastal erosion estimation at interval of 5-years, no coastal erosion estimation is needed during this second monitoring campaign. Therefore, it has not been done during this monitoring campaign and will be done again in the year 2025.

Moreover, the eroded soil in the case of Indus Delta is re-sedimented on the opposite side of the eroded channel side and the carbon contained therein is not released into the atmosphere and instead is re-buried into the soil layers. Therefore, there is nil to only negligible amount of CO_2 emissions from eroded soil material and hence not estimated.

Fossil fuel emissions in the project scenario at the time of monitoring are conservatively not accounted for as these are *de minimus*. See PD Table 18 in Section 3.2.2.6 in PD for justification, which shows that the fuel emissions are 1.4% of net removals in 2016, declining to 0.28% in 2017, 0.11% in 2018 and then to less than 0.1% in subsequent years – all less than 5%. Therefore, fossil fuel emissions are a de minimis emissions source.

3.2.3 Leakage

The project meets the applicability conditions, and requirements set out by VM0033 (see Sections 03.2.3.1 and 3.2.3.2 below), therefore:

$GHG_{LK} = 0$.

3.2.3.1 Activity-shifting leakage and market leakage

Meeting the applicability conditions of methodology VM0033 ensure that activity-shifting leakage and market leakage do not occur. This project meets these applicability conditions, as justified in PD Section 3.1.2, point 3.

Since this ARR/RWE project activity is associated with a REDD+ activity (see Section 2.1.1), it is worthwhile to outline the wider project activities implemented outside the ARR/RWE Project Area to avoid activity-shifting and market-effect leakage.

Table 16: Leakage management activities undertaken by the ARR project.

Leakage Management Activity	Description
Improved and Intensified livestock farming	Livestock is an important component in the livelihoods of some of the local communities, and they have been using mangroves as grazing land and cutting mangrove branches, leaves and propagules as fodder. Through the mechanism of MSAs, these communities have been trained to practice rotational grazing and avoid areas where there is a risk of trampling young natural re-generation or newly planted area. Other associated activities include enhancing and diversifying their income sources through employment creation opportunities in mangroves restoration related works.
Effective law enforcement	Effective law enforcement is an important policy tool alongside economic incentives, awareness creation, training and capacity and social capital development. Therefore, the project emphasizes and has ensured effective law enforcement to avoid the chances of activity shifting. Some of the measures which have been taken include effective enforcement of mangrove stewardship agreements, mobilisation of community and other stakeholders in support of mangroves conservation and sustainable management, more effective forest surveillance, intelligence gathering, forest offenders' apprehension, prosecution, and early and vigorous adjudication of forest offence cases. Mangrove Stewardship Agreements have been executed with local communities to involve them in the protection of newly planted mangrove areas as well protection of existing mangrove forests.
Awareness-raising	Awareness-raising about mangroves and coastal ecosystems among the various stakeholder groups is an important project objective. Toward this end, it has implemented several activities. These include awareness creation about the various ecosystem services of mangroves and coastal ecosystems(provisioning services such as spawning sites and nursery habitats for various types of fishes and shrimps, production of various non-wood products, etc.; regulating services such as the role in climate change mitigation and adaptation, regulation of the harmful impacts of tsunamis, etc.; supporting services such as habitat provision for various types of wildlife; and information, cultural and recreational services), best practices in the conservation, development and sustainable management of mangroves, and mobilisation of financial resources for their conservation and sustainable development. Among other stakeholder groups, an important target group for these awareness-raising activities have been the various agents of deforestation and forest degradation, such as local communities who could potentially shift their harmful deforestation and forest degradation activities to the leakage belt.

Training and capacity building	Training and capacity building of local communities and other stakeholder groups is crucial for mangrove conservation, development and sustainable management in the Project Area and Project Zone. Training activities, among others, have included training in various mangrove rehabilitation and development activities (propagules collection and storage, nurseries raising, mangroves planting and after-care, etc.), eco-friendly mangrove ecosystem management, mangroves and coastal ecosystems biodiversity conservation, participatory planning, implementation, monitoring and evaluation of mangroves conservation and development interventions, rapid rural appraisal and community development measures, etc.

Some of the additional proposed activities in this regard include the following:

Table 17: Future Leakage management activities to be undertaken by the ARR project

Promotion of Agroforestry	The project will promote the planting of fast-growing multi-purpose tree species that will provide alternative sources of timber, fuelwood, fodder and income to the local communities.
Promotion of fuel-efficient cooking stoves	Fuel-efficient stoves are one means of saving on the usage of wood as a source of energy. Their wider use by the local communities alongside other alternative energy sources will reduce the community demand for mangrove wood as a fuel source.
Promotion of alternative energy sources	Local communities use mangroves and other wood as a source of energy. To meet their energy needs, the project promotes planting other tree species for fuelwood purposes in the adjoining areas outside the Project Area to cater to their energy needs. It also encourages the use of solar energy and other energy sources besides various energy conservation measures.

3.2.3.2 Ecological leakage

To demonstrate that there is no ecological leakage, VM0033 requires that tidal range and sediment delivery experienced by wetlands outside the Project Area must remain within the system tolerance. To ensure that this happens and there is no ecological leakage during the monitoring period, the Project has employed avoidance criteria related to a variety of processes that may occur outside the Project Area as explained below:

Ecological leakage process outside project boundary	Avoidance criterion and project justification
Lowering water table that causes increased soil carbon oxidation	Maintain wetland conditions (e.g., converting from impounded water to a wetland does not cause soil oxidation) Justification: The project has not altered the hydrology of the Indus Delta and adjacent lands.
Lowering water table that causes increased N_2O emissions	No conversion of non-seagrass wetland to open water Justification: The project has not altered the hydrology of the Indus Delta and adjacent lands.
Raising water table that causes increased CH_4 emissions	No conversion of non-wetland to wetland Justification: The project does not alter the hydrology of the Indus Delta and adjacent lands. Where such a conversion occurs, it is due to sea level rise.
Raising water table that causes decreased vegetation production that causes decreased new soil carbon sequestration	No causation of vegetated to non-vegetated (or poorly vegetated) conditions Justification: The project has not altered the hydrology of the Indus Delta and adjacent lands. Therefore, it has not caused an alteration of vegetation cover outside the Project Area. The presence of mangrove trees inside the Project Area have slowed tidal flows and increased sediment deposition reducing sediment that flows into the sea, which does not lead to a decreased carbon sequestration outside the Project Area.

3.2.4 Net GHG Emission Reductions and Removals

The total net GHG emission reductions from the ARR/RWE project activity are calculated as follows:

$$NER_{RWE} = GHG_{BSL} - GHG_{WPS} + FRP - GHG_{LK} \quad \textbf{(84)}$$

Where:

NER_{RWE}[21]	Net CO_2e emission reductions from the RWE project activity; t CO_2e
GHG_{BSL}	Net CO_2e emissions in the baseline scenario; t CO_2e
GHG_{WPS}	Net CO_2e emissions in the project scenario; t CO_2e
FRP	*Fire Reduction Premium* (net CO_2e emission reductions from organic soil combustion due to rewetting and fire management); t CO_2e
GHG_{LK}	Net CO_2e emissions due to leakage; t CO_2e

The *FRP* is not relevant for this project because organic soils and fire are not present.

[21] Also stands for $NER_{ARR/RWE}$

Table 18. Baseline emissions or removals, project emissions or removals, leakage emissions and Net GHG emission reductions or removals (t CO_2e)

Year	Baseline emissions removals (t CO_2e)	Project emissions or removals (t CO_2e)	Leakage emissions (t CO_2e)	Net GHG emission reductions or removals (t CO_2e)
2015	–	1,572,286.23	0	1,572,286.23
2016	–	1,904,486.27	0	1,904,486.27
2017	–	1,248,803.22	0	1,248,803.22
2018	–	403,974.37	0	403,974.37
2019	–	168,188.92	0	168,188.92
2020	–	103,559.12	0	103,559.12
2021	–	35,733.71	0	35,733.71
Total	–	**5,437,031.84**	0	**5,437,031.84**
First Monitoring Period	38,896.62	3,536,056.16	0	3,497,159.54
Second Monitoring Period	–	–	0	**1,939,872.30**

Total project GHG removals are **5,437,031.84 tCO2e.** During the first monitoring period the NER_{RWE} equalled **3,497,159.54 tCO_2e.** Therefore, carbon removals during the second monitoring period are **1,939,872.30 tCO_2e.** See Table 18 above.

Estimation of uncertainty

As per methodology, the adjusted value for NER_t to account for uncertainty is calculated as:

$$adjusted\_NER_t = NER_t \times (100\% - NER_{ERROR} + allowable\_uncert) \quad (92)$$

Where:

$adjusted\_NER_t$	Net GHG emission reductions in year *t* adjusted to account for uncertainty; t CO_2e
NER_t	Total net GHG emission reductions from the project activity up to year *t*; t CO_2e
NER_{ERROR}	Total uncertainty for WRC project activity; %
allowable_uncert	Allowable uncertainty; 20% or 30% at a 90% or 95% confidence level, respectively; %

There is no uncertainty associated with key variables for the baseline scenario because they are either *de minimis* or based on default values.

For the project scenario, uncertainties for biomass carbon calculations have been quantified in the excel sheets developed for carbon calculations and uncertainty estimation of those carbon calculations using the formulae provided for uncertainty estimation (these carbon calculations and uncertainty calculations excel sheets have been provided separately).

The total uncertainty as worked out above is 0.03%, and for all strata individually below 6%, which is less than the threshold of 20 % for any deductions to be made on this count. Therefore, no deductions have been made from GHG removals on account of uncertainty in estimates.

The project does not claim reductions from baseline emissions from the soil carbon pool, only removals due to carbon sequestration in biomass and soil.

Estimation of non-permanence buffer and VCUs

The number of verified carbon units (VCUs) is calculated as:

$$VCU_{t2} = \left(adjusted\_NER_{t2} - adjusted\_NER_{t1}\right) - Bufferw_{t2} \quad (93)$$

Where:

VCU_{t2} Number of VCUs in year *t2*

$adjusted\_NER_{t1}$ Total net GHG emission reductions from the project activity up to year *t1* adjusted to account for uncertainty; t CO_2e

$adjusted\_NER_{t2}$ Total net GHG emission reductions from the project activity up to year *t2* adjusted to account for uncertainty; t CO_2e

$Bufferw_{t2}$ Number of buffer credits to be contributed to the AFOLU pooled buffer account in year *t2*

$$Bufferw_{t2} = \left(NER_{stock,t2} - NER_{stock,t1}\right) \times Buffer\%_{t2} \quad (94)$$

Where:

$Bufferw_{t2}$ Number of buffer credits to be contributed to the AFOLU pooled buffer account in year *t2*

$NER_{stock,\ t1}$ Net GHG emission reductions from the project activity up to year *t1*, discarding non-CO_2 emissions from soil and biomass burning and emissions from fossil fuel use; t CO_2e

$NER_{stock,\ t2}$ Net GHG emission reductions from the project activity up to year *t2*, discarding non-CO_2 emissions from soil and biomass burning and emissions from fossil fuel use; t CO_2e

$Buffer\%_{t2}$ Percentage of buffer credits to be contributed to the AFOLU pooled buffer account in year *t2*; %

The percentage of buffer credits to be contributed to the AFOLU pooled buffer account has been determined by applying the latest version of the VCS AFOLU Non-Permanence Risk Tool, see PD Appendix 12: Risk Analysis.

Total VCUs during M-2 period are **1,939,872.30 tCO2e.** Using equation (93) above and the estimated 10% buffer deduction based on Risk Analysis, the total VCU_{t2} after deduction of 10% buffer for M-2 at the time of this monitoring report comes to 193,987.23 tCO2e. Therefore, total net VCUs for M-2 period are **1,745,885.07 tCO_2e**, see Table 19.

Vintages calculations of these VCUs for the three periods spanning over a total of 16 months (01 November 2021 to 31 December 2021; 01 January 2022 to 31 December 2022; and 01 January 2023 to 28 February 2023) has been done in proportionate manner and is given in Table 19.

Leakage

The project meets the applicability conditions and requirements, therefore,

$GHG_{LK} = 0$

Table 19: *NER_{RWE}*, buffer withholding, and Net VCUs for second monitoring period up to year *t*.

Project Year	*Vintage Period*	*NER_{RWE}* (tCO_2e)	Buffer (10%) (tCO_2e)	VCUs (tCO_2e)
7	2021 (Nov 1-Dec 31)	242,484.04	24,248.40	218,235.63
8	2022 (Jan 1-Dec 31)	1,454,904.23	145,490.42	1,309,413.80
9	2023 (Jan 1-Feb 28)	242,484.04	24,248.40	218,235.63
Total	1/11/21-28/02/2023	**1,939,872.30**	**193,987.23**	**1,745,885.07**

3.3 Optional Criterion: Climate Change Adaptation Benefits

3.3.1 Activities and/or processes implemented for Adaptation (GL1.3)

Based on various studies conducted by relevant and competent bodies, likely regional or sub-national climate change and climate variability scenarios and impacts in the absence of the project are given below.

- Increased temperatures
- Erratic rainfall patterns
- Prolonged droughts
- Stronger winds
- Increased intensity and frequency of extreme weather events
- Sea level rise
- Salt water intrusion

Potential changes in the local land-use scenario due to these climate change scenarios in the absence of the project include:

- Increased inundation/flooding of landscapes, settlements and infrastructure, including health, educational, recreational, civic and cultural facilities
- Wetlands and mangroves loss and degradation
- Impeded drainage/high water tables
- Greater shoreline erosion due to strong wind currents and sea-level rise
- Increased salinisation of terrestrial landscapes and loss of agricultural lands and rangelands
- Saltwater intrusion into freshwater bodies
- Greater salinisation of underground aquifers
- More significant landward progression of the inter-tidal zone

These local land-use scenarios in the absence of the project in the Indus Delta Zone are anticipated to have adverse impacts for local communities, their livelihoods as well as biodiversity through their negative consequences in the following sectors:

- Businesses and socio-economic activities;
- Freshwater resources;
- Agriculture and livestock;
- Forestry and wetlands including mangroves;

- Fisheries and aquaculture;
- Wildlife and biodiversity;
- Environment;
- Infrastructure;
- Settlements and human population;
- Health;
- Education;
- Recreation and culture; and
- Overall life, livelihoods and community well-being.

The DBC-1 project, through its various interventions (up-scaled mangrove restoration and conservation of existing mangrove forests, participatory planning and implementation, awareness-raising, training and capacity building, promotion of various gender development and income-generating activities, etc.), has helped the communities and biodiversity adapt to climate change in the following ways as was communicated by the community members in the participatory assessment of impacts of the DBC-1 project:

Community well-being Impacts (See SIA074 to SIA078 in CCB Community Monitoring Plan for community adaptation benefits)

- Protection of communities and reduction in loss of human lives and injuries, morbidity and diseases due to higher temperatures, extreme weather events, and greater occurrence of floods, droughts, disease pathogens, insects, pests and bites by dangerous and poisonous animals;
- Prevention/reduction of loss of productive assets and livelihood earning assets including croplands as well as settlements;
- Prevention/reduction of loss of crops and livestock from floods damages, droughts, diseases, etc.;
- Prevention/reduction of loss of income and livelihoods earning opportunities;
- Prevention/reduction of loss of infrastructure and access to various services;
- Prevention/reduction of the increased cost of living due to more significant cost involved in access to various services and inflation on account of climate change;
- Prevention/reduction of displacements and migration necessitated by floods, droughts; and
- Greater availability of funds with the communities and government to invest in the achievement of SDGs instead of their diversion to cater to disasters caused by climate change, etc.

Biodiversity Impacts (See BIA047 to BI051 in CCB Biodiversity Monitoring Plan for biodiversity adaptation benefits)

Biodiversity conservation status in the Project Zone and surrounding regions have been maintained as explained below:

- Prevention/reduction of loss and fragmentation of coastal and marine habitats, including loss of food and shelter sources due to protection from sea-level rises; prevention/reduction of loss of vegetation, reduction in shoreline erosion; prevention/reduction of saltwater intrusion into wildlife habitats; moderation of temperatures variations on the surface of land and ocean and reduction of ocean acidification, etc.
- Prevention/reduction of loss of species and genetic diversity, particularly of endemic, rare and sensitive species which are not adapted to the new climatic situation and its greater variability
- Prevention/reduction of increased chances of poaching due to wildlife getting exposed and people capturing wildlife to meet their income and livelihoods needs
- Prevention/reduction of an increased prevalence of diseases and pathogens and onslaught of invasive and exotic species

- There will also be less or no diversion of funds by communities and government agencies to cater to damages caused by climate change events instead of investing in wildlife and biodiversity conservation.

4 COMMUNITY



To assess and demonstrate the net community benefits of DBC-1 project for different community groups and stakeholders, the following five broad categories of assessments have been done for the preparation of this monitoring report:

- Evaluation of changes in well-being due to project activities
- Demonstration of net positive well-being impacts for all identified Community Groups
- Description of measures to mitigate negative impacts and to maintain or enhance High
- Conservation Values, helping to ensure net positive impacts
- Demonstration of the fact there are no negative impacts on High Conservation Values related to community well-being
- Demonstration of the fact that project activities do not harm the well-being of Other Stakeholders

4.1 Net Positive Community Impacts

4.1.1 Community Impacts (CM2.1)

Community impacts include improved livelihoods and well-being for fishermen, agriculturists, livestock owners, daily wage laborers, women, youth, landless poor and other marginalised groups. These impacts occur through increased and diversified income, decreased cost of living, improved access to social services, and greater climate change adaptation benefit. All interventions have been guided by and are consistent with the project theory of change developed in conjunction with stakeholders (PD Section 2.1.11).

Impacts have resulted explicitly from the following project activities:

- Direct employment and jobs creation through up-scaled ARR and MSAs (Current M-2 period: 1,246 including 125 women; Cumulative: 11,656 including including1,158 for women);
- Support for fishing communities and sustainable fisheries (12, 529 which are 35 % of the fishing community members of 35,796);
- Participatory land-use planning and awareness-raising (Current M-2 period: 378 including 215 women; Cumulative: 812 community members including 425 women);
- Access to education – (M-2 period: 387 including 161 girls; Cumulative: 773 including 322 girls);
- Access to safe drinking water and hygiene (Current M-2 period: 400 including 150 women; Cumulative: 800, including 300 women);
- Access to improved health care facilities (Current M-2 period: 8,300 people including 3,600 women; Cumulative: 23,424 including 11,262 women);

- Greater access to HCV-4 services due to improved protection from storms surges and other coastal hazards for communities and coastal infrastructure (Current M-2 period: 2,755 people in 16 villages; Cumulative: 24,099 people in 51 villages);
- Increase in HCV-5 services due to significant increase in spawning places for fisheries, shrimps and other marine life in 49 villages for the fishing communities;
- HCV-6 services through conservation of historical and cultural heritage sites and cultural artefacts (Current M-2 period: 1,994 people in 6 villages; Cumulative; 3,831 people of 6 villages);
- HCV-6 services through inspiration, knowledge and information services for artists, musicians, academicians and researchers (Current M-2 period: 2,134 people; Cumulative: 7,596);
- HCV-6 services through increase in aesthetic values and iconic spaces (Current M-2 period: 1,421; Cumulative: 3,256);
- Promotion of greater well-being of people on account of livelihoods improvement, trainings, health, education, drinking water and sanitation services (Current M-2 period: 12,061; Cumulative: 38,815);
- Promotion of gender equality and income-generating activities for women (Current M-2 period: 128; Cumulative: 1,158);
- Training of Sindh Forest and Wildlife Department staff members at various levels (Current M-2 period: 16; Cumulative: 28);
- Community-based sustainable business development and access to microfinance; and
- Sustainable energy development;

To evaluate the extent of the related changes in livelihoods, well-being, increased access to social services and climate change adaptation benefits, the following main categories of aspects have been analysed:

- Economic aspects: Sustainable economic alternatives and sources of livelihood, income from project activities, increased access to credit, reduced cost of living etc.
- Social aspects: Organisation and governance, social capital development, influence on decision making, access to healthcare, education, access to civic facilities, etc.



Figure 14. DBC-1 has surveyed schools in the project zone and provided health equipment to medics

- Environmental services aspects: Improved water quantity and quality, improved hygiene facilities, improved indoor air quality, etc.
- Cultural aspects: Cultural integrity (historical and spiritual connections between people and nature), access to leisure and sports for youth, etc.

The net-positive community impact findings are detailed below and are in line with the project and the without-project scenario.

The findings are the outcome of a monitoring exercise conducted for the monitoring period between 1 November 2021 to 28 February 2023. The monitoring comprised of Focus Group Discussions and Key Informants Interviews held via three separate SBIA workshops in Keti Bandar and Shah Bandar Areas, where participants from most villages in the Project Zone were present. This was complemented with household surveys conducted from September 2022 to February 2023 in 52 Project Zone villages and 233 villages lying within 20-kilometer radius of the Project Zone (Details of these surveys and workshops and details about the participants of these surveys and workshops are available in Appendix 6).

These workshops and household surveys were conducted using proper protocols and following standard operating procedures (SOPs). These were fully documented, and the reports were uploaded to the Project Virtual database. The reports and supporting documents are available for inspection and perusal by the VVB and any other interested party.



Figure 15. DBC-1 interventions provided safe drinking water, health facilities and support to project zone communities

Copies of these SBIA workshops, household surveys and monitoring reports and their summaries have also been made available in the Project head office as well as the Project's field offices in Keti Bandar and Shah Bandar. Various project activities were implemented throughout the project zone during the M-2 monitoring period (1 November 2021 to 31 March 2023) to benefit the above community groups and stakeholders.

These project interventions, among others, include up-scaled ARR over an area of 83,034 ha, protection of planted areas through mangrove stewardship agreements, participatory planning and awareness-raising, improved access to safe drinking water, hygiene and health facilities, access to education, the social organisation of local communities into village development committees as well as a women's organisations, and training and capacity building through various consultative meetings and Social and Biodiversity Impact Assessment workshops.

Based on the secondary and field-collected data analysis, the impacts on different community groups and government departments/local authorities are given in the tables below.

Community Group	Community in general – total population in 60 villages is 43,000 people
Impact (s)	Enhanced ecosystem goods and services and improved livelihoods through better education, health, access to clean water and direct employment as detailed below. <u>Economic and Livelihoods Aspects:</u> • Increased food security and nutrition • Improved survival and livelihood protection threshold

	• Increased ownership of, and access to, production assets • Enhanced productivity • Increased and diversified sources of income due to greater jobs, employment and business opportunities • Acquisition and application of knowledge related to livelihood activities • Access to livelihood support services and markets • Increased access to institutional and affordable credit and therefore reduced debt obligations • Reduced poverty due to improved income and livelihoods • Reduced variations in income levels • Reduced cost of living <u>Social Aspects</u>: • Increased community-level organization and governance • Strong community institution and therefore increased social capital development • Greater influence on decision making • Expanded access to healthcare • Wider access to education • Increased access to civic facilities • Reduced community inequalities • Greater gender equality • Sustainable communities <u>Environmental Services Aspects</u>: • Improved access to safe and affordable drinking • Greater access to hygiene facilities • Improved ambient air quality • Decreased disasters risks • Improved policies, regulations and rights for livelihood development <u>Cultural Aspects</u>: • Greater cultural integrity (historical and spiritual connections between people and nature), • Increased access to leisure and sports for youth <u>Links to/synergies with SDGs achievement</u>: • SDG-1: No Poverty • SDG-2: Zero Hunger • SDG-3: Good Health and Well-being • SDG-4: Quality Education • SDG-5: Gender Equality • SDG-6: Clean Water and Sanitation • SDG-7: Affordable Clean Energy • SDG-8: Decent Work and Economic Development • SDG-10: Reduced Inequalities • SDG-11: Sustainable Communities

	• SDG-12: Responsible/Sustainable Consumption and Production • SDG-13: Climate Action • SDG-14: Life Below Water • SDG-15: Life on Land • SDG-16: Justice and Strong Institutions • SDG-17: Partnerships for Development
Type of Benefit/Cost/Risk	Observed and predicted direct benefit
Change in Well-being	Around 43,000 people are living in the Project Zone villages. Approximately 49% are females, and 51% are males. These community members were surveyed through SBIA workshops and individual household surveys across 52 villages. All those surveyed have indicated that there is improvement in different dimensions of well-being (economic, social, quality of the environment, and cultural aspects as described above), especially noting the following: • Income and wealth (Total people 2,446 including 1,188 females through jobs creation) • Productive work opportunities (Total people: 1,246 including 128 females) • Improved health (Total people: 8300 including 3,600 females) • Expanded access to safe and affordable drinking water and sanitation (Total people: 400. Males: 250. Female: 150. Daily 500 gallons of safe and affordable water for drinking and hygiene) • Awareness, knowledge and skills (Total people: 378 including 215 females) • Improved access to education (Total =387 including 161 girls). • Environmental quality improvement due to restoration of degraded mangrove lands (Total people: 43,000. Males: 21,930. Females: 21,070) • HCV-4: Increased resilience and reduced vulnerability of people and human settlements and land to seawater intrusion (Total people 2,755 in 16 villages) • HCV-5: A significant increase in fish and other marine life catch in 35% of 35,797 fishing community members • HCV-6a: Greater civic engagement (1,994 people in 6 surrounding villages due to the construction of civic centre and conservation of historical and cultural sites and cultural artefacts) • HCV-6b: Inspiration, knowledge and information services of wetland ecosystems (2,134 people in 6 surrounding villages) • HCV-6c: Increase in aesthetic values and iconic spaces (1,421 people in 6 surrounding villages) • Increased social connections (767 people in 4 surrounding villages due to the construction of civic centre) • Improved well-being resulting from Employment+ Health+ Water+ Training+ Education (Total people: 12,061 including 4,266 women) As a result, there is overall betterment in their living conditions. These positive changes in well-being result from the following: • Greater availability of and access to restored mangrove forests and their different ecosystem goods and services (73,125 ha restored mangroves);

	• Increased availability of fish and other natural resources; • Improved and expanded access to various human well-being improving facilities such as drinking water, hygiene, health, education, energy, civic, recreational, cultural and religious facilities; • Increased capacities (knowledge, skills and attitudes) for practising sustainable fishing, natural resources, agriculture and livestock and other livelihoods pursuits related activities; • Increase in and diversification of income and livelihood sources through jobs/employment and business opportunities creation and reduced dependence on natural resources as a source of livelihood; • Increased and easier access to low cost and institutional credit and financial resources with little or lower economically debilitating obligations and terms and conditions due to linkages development; • Improved access to varied markets; • Social and economic empowerment, especially of the marginal and vulnerable groups; • Expanded and easy access to various public and private sector services providers; • Increased human capacities and well-being due to enhancements in knowledge, skills and positive attitudinal changes and perspectives on life brought about as a result of awareness-raising, training and capacity building activities; • Social skills and social capital development resulting in improved collective action, negotiation and conflict resolution skills; • Reduced vulnerabilities to climate change and climate change-induced natural disasters such as floods, waves action, coastal erosion, sea-level rise, saltwater intrusion into cropland and settlements, droughts, cyclones and various other extreme weather events; • Reduced air, water and soil pollution and exposure to toxic materials; and • Increased coping capacities to deal with economic, social and environmental shocks and trends.

Stakeholder Group	Government and local authorities. The group include employees of the Sindh Forest and Wildlife Department and Fisheries Department. 16 Forest Department officials have participated in various training programs of the DBC-1 project, including MRV, conducting socio-economic surveys, SBIA workshops, etc.
Impact (s)	Better execution of their mandate through improved training, equipment, revenue collection and improved relations with communities This group has benefited because of the better execution of their mandate through improved training, equipment and improved relations with the communities.
Type of Benefit/Cost/Risk	The group has both direct and indirect benefits because of greater access to private sector finance for implementing their mandate in the Project Area, besides benefiting from training and capacity building, equipment availability,

	and better relations with the partner communities. Therefore, there is a net positive well-being impact for the group.
Change in Well-being	The change in well-being is positive for this group of stakeholders. There is increased access to private sector funds as well as major gains in developing positive community relations. In addition, there will be increase in revenue after receipt of carbon revenues after the issuance and sale of verified carbon units. The stakeholder group was involved in assessing the impacts of the project during the monitoring period by interviewing them at the time of monitoring.

Community Group	Youth and women Total: About 13,266 people. Women: 4,266. Youth: 9,000.
Impact (s)	Availability of jobs and alternative sources of livelihood. 4,266 Women including girls benefit from various project activities such as employment opportunities for 128; health benefits for 3,600; safe drinking water for 150; girls' education for 161 girls, and awareness-raising/training/capacity building for 215). Youth benefit from employment opportunities, health facilities, education facilities, civic facilities, etc. Project activities have resulted in jobs, employment and business opportunities development; economic and social opportunities expansion due to project activities; markets development and spin-offs creation; knowledge and skills improvements and positive attitudes development; networking and linkages development; etc. Links to/synergies with SDGs achievement: SDG-1: No Poverty SDG-2: Zero Hunger SDG-3: Good Health and Well-being SDG-4: Quality Education SDG-5: Gender Equality SDG-6: Clean Water and Sanitation SDG-7: Affordable Clean Energy SDG-8: Decent Work and Economic Development SDG-10: Reduced Inequalities SDG-11: Sustainable Communities SDG-13: Climate Action SDG-16: Peace, Justice and Strong Institutions
Type of Benefit/Cost/Risk	Observed and predicted direct benefit

Change in Well-being	Around 70 percent of the population of 43,000 (or 30,000 people) comprise this group, including about 21,070 women. There has been improvement in the well-being of 4,266 women. There have been significant livelihood improvements through improved food, social, personal, environmental, human and property security. Specifically, increased and diversified income, broader food sources, better education, health, drinking water and hygiene facilities, civic facilities, a cleaner and healthier environment, and an overall lift in living standards. These positive changes in well-being have resulted from the following as was reported by them during the monitoring surveys undertaken for the preparation of this monitoring report: • Greater availability of and access to restored mangrove forests and their different ecosystem goods and services; • Increased availability of fishes and other natural resources; • Improved and expanded access to various human well-being improving facilities such as drinking water, hygiene, health, education, energy, civic, recreational, cultural and religious facilities; • Increased capacities (knowledge, skills and attitudes) for practising sustainable fishing, natural resources, agriculture and livestock and other livelihoods pursuits related activities; • Increase in and diversification of income and livelihood sources through jobs/employment and business opportunities creation and reduced dependence on natural resources as a source of livelihood; • Increased and easier access to low cost and institutional credit and financial resources with little or lower economically debilitating obligations and terms and conditions due to linkages development; • Improved access to varied markets; • Social and economic empowerment, especially of the marginal and vulnerable groups; • Expanded and easy access to various public and private sector services providers; • Increased human capacities and well-being due to enhancements in knowledge, skills and positive attitudinal changes and perspectives on life brought about as a result of awareness-raising, training and capacity building activities; • Social skills and social capital development resulting in improved collective action, negotiation and conflict resolution skills; • Reduced vulnerabilities to climate change and climate change-induced natural disasters such as floods, waves action, coastal erosion, sea-level rise, saltwater intrusion into cropland and settlements, droughts, cyclones and various other extreme weather events; • Reduced air, water and soil pollution and exposure to toxic materials; and • Increased coping capacities to deal with economic, social and environmental shocks and trends.

Community group	Borrowers and debtors
Impact(s)	Direct access to affordable credit and gains in profits through payment of low interest rates on borrowed money

Type of benefit/cost/risk	Observed and predicted direct benefit
Change in well-being	The group members were consulted and interviewed while assessing the impact of the project on the group at the time of preparation of the monitoring report. They reported improved well-being due to increase in income and livelihood sources as well as reduced cost on account of access to affordable services, there has been a major impact as they now do not need so much of borrowed money and can now access affordable credit on easy terms and have to pay lower interest on borrowed money.

Community Group	Fishermen Total fishing community people: 35,797. Male: 17,122. Female: 18,675. Beneficiaries are 12,529 which are 35 % of the fishing community people
Impact (s)	Direct access to affordable credit and gains in profits through adoption of new technologies that promote sustainable fishing practices and increased fish catch. As a result, the following aspects of their life and well-being have been positively impacted in a major way. <u>Economic and Livelihoods Aspects</u>: • Increased food security and nutrition due to increased fisheries production from increased spawning resulting from mangroves restoration and conservation works • Improved survival and livelihood protection threshold • Increased ownership of, and access to, production assets • Enhanced productivity • Increased and diversified sources of income due to greater jobs, employment and business opportunities • Acquisition and application of knowledge related to livelihood activities • Access to livelihood support services and markets • Increased access to institutional and affordable credit and therefore reduced debt obligations • Reduced poverty due to improved income and livelihoods • Reduced variations in income levels • Reduced cost of living <u>Social Aspects</u>: • Increased community-level organization and governance • Strong community institution and therefore increased social capital development • Greater influence on decision making • Expanded access to healthcare • Wider access to education • Increased access to civic facilities • Reduced community inequalities • Greater gender equality • Sustainable communities

	Environmental Services Aspects: • Improved access to safe and affordable drinking • Greater access to hygiene facilities • Improved ambient air quality • Decreased disasters risks • Improved policies, regulations and rights for livelihood development Cultural Aspects: • Greater cultural integrity (historical and spiritual connections between people and nature), • Increased access to leisure and sports for youth Links to/synergies with SDGs achievement: • SDG-1: No Poverty • SDG-2: Zero Hunger • SDG-3: Good Health and Well-being • SDG-4: Quality Education • SDG-5: Gender Equality • SDG-6: Clean Water and Sanitation • SDG-7: Affordable Clean Energy • SDG-8: Decent Work and Economic Development • SDG-10: Reduced Inequalities • SDG-11: Sustainable Communities • SDG-12: Responsible/Sustainable Consumption and Production • SDG-13: Climate Action • SDG-14: Life Below Water • SDG-15: Life on Land • SDG-16: Justice and Strong Institutions • SDG-17: Partnerships for Development
Type of Benefit/Cost/Risk	Observed and predicted direct benefit
Change in Well-being	There are about 35,797 people of coastal communities in the Project Zone associated with fishing as the primary source of livelihood. Of these, 17,122 are males, and 18,675 are females. These people have been surveyed through the SBIA workshops, key informant interviews, and household surveys to measure the impact of different project interventions on their livelihoods. 12,529 people or 35 % of them have reported significant improvements on account of the following: • Improved trophic structure and food web for fishing as a source of livelihood • Increased fish catch due to improved spawning habitat on account of increased restoration (83,034 ha mangroves) • Increased natural recruitment of fishes and shrimps • Improvements in the recovery of depleted fish species and other aquatic life

	• Increased diversity of fish and different aquatic life • Greater diversity of fishing opportunities • Reduced variance in fish and shrimp yields • Greater involvement of fishermen in decision making • Reduced risks to long-term livelihoods security • Improved peace of mind • Reduced conflicts with law enforcing agencies and improved working relationships • Improved and expanded access to climate change adaptation benefits, including protection from coastal erosion • Significant livelihood improvements are evidenced through improved food, social, personal, environmental, human and property security. Specifically, increased and diversified income, broader food sources, better education, health, drinking water and hygiene facilities, civic facilities, a cleaner and healthier environment, and an overall lift in living standards. These positive changes in well-being result from the following: • Greater availability of and access to restored mangrove forests and their different ecosystem goods and services; • Increased availability of fishes and other natural resources; • Improved and expanded access to various human well-being improving facilities such as drinking water, hygiene, health, education, energy, civic, recreational, cultural and religious facilities; • Increased capacities (knowledge, skills and attitudes) for practising sustainable fishing, natural resources, agriculture and livestock and other livelihoods pursuits related activities; • Increase in and diversification of income and livelihood sources through jobs/employment and business opportunities creation and reduced dependence on natural resources as a source of livelihood; • Increased and easier access to low cost and institutional credit and financial resources with little or lower economically debilitating obligations and terms and conditions due to linkages development; • Improved access to varied markets; • Social and economic empowerment, especially of the marginal and vulnerable groups; • Expanded and easy access to various public and private sector services providers; • Increased human capacities and well-being due to enhancements in knowledge, skills and positive attitudinal changes and perspectives on life brought about as a result of awareness-raising, training and capacity building activities; • Social skills and social capital development resulting in improved collective action, negotiation and conflict resolution skills; • Reduced vulnerabilities to climate change and climate change-induced natural disasters such as floods, waves action, coastal erosion, sea-level rise, saltwater intrusion into cropland and settlements, droughts, cyclones and various other extreme weather events;

	• Reduced air, water and soil pollution and exposure to toxic materials; and • Increased coping capacities to deal with economic, social and environmental shocks and trends.

Community Group	Daily wage paid labour Total population: 3,628 people. Males: 1,734. Females: 1,894. Beneficiaries are 65 % of the community from different activities including mangrove restoration work, health facilities, drinking water facilities, training facilities, and various ecosystem services provided by planted mangroves.
Impact (s)	Availability of jobs, alternative livelihoods and reduced cost of living. Project activities have resulted in the availability of jobs, alternative livelihoods, and decrease in cost of living due to improved and enhanced access to health, water and civic facilities. Links to/synergies with SDGs achievement: SDG-1: No Poverty SDG-2: Zero Hunger SDG-3: Good Health and Well-being SDG-4: Quality Education SDG-5: Gender Equality SDG-6: Clean Water and Sanitation SDG-8: Decent Work and Economic Development SDG-11: Sustainable Communities SDG-13: Climate Action
Type of Benefit/Cost/Risk	Observed and predicted direct benefit
Change in Well-being	This socio-economic group comprises about 3,628 people, of which 1,734 are males, and 1,894 are females. Around 65 % of this group of people work in mangrove restoration and conservation works, which has produced total employment opportunities for them in mangrove ARR and MSAs related work. Their primary livelihood and income-earning come from their daily wage. The group was facing a vicious cycle of increased poverty, environmental degradation, and social deprivation under business-as-usual conditions. Other project activities from which they have benefited from include health facilities, drinking water and hygiene, and other ecosystem goods and services of mangrove ecosystem. Being a stakeholder group, they were involved in the participatory monitoring exercise at the time of the monitoring campaign and were interviewed for assessing impacts of the project on the group. Based on the discussions at the time of interviews, the DBC-1 Project has improved their lot in many ways, including livelihood improvements in economic, food, social, personal, and environmental security and well-being, including increased and

	diversified income and employment sources; better access to health, drinking water and hygiene facilities, and civic facilities; human safety and security; work-life balance; cleaner and healthier environment; and over-all betterment in living conditions. These positive changes in well-being result from the following: • Greater availability of and access to restored mangrove forests and their different ecosystem goods and services; • Increased availability of fishes and other natural resources; • Improved and expanded access to various human well-being improving facilities such as drinking water, hygiene, health, education, energy, civic, recreational, cultural and religious facilities; • Increased capacities (knowledge, skills and attitudes) for practising sustainable fishing, natural resources, agriculture and livestock and other livelihoods pursuits related activities; • Increase in and diversification of income and livelihood sources through jobs/employment and business opportunities creation and reduced dependence on natural resources as a source of livelihood; • Increased and easier access to low cost and institutional credit and financial resources with little or lower economically debilitating obligations and terms and conditions due to linkages development; • Improved access to varied markets; • Social and economic empowerment, especially of the marginal and vulnerable groups; • Expanded and easy access to various public and private sector services providers; • Increased human capacities and well-being due to enhancements in knowledge, skills and positive attitudinal changes and perspectives on life brought about as a result of awareness-raising, training and capacity building activities; • Social skills and social capital development resulting in improved collective action, negotiation and conflict resolution skills; • Reduced vulnerabilities to climate change and climate change-induced natural disasters such as floods, waves action, coastal erosion, sea-level rise, saltwater intrusion into cropland and settlements, droughts, cyclones and various other extreme weather events; • Reduced air, water and soil pollution and exposure to toxic materials; and • Increased coping capacities to deal with economic, social and environmental shocks and trends.

Community Group	Traders and middlemen (including employers and lenders) Their number is around 100 people.
Impact (s)	Predicted impact was indirect costs due to reduced profits on account of shrinking customer base and increase in costs of goods or services. However, the above predicted negative impact has not happened due to project activities that resulted in jobs, employment and business opportunities development; economic and social opportunities expansion; markets development and spin-offs creation; knowledge and skills

	improvements and positive attitudes development; networking and linkages development; etc. Links to/synergies with SDGs achievement: SDG-13: Climate Action SDG-16: Peace, Justice and Strong Institutions SDG-17: Partnerships for SDGs
Type of Benefit/Cost/Risk	Predicted short term direct cost and reduction in income did not happen. Contrary to any negative impacts the group has experienced increased benefits. Hence, the net impact on the group is net positive well-being.
Change in Well-being	This is a relatively small group of community members, not more than 100. There have been significant improvements in their economic, livelihoods, food, social, personal, and environmental security and well-being including increased and diversified income and food sources; better education, health, drinking water and hygiene facilities, and civic facilities; human and assets/property security; cleaner and healthier environment; and over-all betterment in living conditions. Discussions were held with the group members at the time of monitoring surveys. Based on the discussions, it transpired that the group did experience predicted negative impacts which were anticipated due to increase in costs and reduction in income. Instead, the group has positively benefitted from project activities during this first monitoring period. These positive changes in well-being have resulted from the following: ▪ Greater availability of and access to restored mangrove forests and their different ecosystem goods and services; ▪ Increased availability of fishes and other natural resources; ▪ Improved and expanded access to various human well-being improving facilities such as drinking water, hygiene, health, education, civic, recreational, cultural and religious facilities; ▪ Increased capacities (knowledge, skills and attitudes) for practising sustainable fishing; ▪ Increase in and diversification of income and livelihood sources through jobs/employment and business opportunities creation and reduced dependence on natural resources as a source of livelihood; ▪ Social and economic empowerment, especially of the marginal and vulnerable groups; ▪ Expanded and easy access to various public and private sector services providers; ▪ Increased human capacities and well-being due to enhancements in knowledge, skills and positive attitudinal changes and perspectives on life brought about as a result of awareness-raising, training and capacity building activities; ▪ Social skills and social capital development resulting in improved collective action, negotiation and conflict resolution skills; ▪ Reduced vulnerabilities to climate change and climate change-induced natural disasters such as floods, waves action, coastal erosion, sea-level rise, saltwater intrusion into cropland and settlements, droughts, cyclones and various other extreme weather events; ▪ Reduced air, water and soil pollution and exposure to toxic materials; and

	▪ Increased coping capacities to deal with economic, social and environmental shocks and trends.

Community Group	Poachers, fuelwood collectors, fodder collectors This group has representatives from various socio-economic groups mentioned above (agriculturists, livestock owners, youth, etc.). They are estimated to be around 8 % of the total population, or 3,400 people in total.
Impact (s)	The predicted impact was direct costs and reduced income. While it was predicted that there will be potential loss of income in the short-term resulting from discontinuation of these illegal and unsustainable practices and increase in costs of continuing these activities. However, they have benefitted immediately as they have stopped using these illegal practices and instead opted for getting engaged in various ARR, socio-economic and biodiversity conservation-related activities that the project is implementing throughout the delta area. In addition to these direct employment benefits, they have also benefited from the ecosystem goods and services that have resulted from large-scale ARR implementation and various socio-economic and biodiversity conservation-related activities. Hence, they are reaping these project benefits and are actively participating in legal activities and thereby benefiting from the economic, social and environmental benefits of the DBC-1 project. Moreover, they are now not violating various natural resources-related laws and hence are not being subject to monetary fines, legal costs and prison imprisonment, which are very likely if they had continued these illegal activities. Links to/synergies with SDGs achievement: SDG-1: No Poverty SDG-2: Zero Hunger SDG-3: Good Health and Well-being SDG-4: Quality Education SDG-5: Gender Equality SDG-6: Clean Water and Sanitation SDG-8: Decent Work and Economic Development SDG-10: Reduced Inequalities SDG-11: Sustainable Communities SDG-13: Climate Action SDG-15: Life on Land SDG-16: Peace, Justice and Strong Institutions SDG-17: Partnerships for SDGs
Type of Benefit/Cost/Risk	Predicted direct cost and reduction in income did not happen. Predicted benefits for the group have been observed and reported by the group. Therefore, the over-all impact for the group is a net positive benefit for the group.
Change in Well-being	Discussions were held with the group members and were interviewed at the time of SBIA workshops and household and village level surveys. The group

	has reported positive change in well-being after stopping their illegal activities and getting engaged in legal activities being implemented under the auspices of DBC-1 Project. Around 3,400 people are in this group, including members from different socio-economic groups. These people are now availing the employment opportunities that the DBC-1 Project has created through up-scaled ARR work. Hence, they have been given jobs and alternative income sources through engaging them either as mangrove forest custodians within the framework of Mangrove Stewardship Agreements or employing them in mangroves propagules collection, their transportation and storage, nurseries raising and planting activities as well as in other project activities and the ecosystem goods and services that have started accruing to them from the large-scale restoration of degraded mangrove lands. As a result, there have been major improvements in their living conditions, livelihoods, and social status resulting from increased and diversified income and food sources; better education, health, drinking water and hygiene facilities, and civic facilities; human and assets/property security; cleaner and healthier environment; and over-all betterment in living conditions.

Community Group	Upstream dwellers. The number is unspecified as they live outside the Project Zone.
Impact (s)	Predicted impact was direct costs and reduced income. This negative impact, however, has not happened as there is no reduction in irrigation water availability which can be attributed to project activities during this monitoring period. Therefore, there has been no reduction in their livelihood sources. Their relations with coastal communities and other stakeholders have also not been affected and as a result there are no costs for them. Moreover, the possibility of reduced income in the short term that was predicted did not happen either in this monitoring period. There are plans by the Government of Sindh that part of the carbon revenue which is expected shortly from the sale of carbon credits will be spent on improving and upgrading irrigation infrastructure in these areas. This will result in increased incomes for them due to higher agricultural yields. Links to/synergies with SDGs achievement: SDG-13: Climate Action SDG-16: Peace, Justice and Strong Institutions SDG-17: Partnerships for SDGs
Type of Benefit/Cost/Risk	There was predicted possibility of reduced income and direct cost in the short-term. This did not happen as there has been no reduction in irrigation water supplies for them due to project activities during the monitoring period. Also, there have been no costs for them due to deteriorated working relations with project zone communities and other stakeholders. In addition, predicted direct benefits could start accruing to this group in the short, medium, as well as long-term. The benefits are greater than the predicted costs and reduction in income. The anticipated negative impact did not happen. Therefore, there is a net positive well-being impact for the group.

Change in Well-being	Negative impacts predicted on account of reduced income and increase in cost have not happened as there has been no reduction in irrigation water availability to the group which has happened on account of implementation of project activities. Instead, they will benefit as the project activities will lead to the generation of carbon credits. Some of the carbon revenue will be invested by the Government of Sindh in irrigation infrastructure projects. An increase in agricultural yields will happen due to implementing irrigation efficiency increasing projects in the upstream areas. This will result in major improvements in food security, economic well-being, livelihoods, and environmental improvements due to controlling waterlogging and salinity in agricultural lands. Due to greater irrigation efficiency, these upstream dwellers will also have improved coping capacities to deal with economic, social and environmental shocks and trends expected from climate change. The net positive impact is implied on account of the fact that there has been no negative impact on their means of livelihood or ways of life that could reduce their incomes or increase their costs. In the near future, they will be experiencing increase in income due to increase in their crop yields due to greater irrigation water availability for their crops.

4.1.2 Negative Community Impact Mitigation (CM2.2)

All activities implemented by the project have improved the livelihoods and wellbeing of different community groups as well as protected, conserved and enhanced the HCVs identified in the PD document. For the monitoring period, no negative impact on the communities was identified and therefore no measures or activities need to be implemented in this regard. Further, although mentioned in the PD, the identified potential negative impacts on three groups of people who were identified to get potentially negatively affected in the short-term were not in fact negatively impacted on account of the mitigation strategies pursued and implemented by the project during this monitoring period. As a result, the activities and/or processes implemented by the Project do not have any short-term or long-term net negative well-being impacts on the different community groups and for maintenance or enhancement of high conservation value (HCV) attributes in the project description.

The project activities were implemented in way that these are “doing no harm” to the community groups or other stakeholders and comply with the precautionary principle in their implementation approach. The possibilities of any potential negative impacts and related issues were widely discussed and deliberated on with the communities and other stakeholder groups at the time of SBIA workshops held during project design and formulation and the preparation of this monitoring report. It was concluded that the project had no negative impacts during this monitoring period.

The following mitigation strategies put in place by the project proponents have avoided any potential negative impacts either on communities or HCVs areas.

Potential Negative Impact	Mitigation Strategy
Institutional problems and conflicts between different groups of communities, including those between camel and other livestock herders and local communities	Participatory design, planning, implementation and monitoring of different project interventions related to mangroves restoration and sustainable management, community development and biodiversity conservation activities. Examples include entering into Mangrove Stewardship Agreements with local people and setting aside areas for practicing rotational grazing of livestock

	so that damages to newly planted and restored areas are avoided.
Issues arising from over exploitation of forests, fisheries and other natural resources including poachers, livestock grazers and fuelwood collectors.	Provision of alternative sources of income and livelihood for these groups of people so as to reduce their dependence on forests, fisheries and other natural resources.
Exploitative practices of middlemen and traders	Information sharing and access to information through awareness raising and capacity building activities of the groups who were the victims of exploitative practice.
Poor or biased linkages of community sectors	Strategies and actions for effective community participation, ongoing consultation and adaptive management, and worker training programs.
Ineffective socialization processes and communication channels	Socialization meetings and workshops to ensure participation of all groups including marginal groups to ensure access to information for all community groups and giving a say to the marginalized groups in decision making.
Inadequate distribution of project benefits	Design, development and implementation of Benefit sharing System in a way that causes no harm to any group and the precautionary principle is upheld.
Upstream dwellers who could potentially be negatively affected due to the release of environmental water flows.	There has been no reduction in waters supplies to upstream and riparian dwellers due to different project interventions. Hence, no negative effects on upstream dwellers.
Maintenance or enhancement of High Conservation Values (HCVs) attributes	Project activities have positively contributed to the maintenance and enhancement of HCVs attributes and areas by reducing threats to these attributes and areas; restoration of habitats, species and ecosystems; greater awareness creation about the values of biodiversity and HCVs; reduction in human and wildlife conflict; and increase in capacities of stakeholders to protect, conserve and sustainably manage biodiversity and HCVs attributes and areas.

4.1.3 Net Positive Community Well-Being (CM2.3, GL1.4)

Quantitative details of all these implemented activities and the resulting benefits for the communities are given in the CCB Community Monitoring Plan in Appendix 3.1. These project activities have led to positive community impacts on the project zone communities and their various socio-economic groups. Impacts of the project interventions have been assessed following a structured process for impact assessment which comprised of the following major steps and their sub-steps as narrated and explained below:

- Step 1: Impact Assessment Planning and Preparation

- Step 2: Information Gathering: Secondary data analysis and primary data collection
- Step 3: Data Analysis and Estimation of Thresholds and Impacts
- Step 4: Monitoring Report Preparation and Dissemination of Findings

Step-1: Impact Assessment Planning and Preparation

This step comprised of the following sub-steps:

Sub-step 1.1: Definition of the Scope and Objectives of the Impact Assessment

The scope and objectives of the impact assessment were determined keeping in view the approved CCB Community Monitoring Plan of the Project. See Appendix 3.1 for details.

Sub-step 1.2: Design of the Assessment Plan

An impact assessment plan was developed in light of the set scope and objectives of the assessment. This plan included identification of sources from which information and data needed to be and could be collected, development of the questionnaire for primary data collection, the constitution of assessment teams, their training, arrangement of logistics, and establishing contacts with the community groups, key informants, and households, timing for field visits and conduct of SBIA workshops for focus group discussions, household surveys, and key informants' interviews, etc.

Sub-step 1.3: Organisation and Training of the Assessment Team

Since this sub-step is key to ensuring the data and information are collected efficiently and effectively, assessment teams of professional staff (both male and female) were constituted, trained and facilitated to collect both secondary and primary data using participatory impact assessment methods and tools. While forming the teams, care was taken to include the needed range of skills and diversity in gender, language and experience. Proper roles and responsibilities were assigned to different team members.

Also, field and data collection work were designed and organized with the teams for both secondary data gathering and primary data collection and analysis. The data collection tools were thoroughly analysed, translated in Urdu and Sindhi languages and tested by the team members to make sure that the information requested was clear to all team members and interviewees and community members groups.

Database formats were developed to enter data collected in the field into electronic form for analysis and archiving purposes. Decisions were taken on the units of measures to be used and how to later transform these into standard metric formats needed to prepare the monitoring report. Male and female community members were asked different questions in a culturally sensitive setting and manner.

Step-2: Information Gathering Methodologies: secondary and primary data collection

Both rapid and in-depth assessments have been done. Rapid assessments were primarily based on secondary data, while primary information was collected for in-depth analysis. Existing secondary information from different sources was reviewed alongside primary data and information from community groups, households, key informants, and key stakeholders. Reviewing secondary information included accessing relevant government documents and reports, research and survey reports by other organizations, and background documents like the Population and Household Survey Reports of the Government of Pakistan.

Different team members gathered and analysed the qualitative and quantitative secondary data. Participatory processes were used for data collection in the field. The main information collection tools were semi-structured interviews with key informants, focus group discussions in an SBIA workshop, and household surveys.

Focus group discussions were set up with representatives of each socio-economic group. It was explained to them that we are not interested in individuals' information, but what is representative of the group they represent. In order to objectively source this data, questions were asked in a de-personalized manner. Various sources, tools and techniques helped in the triangulation of the collected information.

The primary data was collected through a series of household and village surveys and interviews conducted with key informants from September 2022 to February 2023. Details of these surveys, interviews and workshops conducted are given in Appendix 6. These have been appropriately documented and uploaded to the project website's database and are also available in hard format in the project office.

Step-3: Data Analysis and Estimation of Thresholds and Impacts

In Step-3, the information gathered through Steps 1 and 2 was analysed to develop context-specific thresholds and impacts on a different dimension of well-being, including overall positive effects on community well-being, identification of any negative impacts, estimation of net positive impacts, impacts on conservation/maintenance and enhancement of High Conservation Values Areas, and specific impacts on marginal and vulnerable groups.

This step is the critical component of the project's impact analysis process and involves identifying and quantifying the impacts and the impact pathways. In measuring and monitoring the effects of the DBC-1 Project on local communities and other stakeholders, the project applied the cause-and-effect logic and associated theories of change as given in the project PD. This causal model and theory of change were developed and substantiated with local communities and other stakeholders in stakeholders' engagement meetings and interactions conducted as part of the SBIA workshops held at the time of PD development. In these meetings and prior engagement and interactions, three focal areas have been identified that needed to be addressed to achieve the project's climate change, community development, and biodiversity conservation objectives.

Using the causal chain flow diagrams for these focal areas (PD Section 4.4.1), it was possible to engage the local communities and other stakeholders, think about and work out how things would have been in the without project scenario, as well as envisage and anticipate how they are with the project, besides identifying any potential risks and negative impacts.

Step-4: Report Preparation and Dissemination of Findings

In Step-4, a Community Monitoring Report has been prepared following the report preparation template of VERRA besides disseminating the findings of the monitoring exercise to communities, their groups and other stakeholders. This monitoring report is a product that can and will be used for many purposes, including internal and external meetings and will serve as a useful reference document in the future.

The majority of local communities in the Project Zone live in climate-related hazard prone areas. These coastal areas face the challenge of getting affected by various climate related phenomena such as storm surges, flooding, sea water intrusion into inland areas and droughts. As a result, they could potentially suffer economic and well-being losses, if proper adaptation measures are not undertaken. These for example include losses of their physical, natural and economic assets and livelihood means. Consequently, their resilience and adaptive capacities to deal with negative impacts of climate change is reduced without appropriate adaptation measures. Moreover, with increasing population and increase in environmental stressors, their exposure would increase as increase in population and environmental stresses would put more people and their assets in harm's way.

Mangrove restoration and other project activities implemented by the project during this monitoring period have helped the local communities adapt to climate change in three major ways. They have led to reduction in the number of hazard-causing events, have increased the resilience and adaptive capacities of communities, and have reduced their exposure to such events.

Planting of more areas with mangroves and improved protection of existing mangrove vegetation have reduced the intensity and frequency of climate caused events like storms surges and flooding by attenuating wave energy. These have also stopped or reduced the landward progression of salt water intrusion thereby protecting settlements, agricultural lands and ground water resources from saline water contamination. By acting as fish spawning and feeding sites, mangroves have led to increased production of fishes, shrimps and crabs. This has led to increase in the incomes of local communities the majority of whom are fishermen, women and youth. Besides increasing income sources, project activities

have also diversified income earning opportunities for local communities by providing them with alternative sources of livelihood earning.

In addition to the reduction in hazardous events, decrease in vulnerability and increase in climate change resilience of communities, project activities have also reduced the exposure of local communities thereby contributing to disaster risk reduction for communities. Due to project activities the public safety and well-being of communities has increased and they are no more jeopardized by the disruption of crucial lifelines, such as communication lines, drinking water facilities, health facilities, shelter facilities, etc.

Thus, project mangrove restoration and other community development and biodiversity conservation related activities implemented during this monitoring period have increased the adaptive capacity of communities to climate change by reducing the number and intensity of hazard causing events, reduced their vulnerability as well as exposure to such events, thereby increasing their resilience to climate change negative impacts.

An analysis was undertaken within the community, focusing on the various project activities' positive and negative impacts on the identified groups. This was conducted in the SBIA workshops discussions, households' surveys, and key informant interviews. Based on analysis of responses from these group discussions, household surveys and key informant interviews, net positive impacts have been found, greater adaptation to climate change impacts has been observed and no negative impacts have been reported by any community group in the different surveys carried out by the project at the time of preparation of this monitoring report.

Different project activities (including mangroves protection, rehabilitation, restoration and sustainable management as well as other community development and biodiversity conservation measures) have also assisted communities (based on discussions with them in the SBIA workshops, Focus Group Discussions, household surveys and in other meetings and discussions) to greater adaptation to the existing and future probable impact of climate change in several ways as explained above and in section 4.4 (Optional Criterion: Exceptional Community Benefits).

4.1.4 Protection of High Conservation Values (CM2.4)

The following three High Conservation Values (HCVs) related to community well-being have been identified in the project description document.

Table 20. Community-related HCVs

HCV	Qualifying Attribute	Focal Area
HCV-4: Environmental Services	The Project Zone is part of a landscape that is important for the provision of water and prevention of floods	Communities living inside the creeks or those very close to mangrove areas depend on these environmental services of mangrove forests
	The Project Zone holds areas important for the prevention of erosion and sedimentation	This ecosystem service is especially important for land owning communities and communities living on the fringes of creeks
	The Project Area is part of a landscape that functions as a natural break to saltwater intrusion	All mangroves in the Project Zone cater to and provide regulating and supporting ecosystem services

HCV-5: Natural Areas critical for meeting the basic needs of local people	The Project Zone is important for providing different mangrove ecosystem goods and services (provisioning services) such as serving as spawning sites for fish and shrimps and providing detritus to crabs.	The whole of the Project Zone caters to the provisioning ecosystem services of coastal wetlands and mangrove forests
HCV-6: Areas critical for maintaining the cultural identity of local communities	The Project Zone contains areas critical for maintaining the cultural identity of local communities	The whole of the Project Zone supports the provision of cultural ecosystem services of coastal wetlands and mangrove forests

All the HCVs as mentioned above have been positively affected by the different project interventions, particularly the restoration of degraded mangrove lands, execution of MSAs, implementation of various income-generating activities due to the nurseries raising and planting related works and other project interventions, participatory planning and awareness-raising, and training and capacity building.

4.2 Other Stakeholder Impacts

4.2.1 Mitigation of Negative Impacts on Other Stakeholders (CM3.2)

Based on participatory assessment done through the Focused Group Discussions in SBIA workshops, household surveys and key informant interviews as described above, there are no negative impacts on other stakeholder groups. Therefore, no mitigation strategies are required, and this section is not applicable.

4.2.2 Net Impacts on Other Stakeholders (CM3.3)

As there are no negative impacts on other stakeholders, the positive impacts described in sections 4.1.1, 4.1.3and 4.1.4are the net impacts on other stakeholders.

4.3 Community Impact Monitoring

4.3.1 Community Monitoring Plan (CM4.1, CM4.2, GL1.4, GL2.2, GL2.3, GL2.5)

Monitoring of different activities implemented by the project was undertaken collaboratively with the local communities as indicated in CCB Community Monitoring Plan given as Appendix 3.1 to assess their following impacts:

Impacts on all communities and community groups (section 4.1.1)

Impacts on other stakeholders (section 4.1.3)

Impacts on community-related HCVs. (section 4.1.4)

All these impacts were positive, and there were no negative impacts. Hence, the net impact of the project on all the above has been assessed to be positive.

The monitoring work was done from 01 September 2022 to 28 February 2023. The approach used for monitoring has been explained in section 4.1.1. Monitoring was undertaken by professionally trained teams who have experience implementing SBIA workshops, Focus Group Discussions, household surveys, and conducting key informant interviews. The whole monitoring process is fully documented in reports, photographic and videographic form.

Since the project is validated to the Gold Level for exceptional community benefits, additional monitoring data has been collected, analysed and reported to demonstrate that the project meets all required criteria. This was done by assessing the increase in adaptation benefits for communities for which

monitoring indicators SIA074 through SIA078 are specifically meant, and data on these indicators were collected, analysed, and reported.

4.3.2 Monitoring Plan Dissemination (CM4.3)

Monitoring of community impacts, stakeholder impacts, and impacts on HCVs has been undertaken according to the CCB community monitoring plan given in the validated project description document. The resultant monitoring report has been disseminated and made publicly available on the internet (VERRA website) and in the Project's head office and field offices.

Summaries of the monitoring report findings have been prepared and translated into Urdu and Sindhi languages. Copies of these summary documents have been communicated to the communities, and other stakeholders have been kept in and are available in the two regional project offices (Keti Bandar and Shah Bandar) and the project head office in Karachi. These documents have also been shared, discussed and fully explained to communities in various meetings and workshops. Further, these are also uploaded to the project website.

The project has a community message board at each of the two regional offices to reach out to community members and share important project information with them. A poster/notice in Urdu and Sindhi languages advertising the public comment for the monitoring report has been posted in communities throughout the Project Zone. It included details on how a comment can be made to the CCB. The project's community outreach workers also contacted community members through their local networks in the Project Zone and informed them of the notice period for comments.

4.4 Optional Criterion: Exceptional Community Benefits

Pakistan is a medium human development country, but more than 70% of Project Zone households live below the national poverty line. Thus, the Project Zone qualifies as a rural area with a large proportion of the population living under the national poverty line.

4.4.1 Short-term and Long-term Community Benefits (GL2.2)

All community members in the Project Zone are dependent on mangrove resources and are thus benefiting from their conservation, restoration and sustainable management. Where these management practices prevent or curtail previous livelihood activities of dependent communities, the project has put in place actions to mitigate any negative consequences for those community groups. The management system of the project is providing exceptional community benefits to the entire Project Zone population of 43,000 people. These outstanding community benefits have been assessed in a participatory manner with the dependent communities and have been found to be positive as per details given in the CCB Monitoring Plan given in Appendix 3.1. The exceptional community benefits among others include the following:

Livelihood and income-earning benefits: Mangroves provide spawning sites and nursery habitats for fishes and shrimps on which the entire fishing community in the Project Zone is 84% of the total population. As a result of project interventions, 12,529 people in 49 villages which are 35% of the fishing community population are having improved livelihood and income-earning from mangrove restoration and conservation works on account of increase in fish spawning sites.

Coastal protection benefits: 2,755 people in 16 villages are getting increased protection from tsunamis and flood damages

Climate change adaptation benefits: The entire coastal community (43,000 people) is benefiting from climate change adaptation benefits of mangroves

Pollution prevention and control benefits: Mangroves act as filters against seawater pollution from which the whole coastal community in the Project Zone benefits

Erosion control and shoreline stabilization: Due to their attenuation of tidal waves and wind energy, mangroves prevent and control coastal land erosion and thus help ensure shoreline stabilization. All the coastal communities (43,000 people), particularly those in HCV-4 areas (2,755 in 16 villages or so far 24,099 people in 51 villages during project lifetime), are beneficiary of this ecosystem function of mangroves

Control of saltwater intrusion into adjoining lands: Saltwater intrusion has become a big issue in coastal areas because of sea-level rise due to global warming and climate change. Mangroves help prevent and reduce saltwater intrusion into adjoining agricultural lands. This is particularly beneficial to the farming community in the Project Zone (1800 people).

Increase of agricultural and livestock productivity: The increased income accruing due to enhanced and diversified income-earning opportunities from up-scaled ARR interventions and other project activities has enabled people to invest in improved agricultural and livestock inputs for increased agricultural and livestock productivity. It has helped in increasing agricultural and livestock productivity. This benefits the people associated with these professions. Additionally, insects living in mangrove forests assist the pollination of agricultural and horticultural crops, thereby increasing the production of these crops and consequently the productivity of croplands in the area.

The project is also generating other short-term and long-term community benefits on account of it providing income-earning opportunities through businesses promotion; increasing social and human capacities; improving access to education, health, safe drinking water and hygiene, civic facilities, cultural and leisure activities; linkages development; reducing exposure and vulnerabilities various other types of shocks and trends (economic, environmental, and social); greater empowerment and social inclusion on account of awareness-raising and capacity building; etc.

Conservation, restoration and sustainable management of mangroves in the Project Zone yield a suite of provisioning, regulating, supporting and cultural services which provide both short-term and long-term benefits for the Project Zone communities and other stakeholders, including marginalized and/or vulnerable groups, smallholders, women, youth and various categories of poor and destitute people.

4.4.2 Marginalized and/or Vulnerable Community Groups (GL2.4)

The project is engaging with the following community groups and they have or are on track to gain net positive benefits as a result of the project interventions as explained in the following tables. The following barriers or risks that might prevent benefits going to marginalized and/or vulnerable smallholder/ community members have also been addressed by taking the following measures:

Problem of elite capture of benefits: The whole communities are being informed of the various project benefits and information related to the various project benefits is shared through different meetings that are held in open session forum manner.

Problem of exclusion: The representation of smallholder/community groups and different marginal/vulnerable groups in various village level bodies/organizations such as village development committees, women organizations, etc. is ensured.

Implementation of dedicated project interventions for smallholders and marginal groups: A number of project interventions specifically aim at improving the well-being of smallholder and marginal groups. These among others their involvement in all mangrove conservation, restoration and sustainable management related activities; the implementation of various infrastructure development activities such as the construction of civic centre and the repairs and reconstruction work done in various health facilities; provision of networking opportunities; and linking them to the credit and microfinance institutions once these take root and start their operations in the Project Zone.

Access to information, knowledge enhancement and skills building: Special attention is paid to increase their access to information, enhance their knowledge and build their skills when different awareness raising and capacity building interventions are implemented under the project.

Curbing exploitative practices: The problem of exploitation by lenders, purchasers, middlemen, local employers and exploitative agents is being tackled through the following measures:

- Linking to institutional credit providers such as Akhuwat
- Providing for a dedicated credit opportunities program once carbon revenues become available
- Facilitation in getting access to cold storage facilities for small scale fishermen
- Facilitation in market access
- Creation of job opportunities at their door steps through implementation of various project interventions
- Implementation of skills and capacity building programs to negotiate with middlemen and employers for fair return and wage rates

Community Group 1	Coastal fishing communities
Net positive impacts	84 % of the Project Zone communities are associated with fishing activities. Numbering 35,797 people (17,122 males and 18,675 females), 12,529 or 35 % of the fishing community members have reported improved well-being due to project interventions during this monitoring period. Increase in fish, shrimps and crabs catch; the availability of alternative sources of livelihoods; increased access to different ecosystem goods and services of mangrove forests; reduced debt burden and increased protection from negative impacts of climate change have contributed to improving their well-being. The project activities have or are on track to generate net positive impacts on the well-being of this group of marginalized and/or vulnerable community groups as described below. ▪ Increased fisheries resources in the presently as well as in the long-run due to the protection and conservation of existing mangrove forests, restoration of degraded and de-vegetated mangrove lands, and sustainable management of both existing and planted mangrove forests ▪ Better protection of damages resulting from tsunamis, cyclones and floods ▪ Increased income opportunities ▪ Increased employment opportunities ▪ Better livelihoods opportunities ▪ Improved access to safe and affordable drinking water facilities ▪ Better and expanded access to sanitation and hygiene facilities ▪ Improved access to educational facilities ▪ Better medical care and health facilities ▪ Improved and expanded access to physical capital ▪ Improved and expanded access to HCVs areas ▪ Social capital development and enhanced empowerment ▪ Improved linkages with other communities and other stakeholders and service providers ▪ Improved access to information, and enhanced knowledge and skills levels ▪ Clean ambient air ▪ Reduced exposure and vulnerabilities to various types of hazards ▪ Greater involvement and participation in community development activities
Benefit access	There is easier, expanded and more secure access to all of the above benefits. Different barriers or risks that might prevent benefits going to marginalized and/or vulnerable smallholder/community members have been addressed as

	described above. At the time of monitoring survey, the group members did not report any barriers or risks that might prevent benefits going to the group.
Negative impacts	No negative impacts have happened for this group during the monitoring period. They have reported increase in fish and shrimp catch as well as huge increase in the number of crabs in the area due to mangrove restoration work as mangroves provide spawning sites for fishes and shrimps and are a source of detritus for crabs which feed on the mangrove detritus. They also have reported alternative income and livelihood opportunities and wider access to different ecosystem goods and services that have accrued from the conservation, restoration and sustainable management of mangrove forests.

Community Group 2	Coastal communities engaged in agriculture and crop husbandry
Net positive impacts	4,830 people (including 2,706 females) in the Project Zone are involved in agriculture and horticultural crops husbandry. Their principal issues in the without project scenario were increased threats to their crop lands from potential salt water intrusion into their lands and the increased salinization of surface and underground water sources, inadequate access to alternative livelihood opportunities, drinking water and hygiene facilities, health and education facilities, civic facilities, and vulnerability to flooding and soil erosion. Project activities such as restoration of mangrove forests and implementation of various community development and biodiversity conservation activities have been helpful in addressing their problems. The project activities have or are on track to generate net positive impacts on the well-being of this group of marginalized and/or vulnerable community groups as described below. ▪ Increased agricultural products production due to productivity enhancement, soil erosion prevention; prevention, control, and reduction of saltwater intrusion into croplands; pollination of agricultural crops by insects residing in mangrove forests; etc. ▪ Better protection of damages resulting from tsunamis, cyclones and floods ▪ Increased income opportunities ▪ Increased employment opportunities ▪ Better livelihoods opportunities ▪ Improved access to safe and affordable drinking water facilities ▪ Better and expanded access to sanitation and hygiene facilities ▪ Improved access to educational facilities ▪ Better medical care and health facilities ▪ Improved and expanded access to physical capital ▪ Improved and expanded access to HCVs areas ▪ Social capital development and enhanced empowerment ▪ Improved linkages with other communities and other stakeholders and service providers ▪ Improved access to information, and enhanced knowledge and skills levels ▪ Clean ambient air ▪ Reduced exposure and vulnerabilities to various types of hazards ▪ Greater involvement and participation in community development activities

Benefit access	During stakeholder surveys at the time of monitoring, the group members said that there are no barriers or risks that have or would prevent project benefits going to the group. They have easier, expanded and more secure access to all of the above project benefits.
Negative impacts	In their responses at the time of monitoring survey conducted in the 52 Project Zone villages and 233 villages lying within 20-kilometer radius of the Project Zone and where people have dependence on project interventions, the group members have not experienced any negative impacts nor anticipate any negative impacts from project interventions.

Community Group 3	Coastal communities engaged in livestock raising
Net positive impacts	About 5,913 people (including 2,807 females) in the Project Zone are involved in livestock and animal husbandry. Under the baseline and without project scenario, this group of community members, like other groups, suffered from inadequate access to alternative livelihoods opportunities, drinking water and hygiene facilities, health and education facilities, civic facilities, vulnerabilities to flooding, saltwater intrusion into their settlements and fodder lands, and decrease in animal productivity due to climate change issues and decreased availability of animal feed. During the monitoring campaign the group members have been involved in a participatory manner and interviewed too. Twenty percent of this socio-economic group has benefited from implementing different project activities, including restoring degraded and de-vegetated mangrove lands. The project addressed various issues that could potentially would have negatively impacted them. These for example include making arrangements for rotational grazing and providing them with alternative sources of livelihoods and increased access to other ecosystem goods and services from different project interventions. This has thus resulted in the overall improvement of their living conditions. The project activities have or are on track to generate net positive impacts on the well-being of this group of marginalized and/or vulnerable community groups as described below. ▪ Increased access to improved livestock husbandry and management practices ▪ Better protection of damages resulting from tsunamis, cyclones and floods ▪ Increased income opportunities ▪ Increased employment opportunities ▪ Better livelihoods opportunities ▪ Improved access to safe and affordable drinking water facilities ▪ Better and expanded access to sanitation and hygiene facilities ▪ Improved access to educational facilities ▪ Better medical care and health facilities ▪ Improved and expanded access to physical capital ▪ Improved and expanded access to HCVs areas ▪ Social capital development and enhanced empowerment ▪ Improved linkages with other communities and other stakeholders and service providers

	▪ Improved access to information, and enhanced knowledge and skills levels ▪ Clean ambient air ▪ Reduced exposure and vulnerabilities to various types of hazards ▪ Greater involvement and participation in community development activities
Benefit access	The group has not experienced any barriers or risks that has prevented them from availing project benefits during this monitoring period.
Negative impacts	Rotational grazing system has been devised for the group under which they graze their livestock in identified areas so as to not cause damage in the newly planted areas. With avoidance of negative impacts and increased access to alternative sources of livelihoods and other positive results from project interventions, the well-being of the group has improved. No negative impacts have happened for the group during this monitoring period. During discussions with the group members at the time of monitoring activity in the Project Zone villages (52 number) and 233 villages lying within 20-kilometer radius of the Project Zone, the group members reported that they have access to alternate grazing area under the rotational grazing system. In addition, due to planting of mangrove plants, they now have increased availability of mangrove propagules for use as livestock fodder. Moreover, they now have access to alternative income and livelihood earning opportunities on account of implementation of various project activities and the different ecosystem goods and services that will accrue from the conservation, restoration and sustainable management of mangrove forests.

Community Group 4	Coastal communities engaged in daily wage labour
Net positive impacts	Both male and female members of the daily wage paid labour (3,628) have benefited from project activities. During monitoring survey 65% of the group members have reported a net positive impact on them from different project interventions-upscaled ARR, health interventions, drinking water and hygiene interventions and different ecosystem goods and services from restored mangrove lands. They now have access to more jobs, employment and business opportunities and hence greater income; and improved access to various critical services such as health, water, hygiene and civic facilities and therefore reduced cost of living. The project activities have or are on track to generate net positive impacts on the well-being of this group of marginalized and/or vulnerable community groups as described below. ▪ Increased income earning opportunities from work in coastal tourism activities that are emerging as a result of mangrove restoration and landscape aesthetics enhancement ▪ Better protection of damages resulting from tsunamis, cyclones and floods ▪ Increased income earning opportunities from various project interventions ▪ Increased employment opportunities ▪ Better livelihoods opportunities ▪ Improved access to safe and affordable drinking water facilities ▪ Better and expanded access to sanitation and hygiene facilities ▪ Improved access to educational facilities ▪ Better medical care and health facilities

	▪ Improved and expanded access to physical capital ▪ Improved and expanded access to HCVs areas ▪ Social capital development and enhanced empowerment ▪ Improved linkages with other communities and other stakeholders and service providers ▪ Improved access to information, and enhanced knowledge and skills levels ▪ Clean ambient air ▪ Reduced exposure and vulnerabilities to various types of hazards ▪ Greater involvement and participation in community development activities
Benefit access	As reported by them during the surveys, there are no barriers or risks that have or might prevent them from accessing the project benefits. All of them reported easier, expanded and more secure access to all of the above benefits. With access to all of the above project benefits, the different barriers or risks that might prevent benefits going to marginalized and/or vulnerable smallholder/community members already stand addressed.
Negative impacts	There has been no negative impact on the group livelihood, income sources and socio-economic well-being at the time of present monitoring conducted in the 52 Project Zone villages and 233 villages lying within 20-kilometer radius of the Project Zone. Neither are they anticipating any future negative impacts as indicated by them during the survey meetings. Therefore, no negative impacts are not anticipated for this group.

Community Group 5	Women
Net positive impacts	Women and youth group have been actively involved in project planning, implementation and monitoring activities. They have been positively impacted by the project due to the availability of greater jobs, employment and business opportunities which has not only increased but also diversified their sources of income earning. They now have greater access to different ecosystem goods and services and enhanced access to services facilities (health, water and hygiene, education, recreation and socialization). As a result, they feel socio-economically empowered now. This has improved their over-all well-being including economic, psychological and social well-being. The project activities have or are on track to generate net positive impacts on the well-being of this group of marginalized and/or vulnerable community groups as described below. ▪ Increased income earning and leisure opportunities for both women and youth created as a result of implementation of various project activities ▪ Better protection of damages resulting from tsunamis, cyclones and floods ▪ Increased income opportunities from business spin-offs that happen due to mangroves restoration and project implementation ▪ Increased employment opportunities ▪ Better livelihoods opportunities ▪ Improved access to safe and affordable drinking water facilities ▪ Better and expanded access to sanitation and hygiene facilities ▪ Improved access to educational facilities ▪ Better medical care and health facilities ▪ Improved and expanded access to physical capital

	▪ Improved and expanded access to HCVs areas ▪ Social capital development and enhanced empowerment ▪ Improved linkages with other communities and other stakeholders and service providers ▪ Improved access to information, and enhanced knowledge and skills levels ▪ Clean ambient air ▪ Reduced exposure and vulnerabilities to various types of hazards ▪ Greater involvement and participation in community development activities
Benefit access	Steps taken by the project as explained in section 4.4. 3 (Net Impacts on Women) have made sure that there are no barriers or risks to the group accessing the benefits that are accruing from the project. Due to these specific project interventions, they now have easier, expanded and more secure access to all of the above benefits. This is because the different barriers or risks that might prevent benefits going to marginalized and/or vulnerable smallholder/community members have been addressed as described in section 4.4.3 below.
Negative impacts	It is a win-win situation for the group. There have been no negative impacts during this monitoring period nor are they anticipating any negative impacts in future as reported by the group members during the interviews conducted for the preparation of this monitoring report in the 52 Project Zone villages and 233 villages lying within 20-kilometer radius of the Project Zone.

Community Group 6	Landless poor and other marginal groups
Net positive impacts	Both male and female members of the group have benefitted from project activities in positive ways. Their incomes have increased on account of creation of more jobs and employment opportunities. Moreover, their cost of living has been reduced due to improved and expanded access to different services and service facilities which are important for them. These in particular include health facilities and increased protection from the negative impacts of climate change. The project activities have or are on track to generate net positive impacts on the well-being of this group of marginalized and/or vulnerable community groups as described below. ▪ Increased income earning and leisure opportunities as a result of implementation of various project activities ▪ Better protection of damages resulting from tsunamis, cyclones and floods ▪ Increased income opportunities from business spin-offs that happen due to mangroves restoration and project implementation ▪ Increased employment and business opportunities ▪ Better livelihoods opportunities ▪ Improved access to safe and affordable drinking water facilities ▪ Better and expanded access to sanitation and hygiene facilities ▪ Improved access to educational facilities ▪ Better medical care and health facilities ▪ Improved and expanded access to physical capital ▪ Improved and expanded access to HCVs areas ▪ Social capital development and enhanced empowerment

	▪ Improved linkages with other communities and other stakeholders and service providers ▪ Improved access to information, and enhanced knowledge and skills levels ▪ Clean ambient air ▪ Reduced exposure and vulnerabilities to various types of hazards ▪ Greater involvement and participation in community development activities
Benefit access	The group members who participated in the interviews at the time of preparation of the monitoring report, indicated that they have not experience any barriers or risks to them accessing the project benefits. This is because they have been actively engaged by the project proponents at different stages including planning, implementation and monitoring. Therefore, they have easier, expanded and more secure access to all of the above benefits.
Negative impacts	Negative impacts have neither happened during this monitoring period nor are they anticipating any negative impacts in future too as per survey conducted in the Project Zone villages as well as villages within 20-kilometer radius of the Project Zone. This is because the group is actively engaged in the planning, implementation and monitoring of project activities.

4.4.3 Net Impacts on Women (GL2.5)

The project has generated net positive impacts on the well-being of women. Women now participate in or influence decision making regarding mangroves (conservation, restoration and sustainable management, biodiversity conservation and community development related matters. These positive impacts and the ability to participate in and influence decision making has been made possible by the implementation of project activities which have increased their income, improved their social status and over-all well-being.

Specific project activities that have produced these impacts include the following: participatory planning and awareness raising, training and capacity building, social mobilization and social organization into women organizations, creation of jobs/employment and business/earning opportunities, access to education, access to health, access to safe drinking water and hygiene, access to civic facilities, and expanding their over-all role in decision making regarding mangroves and other coastal resources conservation, restoration and sustainable management. See sections 4.1.1, 4.1.3 and 4.1.4 for details.

Further, to ensure that the project interventions implemented and the benefits generated specifically for improving the well-being of women are actually realized by them, the following additional steps have been taken.

Addressing the problem of men capture of benefits: Exclusive and dedicated information meetings are being held with the women on a regular basis whereby they are informed of the various project benefits that are meant for them

Dealing with the problem of exclusion: To address the problem of women exclusion, 13 Women Organizations have already been established in 13 Project Zone villages and there is was continuous interaction with these 13 Women Organizations. This number will be eventually further increased so as to cover women from all the 60 Project Zone villages. Women have also been asked to give their suggestions for further increasing their role in decision making and to give them greater representation in other forums related to mangroves, biodiversity conservation and community development.

4.4.4 Benefit Sharing Mechanisms (GL2.6)

The benefit sharing mechanism described in the project description document aims at putting into place and implementing a benefit sharing and incentives allocation mechanism that gives voice to members of the different community groups through establishing and supporting broad based community bodies in the form of village development committees and women organization.

Accordingly, 10 number of village development committees and 13 number of women organizations have been established and are being supported. These bodies decide on the benefit distribution and cost sharing arrangements under the project.

The village development committees and women organizations formed under the project are socially inclusive and have representation of the marginal and vulnerable groups. Therefore, these traditionally excluded and left-out groups have been included and have been given a say in various aspects of the project including benefit and cost sharing arrangements.

Also, the benefit and cost sharing arrangement will be further expanded and institutionalized once carbon benefits start accruing.

4.4.5 Governance and Implementation Structures (GL2.8)

To ensure that the project's governance and implementation structures enable full and effective participation of smallholders/community members in project decision-making and implementation, the project has established a Community Development Unit/Community Development, Extension and Gender Development Directorate in its organizational set-up.

This unit is staffed by qualified professionals, both male and female, who specialize in community development, extension and gender development. The professionals and other staff from this unit regularly undertakes field visits and coordinate with the local communities and other stakeholders for effective implementation of different project activities and on how to increase their role in decision making.

Towards this end, the unit staff has identified key informants and focal persons from amongst the smallholder/community members to give regular feedback about their issues and how to increase their role in decision-making and matters related to implementation of different project activities. Besides, the unit has established 10 village development committees and 13 women organizations which have representation of smallholder/community members.

These smallholder/community members ensure that their village and groups interests are protected as they participate in and give suggestions when designing, planning, implementing and monitoring various project interventions.

Regular feedback is received from the key informants as well as these village organizations for which purpose meetings are held with them in culturally appropriate manner at designated places, times and with already agreed meeting agendas.

The proceedings of these meetings are properly documented and circulated. Also, decisions taken in these meetings are implemented through appropriate entities constituted for the purpose. The project has also put in place a well-organized feedback and grievance redress mechanism (FGRM) for receiving and addressing the concerns of communities and other stakeholders including smallholder/community members.

4.4.6 Smallholders/Community Members Capacity Development (GL2.9)

Village development committees, women organization and smallholders/community members are involved in the design, planning, implementation, monitoring and management of different project activities related to mangroves conservation, restoration and sustainable management; biodiversity conservation and over-all community development. For their capacity development the following specific measures have been implemented:

Sites selection for restoration work: Training and capacity building of community members in proper sites selection for undertaking mangroves restoration work based on suitability of edaphic and other factors that ensure success of the restoration work

Mangrove propagules collection, transportation and storage: Capacity building of community members in deciding on the right time for propagules collection, and their appropriate collection, transportation and storage methods

Mangrove nurseries raising: Mangrove nurseries raising is a technically demanding work. Therefore, community members including smallholders and women are trained in proper raising of mangrove species nurseries

Mangrove restoration work under ecological restoration principles: Smallholders/community members have been trained in ecological restoration principles

High conservation values (HCVs) areas and their conservation: Awareness raising and capacity building related to the identification, mapping, conservation and management of HCVs areas

Conduct of participatory planning, implementation and monitoring: Communities have been trained in participatory planning, implementation and monitoring of different project interventions

Conduct of SBIA workshops: Training on SBIA workshops has been imparted through learning by doing exercises

Conduct of Free, Prior and Informed Consent (FPIC) Activities: Communities have been trained in the conduct of FPIC through learning by doing

Effective implementation of Mangrove Stewardship Agreements (MSAs): Local communities have been trained in effective implementation of MSAs.

Conduct of community meetings: Capacity building in the conduct of community meetings through the platforms of village development committees and women organizations

5 BIODIVERSITY

5.1 Net Positive Biodiversity Impacts



5.1.1 Biodiversity Changes (B2.1)

There have been positive biodiversity changes in the project zone as compared to the baseline as well as First Monitoring Report period situation due to implementation of various project interventions in support of biodiversity and HCVs conservation during M-2 period. The different project interventions which have been implemented during this monitoring period (1 November 2021 to 28 February, 2023) and which have produced positive biodiversity impacts include the following:

- Tidal wetlands restoration and coastal and marine habitats improvement through large-scale mangrove planting over an area of 9,909 ha and cumulative total restored area of 83,034 ha so far.
- Promotion of assisted natural re-generation into planted areas
- Restoration of vegetation and other habitat improving features to difficult sites such as highly saline areas, hard substratum areas, low-lying sub-merged areas and high lying areas which do not get enough inundation thereby reducing habitat fragmentation and increasing biodiversity corridors and connectivity
- Habitat security enhancement through effective enforcement of laws and reducing human-wildlife conflict
- Conservation and promotion of sustainable management of coastal resources through preventing and controlling unsustainable use of natural resources including that of mangrove species, fish species and other biodiversity
- Increasing awareness and capacities for biodiversity and HCVs conservation through different measures including SBIA workshops
- Executing Mangroves and Biodiversity Conservation Stewardship Agreements with the local communities and thus using them as front-line defenders for biodiversity and HCVs conservation
- Mobilization and organization of local communities and other stakeholders through organizing them into village development committees and women organizations

The impacts of these interventions on floral and faunal biodiversity and HCVs are given in the following tables:

Change in Biodiversity	Flora and HCVs
Monitored Change	Direct positive changes have happened in species diversity/composition. The majority of planted areas which initially had preponderance of one species now are more diverse and balanced in species composition. Starting conditions of areas initially planted with either *Avicennia marina* or *Rhizophora mucronata* and hence dominated by these species now have species mix of *Avicennia marina* and *Rhizophora mucronata* of about 50-50 %. In addition, plants of *Ceriops tagal* and *Agericeras corniculatum* are also found in these areas. As a result, vegetation structure and distribution is now more diverse and hence has greater resilience to shocks.
Justification of Change	Positive changes have resulted from the following: ▪ Large-scale planting of native vegetation ▪ Promotion of assisted natural regeneration to supplement the planted vegetation ▪ Maintenance and enhancement of the species composition, ecological processes, vegetation structure and over-all spatial distribution of vegetation in the landscape ▪ Reduction of human impacts that lead to deforestation and vegetation degradation such as open-range grazing of livestock, cutting of vegetation for fodder and fuelwood collection ▪ Reduction of opportunities for the spread of invasive and alien plant species As a result of the above interventions, plant species composition has been improved, proper age-structure is being restored, spatial distribution of vegetation in the landscape is being enhanced and a balance is being restored in the proportion of four different mangrove species in the project zone instead of one species of *Avicennia marina* only. All these positive changes are leading to not only in an increase in the area of HCVs but also their character and potential for the provision of various ecosystem goods and services including improved habitat functioning is getting substantially increased besides their capacity to enable wildlife and biodiversity to adjust and adapt to the negative impacts of climate change. In addition, there have been no negative impacts on floral biodiversity or associated HCVs values due to various project interventions during this monitoring period as assessed during the initial period and this monitoring period. The whole monitoring process is fully documented in text, photographic and videographic form and is available for review by the VVB.

Change in Biodiversity	Fauna and HCVs
Monitored Change	Direct positive changes have happened in terms of species, sites, habitats, refugia and landscape maintenance and enhancement which directly and indirectly contribute to both faunal and floral species

	conservation as well as HVCs areas conservation. Compared to baseline situation and first monitoring period, birds' species diversity has increased substantially. In the base line condition, there were a total of 26 birds' species, at the time of first Monitoring Report the number had increased to 29 species. Now during M-2, the number of bird species recorded in the Project Zone are 89. Of these new 60 additional species found in the Project Zone at the time of M-2, 2 are Endangered species and 8 species are Near Threatened. Following is the detail of mammal species in the Project Zone at the time of baseline, M-1 period and M-2 period: Baseline time: 5 species M-1 period time: 7 species M-2 period time: 11 Of these additional 4 mammal species found in M-2 period compared to M-1 period, 1 is Endangered species. Also, species diversity of reptiles has increased from 4 species at the time of M-1 to 5 species during M-2. The additional species recorded during M-2 is a Near Threatened species. Similarly, fish species has increased substantially from 22 species during M-1 to 59 species during M-2. Of the 37 new species recorded compared to M-1, 1 species is Endangered and 3 are Vulnerable. Not only the number of species in different fauna categories have increased but there is also increase in the number of individuals recorded in the existing species of these fauna types. Details of these additional faunal species as well as the number of individuals in the existing species and the additional species found in M-2 period compared to M-1 and Baseline period are given in Appendices 9-14.
Justification of Change	Positive changes have resulted from the following: ▪ Large-scale planting of native vegetation that contribute to sites, habitats, refugia and landscape maintenance and enhancement ▪ Identification, demarcation and mapping of biodiversity hotspots and HCVs areas throughout the project zone ▪ Promotion of assisted natural regeneration that further enrich the habitats for various faunal species and increase their HCV values ▪ Community and other stakeholders' sensitization, mobilization and engagement for collective action in support of biodiversity and HCVs conservation ▪ Reduction of human-wildlife conflict through effective enforcement of laws ▪ Prevention and control of unsustainable use of wildlife and biodiversity ▪ Laying out the foundation for the declaration of Marine Protected Zones ▪ Paying more attention to and prioritizing actions in support of Ramsar Sites protection in the project zone. Positive faunal biodiversity and HCVs conservation has been assessed and monitored through comparing baseline biodiversity and HCVs

	conditions with the under the project scenario biodiversity and HCVs conditions using internationally acceptable standard methods for faunal biodiversity and HCVs assessment using third party independent consultants. These surveys have indicated increasing trends of protected species, threatened and vulnerable species as well as trigger species like Indian Ocean Humpback Dolphin and Fishing Cat, etc. The positive trend is in all types of faunal species-avian, mammalian, fishes, reptiles, etc. The number of fish species whose population had got critically reduced and which had a population of less than 1 percent were 12 in the initial survey. The number of such species with low occurrence has come down to 9. Hence, there is population recovery of these critical fish species. Also, the areas and locations of different HCVs have been identified, demarcated and mapped for undertaking targeted actions in these HCVs areas. As a result of these targeted actions as highlighted above, there has been a substantial increase in the extent, character and spatial distribution of both biodiversity and HCVs areas under the project scenario as assessed during this monitoring period as compared to the baseline situation. Moreover, no negative impacts on faunal biodiversity and HCVs areas have been observed during the monitoring period. The whole monitoring process is fully documented in text, photographic and videographic form and is available for review by the VVB.

Report of the independent research and academic organization, LUAWMS, engaged for marine biodiversity assessment is given at Appendix 9-Project Zone Marine Biodiversity Assessment Report 2023. It is available for review by the VVB, other stakeholders and has also been uploaded to the project Dropbox which contains raw data and other information besides this report.

5.1.2 Mitigation Actions (B2.3)

None of the implemented project activities have produced any negative impact on biodiversity or HCVs areas. In fact all the project interventions have been specifically designed, planned and implemented to create positive impacts for biodiversity through reducing direct or indirect threats to biodiversity and HCVs; maintaining or enhancing species, sites, habitats and landscapes for maintenance and enhancement of biodiversity and HCVs; preventing and reducing human-wildlife conflict; stakeholders sensitization, mobilization/organization, engagement and capacitation; and increased availability and provision of different types of resources for biodiversity and HCVs conservation.

Hence there is no uncertainty or risks associated with the implementation of various project activities regarding biodiversity and HCVs conservation. Therefore, the need for explicit application of the precautionary principle does not arise.

5.1.3 Net Positive Biodiversity Impacts (B2.2, GL1.4)

The different project activities planned and being implemented under DBC-1 project have resulted in clear biodiversity conservation, HCVs conservation, over-all environmental improvement and socio-economic development in the project zone as compared to the without project scenario. Based on literature review (Feller, I.C. and M.Sitnik, 1996. Mangrove Ecology Workshop Manual, Smithsonian Institution, Washington, D.C.) and baseline biodiversity assessment study conducted by DBC-1 project, mangrove forests create and maintain habitat conditions for a number of faunal species in different vertical strata of the ecosystem. The arboreal part of mangrove ecosystems is occupied by and serves as habitat for birds, reptiles, crabs, snails, insects and spiders.

The middle or intertidal stratum of mangrove ecosystem extends from the high to low tide water levels/heights and aerial roots of mangroves. Major organisms inhibiting this zone include barnacles, isopods, crabs, oysters, amphipods, snails and algae.

The lower or the sub-tidal stratum of mangrove ecosystem below the water mark where mangrove roots provide substrate for organisms adapted to constant submergence like algae, sponges, tunicates, anemones, octocorals, shrimps, polychaetes, brittlestars, nudibranchs and jellyfish). Therefore, restoration and conservation of mangrove forest ecosystem in the Indus Delta area by DBC-1 project is contributing to faunal biodiversity enhancement and maintenance in addition to the floral species which are found in the close by inland areas that also are getting protected due to conservation efforts of DBC-1 project. No negative biodiversity or HCVs conservation related impact resulting from project activities implementation has been observed either on-site or off-site. In fact, the following project interventions have resulted in both direct and indirect benefits for biodiversity and HCVs conservation on account of the following:

- More funds have been spent by DBC-1 project on mangroves restoration and other activities that have contributed to biodiversity conservation as compared to baseline scenario
- Identification, demarcation, mapping and better protection and management of HCVs areas
- Implementation of participatory natural resources and biodiversity related conservation activities
- Habitat improvement and restoration through implementation of large-scale mangrove restoration work over an area of 83,034 ha of degraded and de-vegetated mangrove lands
- Species, sites, habitats and landscapes security enhancement through effective enforcement of laws
- Species, habitats and refugia conservation through control of unsustainable levels of resource use
- Social mobilization and organization of local communities and other stakeholder groups through MSAs
- Implementation of awareness raising and capacity building related interventions

Given the fact that there are positive impacts and no negative impacts resulting from different project activities; therefore, the net biodiversity impact of the project is positive.

5.1.4 High Conservation Values Protected (B2.4)

All biodiversity related HCVs Areas are present in the project zone and the project has been implementing activities that protect, maintain and enhance these valued biodiversity features and landscapes and other sites of biodiversity significance and value in a manner commensurate with their conservation significance/status or identified quality in the biodiversity conservation plan. The different project activities have helped to improve biodiversity, HCVs areas and other local environmental conditions such as air, water and landscape quality, taking into account relevant information. As a consequence, the project has contributed to the enhancement and maintenance of these HCVs Areas and have had no negative impact on these as described below.

HCV	Project Interventions Impact on the HCV
HCV-1: Concentrations of biological diversity including endemic species, and rare, threatened or endangered species, that are significant at global, regional or national levels	The project has maintained and enhanced HCV-1 in the following ways: • Identification and mapping of the HCV-1 areas in the project zone • Assessment of baseline status of the endemic, rare, threatened, endangered and vulnerable species found in the project zone • Species habitat enhancement and improvement through implementation of large-scale ARR activities over an area of around

HCV	Project Interventions Impact on the HCV
	83,034 ha which is positively contributing to their protection, conservation, restoration and sustainable management • Entering into Mangrove Stewardship Agreements with local communities that also provide for their protection, conservation, restoration and sustainable management • Species habitat security enhancement through effective enforcement of applicable laws • Species and their habitat conservation through controlling unsustainable use of resources such as open-range grazing, fodder and fuelwood collection, and other species damaging activities • Undertaking of different project activities that have increased awareness about and built the capacity of various stakeholder groups regarding HCV-1 areas • Organizing local communities into VDCs and WOs for greater and collective action regarding biodiversity conservation • Provision of alternative sources of livelihood to stop irregular, unregulated, and illegal biodiversity harvesting and degradation for subsistence or commercial purposes • Linkages development with concerned departments like Wildlife, Fisheries and Environmental Protection Agency (EPA) • Development of partnership arrangements with other conservation organizations and academic and research institutes like IUCN and WWF Pakistan and LUAWMS. • Mobilizing a cadre of experts who are working on biodiversity issues
HCV-2: Large landscape-level ecosystems and ecosystem mosaics that are significant at global, regional or national levels, and that contain viable populations of the great majority of the naturally occurring species in natural patterns of distribution and abundance	• Recognizing the intrinsic character and biodiversity value of the landscape level ecosystems and ecosystem mosaics found in the project zone, and the wider biodiversity benefits and other natural capital and ecosystem services of these areas including their ability to contain viable populations of the great majority of the naturally occurring species in natural patterns of distribution and abundance, the project has done the following for these HCV-2 areas: • Identification and mapping of the HCV-2 areas in the project zone • Assessment of baseline status of the landscape level ecosystems and ecosystem mosaics found in the project zone • Maintenance and enhancement of the character of the ecosystems and ecosystem mosaics by removing discontinuities and fragmentation as well as establishing biodiversity corridors through increasing connectivity • Maximizing positive impacts on HCV-2 areas and providing net gains for biodiversity through undertaking ANR thereby establishing coherent ecological networks that are more resilient to current and future pressures on these areas • Reducing risks to HCV-2 areas by preventing unacceptable levels of soil, air or water pollution and shoreline and land erosion or being adversely affected by such factors • Remediating and restoring degraded, derelict and otherwise difficult microsites (highly saline, hardpans in the substratum, sub-merged or high-lying areas) within the landscape through special that are otherwise difficult to restore through normal adoption specialist • Taking a strategic approach to maintaining and enhancing networks of ecosystems and mosaics of ecosystems and green infrastructure

HCV	Project Interventions Impact on the HCV
	and planning for the enhancement of these landscape level ecosystems and mosaics of ecosystems at the Indus Delta landscape level • Considering these as sites of special conservation interest • Prioritizing for rehabilitating and restoring these ecosystems and mosaics of ecosystems by conserving and enhancing their conservation values • Identifying and pursuing opportunities for securing measurable positive net gains for biodiversity in such HCVs areas • Species habitat enhancement and improvement through implementation of large-scale ARR activities over an area of around 83,034 ha which is positively contributing to their protection, conservation, restoration and sustainable management • Entering into Mangrove Stewardship Agreements with local communities that also provide for their protection, conservation, restoration and sustainable management • Species habitat security enhancement through effective enforcement of applicable laws • Species and their habitat conservation through controlling unsustainable use of resources such as open-range grazing, fodder and fuelwood collection, and other species damaging activities • Undertaking of different project activities that have increased awareness about and built the capacity of various stakeholder groups regarding HCV-1 areas • Organizing local communities into VDCs and WOs for greater and collective action regarding biodiversity conservation • Provision of alternative sources of livelihood to stop irregular, unregulated, and illegal biodiversity harvesting and degradation for subsistence or commercial purposes • Linkages development with concerned departments like Wildlife, Fisheries and EPA • Development of partnership arrangements with other conservation organizations like IUCN and WWF Pakistan and academic and research institutes like LUAWMS. • Mobilizing a cadre of experts who are working on biodiversity issues
HCV-3: Rare, threatened, or endangered ecosystems, habitats or refugia	HCV-3 areas have been supported and strengthened through the following measures: • Identifying, mapping and protecting mangrove forests and mangrove forest-mosaic sites of particular importance for biodiversity conservation of rare, threatened or endangered ecosystems/habitats/refugia for shelter, feeding or reproduction. • Paying special attention to the fact that there is no loss or deterioration of these key biodiversity areas/irreplaceable habitats • Giving the needed protection to these HCV-3 areas as is required for Ramsar sites like these • Mobilizing financial, human and other resources needed for protection and enhancement of HCV-3 areas • Controlling degradation of HCV-3 areas • Supporting the habitat and refugia functions of these areas through enhancing their habitat values for shelter, feeding and breeding

HCV	Project Interventions Impact on the HCV
	• Engaging communities' members and other stakeholders in HCV-3 areas protection • Managing human wildlife conflict through awareness raising, capacity building and effective enforcement of laws • Regular HCVs threat and trend monitoring as well as monitoring of mangroves restoration and other habitat restoration measures

5.1.5 Invasive Species (B2.5)

No invasive species, either floral or faunal, has been introduced or used by the project in its different interventions in any of the areas affected by the project. The project is closely monitoring the presence and populations of various species in the project zone and there are no reported cases wherein invasive species have either been introduced or the population of any invasive species has increased as a result of the project.

5.1.6 Impacts of Non-native Species (B2.6)

The project has neither used nor intends to use any non-native or alien species in its restoration work. Therefore, giving justification for their use is not needed nor is the need for assessing their adverse effects.

5.1.7 GMO Exclusion (B2.7)

No genetically modified organisms (GMOs) have been used during this monitoring report period nor is their use anticipated in future project periods. Therefore, it is guaranteed that no GMOs have been used to generate GHG emission reductions or removals.

5.1.8 Inputs Justification (B2.8)

No agrochemicals like insecticides, weedicides, pesticides, fertilizers, biological control agents or other environmentally undesirable inputs have been used while implementing the different project activities during the period nor is their use anticipated in the future in the project; therefor the need for justification for the use of these inputs is not needed, nor can there be any adverse effect from their use when their use has not happened to begin with.

5.2 Offsite Biodiversity Impacts

5.2.1 Negative Offsite Biodiversity Impacts (B3.1) and Mitigation Actions (B3.2)

DBC-1 project activities have been designed, planned and implemented in a manner that these have produced only positive impacts as described above. None of the project interventions has had any negative consequence for any aspect of coastal or marine biodiversity or any of the HCVs areas either on-site or offsite as assessed at the time of preparation of this monitoring report.

Project interventions during the period have been carried out on degraded and de-vegetated mangrove lands which had no agricultural, livestock, aquaculture or any other community subsistence or commercial activity being carried out on these lands. The areas which have been restored under the project do not have any special biodiversity significance which could have been lost as a result of their restoration. Moreover, the sources of threats to biodiversity are of local nature and, therefore they are unlikely to be transferred outside the project zone. As a result, there are neither any subsistence or commercial activities or biodiversity dimensions/aspects which have the potential to be displaced or negatively impacted. Therefore, there are no unmitigated negative impacts outside the project zone.

Having said that, the situation is being monitored very closely and if and when it is felt that there are any chances of any negative impacts, the same will be assessed, quantified and mitigated on an immediate basis. Since prior to and at the time of the preparation of this monitoring report or first monitoring report, no negative offsite impacts have been observed or are anticipated, no mitigation strategy under the precautionary principle is required at this point in time.

5.2.2 Net Offsite Biodiversity Benefits (B3.3)

As there have been no negative impacts to biodiversity during the M-2 period from 1 November 2021 to 28 February 2023 and at the time of preparation of this monitoring report, an evaluation of unmitigated offsite biodiversity impacts is not applicable. Since, only positive biodiversity impacts have resulted from different project interventions and there have been no negative biodiversity impacts, either on-site or offsite, therefore the net effect of the project on biodiversity is assessed to be positive.

5.3 Biodiversity Impact Monitoring

5.3.1 Biodiversity Monitoring Plan (B4.1, B4.2, GL1.4, GL3.4)

Monitoring of the biodiversity impacts and impacts on biodiversity related HCVs of various project activities implemented by the project was undertaken through in-house project teams as well as via an independent research and academic University-LUAWMS-who did this work in a collaborative manner with the local communities to assess their following impacts:

- Impacts on all biodiversity variables identified in the monitoring plan
- Impacts on various HCVs
- Impacts on climate change adaptation benefits for biodiversity
- Over-all results and evaluation of biodiversity monitoring.

Based on findings of the monitoring report, all the above-mentioned biodiversity, HCVs and other related impacts were found to be positive and there were no negative impacts. Hence, the net impact of the project on all the above aspects of biodiversity and HCVs has been assessed to be positive.

The monitoring work was done during the period from 01 September 2022 to 28 February, 2023. The approach used for monitoring has been explained in the monitoring report. The whole monitoring process is fully documented in the report and has supporting photographic and videographic evidence. Results of the CCB Biodiversity Impact Assessment Plan are given in Appendix 3.2. For both current and future monitoring of biodiversity impacts, biodiversity assessment stations have been established in the project zone wherefrom data related to biodiversity and HCVs assessment has been collected during this monitoring campaign and wherefrom data will be collected on a continuous basis in the future too.



Figure 16. Key trigger species including the+ Egyptian vulture, Indian ocean humpback dolphin – as well as turtles – found in the project area.

5.3.2 Biodiversity Monitoring Plan Dissemination (B4.3)

Monitoring of the project's biodiversity impacts and impacts on biodiversity related HCVs (HCV-1,2 and 3) was undertaken in accordance with the CCB biodiversity monitoring plan as given in Appendix 3.2 which is based on Appendix-16 (CCB Biodiversity Monitoring Plan) of the PD in the validated project description document of the project. The resultant monitoring report has been disseminated and made publicly available on the internet as well as in the Project's head office in addition to the field offices.

Summaries of findings of the monitoring report have been prepared and have also been translated into Urdu and Sindhi languages. Copies of these summary documents have been communicated to the communities and other stakeholders and have been kept in and are available in the two regional project offices (Keti Bandar and Shah Bandar) and the project head office in Karachi. These documents have also been shared, discussed and fully explained to communities in various SBIA meetings and workshops. Further, these are also uploaded to the project website.

The project has a community message board at each of the two regional offices for reaching out to community members and for sharing with them important project information including the dissemination of information related to the preparation of monitoring reports. A poster/notice in Urdu and Sindhi languages advertising the public comment for the monitoring report is also being posted and made available to communities throughout the Project Zone. It includes details on how a comment can be made to the VERRA/CCB. The project's community and biodiversity outreach workers have also contacted community members through their local networks in the Project Zone and informed them of the notice period for comments.

5.4 Optional Criterion: Exceptional Biodiversity Benefits

The project has also helped species and biodiversity to adjust and adapt to negative climate change impacts through protecting and expanding a variety of sites, habitats, refugia and landscapes thereby helping and protecting them from any potential habitat losses/destruction, tackling human human-wildlife conflict which has the potential to increase due to climate change, and control and management of invasive and alien species as well as increasing resilience to different types of stresses caused by climate change.

Because of these exceptional biodiversity benefits, the DBC-1 project qualifies for and meets the Gold Level for exceptional biodiversity benefits.

5.4.1 Trigger Species Population Trends (GL3.3)

Population status and/or trends of the various trigger species given in the project description has improved on account of the different actions taken by the project to maintain or enhance the population status of each of these trigger species in the project zone as shown in the below given tables for each of the trigger species.

Trigger Species	Indian River dolphin (*Platanista minor*) and the Indian Ocean Humpback Dolphin (*Souza plumbea*)
With-project Scenario	• Improved habitat development and feed availability due to increased production of their food resulting from mangrove restoration works • Greater awareness creation about the importance of the species and the need for its conservation • Reduced threats to the species Therefore, population status and/or trends of these endangered species have improved during the monitoring period and since the start of the project.

Trigger Species	Indian Pangolin (*Manis crassicaudata*)
With-project Scenario	• Curbing the illegal trade in the species through stricter enforcement of forest and wildlife law, awareness creation, training and capacity building and improvement in over-all biodiversity governance • Greater allocation of resources (human, technical, material and financial) for their conservation • Reduced threats to the species • Improvement of habitat due to greater shelter and feed availability

	The, population status and/or trend of this endangered species is anticipated to increase with the passage of time as was indicated by the locals during the monitoring period and since the start of the project.

Trigger Species	Fishing Cat (*Prionailurus viverrinus*) As per IUCN Red List, the Fishing Cat is currently categorized as a vulnerable species. However, the species was experiencing a declining population trend in the baseline and without project scenario. It was therefore facing a high risk of extinction throughout its range. It is also thought to be amongst the most vulnerable of the small and medium sized cats in South and Southeast Asia, including Indus Delta Area. There is a very low overlap of its occupied habitat with protected areas and conservation interventions (Duckworth et al., 2014). The major threats across its South Asian range (including the Indus Delta Area) are habitat loss and fragmentation by various anthropogenic activities, where as in Southeast Asia persecution is the major threat (Melisch et al., 1996; Cutter and Cutter 2009; Tantipisanuh et al. 2014 and Willcox et al., 2014). Given the above threats to the species, DBC-1 Project is giving high priority to conservation of this vulnerable species as it is on its way to becoming threatened locally and therefore liable to extinction if concrete steps for its conservation are not taken under the project.
With-project Scenario	• Addressing of direct and indirect threats to the species • Improvement of habitat due to greater shelter, feed, growth and breeding places availability on account of upscaled mangroves restoration • Greater awareness creation about the importance of the species and the need for its conservation • Greater allocation of resources for undertaking species conservation related interventions • Taking of targeted conservation measures • Regular monitoring of the status of the species Therefore, population status and/or trend of this vulnerable species has improved during the monitoring period and since the start of the project as indicated by this biodiversity impact assessment survey and based on discussions with the local community.

Trigger Species	Egyptian Vulture (*Neophron percnopterus*)
With-project Scenario	• Improved habitat development and feed availability due to increased production of their food resulting from mangrove restoration works • Greater awareness creation about the importance of the species and the need for its conservation • Reduced threats to the species

	• Taking of targeted conservation measures • Regular monitoring of the status of the species Hence, population status and/or trend of this endangered species has been reported by the communities to have improved during the monitoring period and since the start of the project.

6 APPENDICIES

Appendix 1: New Project Areas and Stakeholders

No new Project Areas have been added. Similarly, no new Stakeholders have been added during this monitoring period. Therefore, the need for filling this table does not arise. Project Area boundaries as given in Table 1 of PD are relevant and applicable. Similarly, Stakeholders as given in Appendix 1-Stakeholders Identification Table, are the stakeholders at the time of this monitoring report.

Stakeholder Identify communities and any community groups within them, any cross-cutting community groups, and list other stakeholders.	Rights, interest, and overall relevance to the project	Demonstrate how they meet the eligibility criteria (G1.14)	Demonstrate how their inclusion does not violate the scalability limits (G1.15)

Appendix 2: Project Risks Table

(See Section 2.2.6 and MR- Additional Appendix – Non-Permanence Risk Report)

Risk Analysis of the Project has been done at the time of MR preparation as per VCS AFOLU Non-Permanence Risk Tool v 4.0 dated 19 September, 2019. It is provided separately as an Additional MR Appendix: Non-Permanence Risk Report. The Risk Analysis in the said Appendix has analysed Internal Risks (Project Management, Financial Viability, Opportunity Cost, and Project Longevity), External Risks (Land Tenure and Resource Access/Impacts, Community Engagement, and Political Risk) as well as Natural Risks (Fire Risks, Extreme Weather Risks, and Geological Risks). As per this Non-Permanence Risk Report, the sum total of internal risks, external risks and natural risks is 2. Therefore, the risk buffer applied to the project is 10% buffer deduction.

Identify Risk	Potential impact of risk on climate, community and/or biodiversity benefits	Actions needed to mitigate the risk

Appendix 3: Additional Information on CCB Community and Biodiversity Monitoring Plan Implementation

Appendix 3.1. CCB Community Monitoring Plan Implementation

Activity area – Community livelihoods and well-being									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-2 Done?	Where?	This Monitoring Result/Outcome
Decrease in living costs, improved community health and education	By 2027, 100% of community members with direct livelihood and well-being benefits from DBC-1	SIA001	# Schools constructed, repaired or equipped	Output	Internal report	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	Based on earlier work, detailed foundational and needs assessment work (construction, repair and equipment) done in 23 number of schools, which have enrolment of 760 students. Out of these 9 schools are non-functional having an enrolment of 387 students. Refurbishment work has begun in 2022 and will continue till the 9 non-functional schools are refurbished. Also, contacts have been established

Activity area – Community livelihoods and well-being									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-2 Done?	Where?	This Monitoring Result/Outcome
									with other organizations to become partners in making these schools functional.

Activity area – Community livelihoods and well-being									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-2 Done?	Where?	This Monitoring Result/Outcome
		SIA002	# Teachers employed	Outcome	Internal report	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	Needs assessment with regard to students (especially girl students) and teachers' requirements has been done in 23 number of schools. Plans have been made for meeting the students' needs. Also, the assessed needs of teachers are being discussed with potential partners for making arrangements for teachers' deployment in these schools.
		SIA003	# Functional schools in the Project Zone	Outcome	Internal report	Community outreach team	Annually.	Project Zone	A survey has been conducted during M-1 period in the Project

Activity area – Community livelihoods and well-being									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-2 Done?	Where?	This Monitoring Result/Outcome
							Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.		Zone to determine the number of both functional and non-functional schools. Based on this survey, the number of non-functional schools and functional schools are 9 and 14 respectively. During M-2 period, discussions are on-going with partners for making the non-functional schools functional as well as improve the learning environment in the functional schools.

Activity area – Community livelihoods and well-being									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-2 Done?	Where?	This Monitoring Result/Outcome
		SIA004	# Students benefiting from bursary schemes/ better access to education	Impact	Household surveys / PRAs / internal report	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	Now that carbon finance has been received, the already started assessment work has been continued to determine the number and types of bursaries which are needed, especially for talented girl students so that they can have better access to education. Work on program development has also been started so that these deserving talented students can benefit from the bursary scheme.

		SIA005	# Health facilities built or equipped	Output	Internal report	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	A memorandum of cooperation has bene signed with SHINE Humanity, an organization working on health issues. A health specialist/doctor has been engaged via this partnership arrangement who visits the project area once a week each month throughout the year and provides free medical services to the project zone communities. In addition, the mobile health facility that was provided during the first monitoring campaign in Bhanbore Area has been further equipped and strengthened for improved and enhanced health services provision

									to the local communities. Similarly, the Rural Health Center of Keti Bandar Area has also been given additional support for improved and expanded health services provision. Discussions have been held with SHINE Humanity to make similar arrangements for a mobile health facility in Shah Bandar Area. These health facilities have provided health related services from which 8,300 number of community members have benefitted of which 3,600 are women. Cumulative beneficiaries of these facilities since the start of the project is

Activity area – Community livelihoods and well-being									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-2 Done?	Where?	This Monitoring Result/Outcome
									23,424. These include 11,262 female beneficiaries.

Activity area – Community livelihoods and well-being									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-2 Done?	Where?	This Monitoring Result/Outcome
		SIA006	# of functional health facilities in Project Zone	Outcome	Internal report	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	The number of health facilities have been surveyed in the Project Zone, which is 3 number. Out of these the functional number of health facilities now is 1. The other two need some kind of construction, repair, equipment, medicines or staff provision. Work on making one of the non-functional facilities functional in 2023 has begun and will be completed by the end of the year. The other one will be made functional during 2024.

Activity area – Community livelihoods and well-being									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-2 Done?	Where?	This Monitoring Result/Outcome
		SIA007	% Community members benefiting from DBC-1 related health schemes	Impact	Household surveys / PRAs / internal report	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	Of the total number of 43,000 people in the Project Zone, based on the surveys conducted for the preparation of this monitoring report, 54% (or 23,424 number) of the community members are benefiting from DBC-1 health related schemes.

		SIA008	# Reverse osmosis (RO) plants made functional through repair and operation and maintenance	Output	Internal report	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	There are 6 Reverse Osmosis (RO) plants in DBC-1 Project Zone. All these RO plants require some kind of rehabilitation to become functional. Of these the one requiring major repairs and provision of equipment has been made functional. Survey work has been done about the rehabilitation needs of the other 5 RO plants. Restoration work on the rehabilitation of 2 of these RO facilities has been started and will be completed during the year 2023. Also, linkages have been developed between the communities and the RO plants

Activity area – Community livelihoods and well-being									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-2 Done?	Where?	This Monitoring Result/Outcome
									operating organizations.
		SIA009	# People with easy access to clean drinking water	Impact	Household surveys / PRAs / internal report	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	The non-functional RO plant which was made functional by the project has provided clean and affordable drinking water facilities to 400 people including 150 females during this M-2 period. The number of beneficiary people since the project start is 800 (including 300 females). These people are getting 500 gallons of clean drinking water on a daily basis.
		SIA010	# Hygiene	Output	Internal report	Community	Annually.	Project	The provision of

Activity area – Community livelihoods and well-being									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-2 Done?	Where?	This Monitoring Result/Outcome
			facilities provided/ rehabilitated			outreach team	Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Zone	clean drinking water is helping the above community members in hygiene also.

Activity area – Community livelihoods and well-being									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-2 Done?	Where?	This Monitoring Result/Outcome
		SIA011	# Communal meeting facilities provided / rehabilitated	Output	Internal report	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	A communal meeting facility has been constructed in the Bhanbore area. Around 800 residents of the surrounding 5 villages have benefited from this facility during M-2 period.
Higher income levels	By 2025, 10% of community members earning direct income from DBC-1 and associated activities	SIA012	# of people directly employed by the DBC-1	Impact	Household surveys / PRAs / internal report	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from	Project Zone	Total direct employment provided by the project during M-2 period is 1,246. Of these 128 are women. Cumulative employment generated so far

Activity area – Community livelihoods and well-being									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-2 Done?	Where?	This Monitoring Result/Outcome
							01 September 2022 to 28 February 2023.		since the start of the project is 11,656. Cumulative employment generation for females is 1,158. This includes employment in ARR activities and MSA. There are a total of 150 MSAs. These include 147 male-headed households and 3 female-headed households. Each household is on average of 9 persons.
		SIA013/ BIA015	# of Mangrove Stewardship Agreements signed with communities	Outcome	Internal report	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was	Project Zone	150 number of Mangrove Stewardship Agreements have been signed with community households. Each household has on

Activity area – Community livelihoods and well-being									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-2 Done?	Where?	This Monitoring Result/Outcome
							done from 01 September 2022 to 28 February 2023.		average 9 number of people. Therefore, the total beneficiary persons of MSAs are 1,350 people during M-2 period.
		SIA014	# Community members who have accessed microfinance schemes	Outcome	Household surveys / PRAs / internal report	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	This activity has not been implemented at this point in time and is planned for future. Plans have been made to link the community members to Akhuwat organization for accessing microfinance.
		SIA015	# Community members trained in alternative	Output	Communications and meetings records, Internal progress	Community outreach team	Annually. Second Monitoring	Project Zone	People from 150 households have been trained in alternative

Activity area – Community livelihoods and well-being									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-2 Done?	Where?	This Monitoring Result/Outcome
			livelihoods		reports		Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.		livelihoods (propagules collection, proper storage and transportation, mangroves nurseries raising, mangrove planting and proper protection) through a number of project activities which include participation in MSAs programs. These trained people are now supporting their household members which on average are 10. This includes both male and female members of the community.
		SIA016	# Households reporting increased income	Impact	Household surveys / PRAs / internal report	Community outreach team	Annually. Second Monitoring Report	Project Zone	2,446 number of people have reported improved livelihoods during M-2 period. Of

Activity area – Community livelihoods and well-being									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-2 Done?	Where?	This Monitoring Result/Outcome
							related preparatory and field work was done from 01 September 2022 to 28 February 2023.		these 140 are women.

Activity area – Wetland restoration and conservation									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
Wetlands restored	By 2027, 226,378 hectares of degraded wetlands under restoration	SIA017	# of hectares brought under mangroves plantations	Output	Copies of agreements, Internal progress reports	Field operations and GIS teams	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Area	During M-2 period, 9,909 ha have been restored. Cumulative area restored so far is 83,034 ha of degraded mangrove lands which have been brought under mangrove plantations.
		SIA018	# of hectares within the landscape restored or protected for their ecological importance	Output	Internal progress reports	Field operations and GIS teams	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February	Project Zone	Restoration and conservation activities have been implemented over 198,465, of which 83,034 ha were degraded mangrove lands which have been restored and brought under sustainable management in the Project Zone which are now conserved and

Activity area – Wetland restoration and conservation									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
							2023.		sustainable managed. Restoration work done during M-2 period is 9,909 ha.
		SIA019	# of hectares within target landscape brought under improved practices	Output	Internal progress reports	Field operations and GIS teams	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	198,465 ha of landscape have been brought under improved practices and are being sustainably managed.
		SIA020	Ten further indicators in Biodiversity Monitoring Plan (BIA001-BIA010)						Progress reported under relevant indicators (BIA001 to BIA010) in the Biodiversity Monitoring Plan. Please refer to CCB Biodiversity Monitoring

Activity area – Wetland restoration and conservation									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
									Plan implementation status in Appendix 3.2 for progress on these indicators.
Mangrove forests protected and conserved	By 2025 the main drivers of forest degradation such as the practice of unregulated free-range grazing and fuelwood collection tackled and reduced, and mangroves management plan prepared and being implemented	SIA021	Nine indicators in Biodiversity Monitoring Plan (BIA027-BIA038)				Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.		Progress reported under relevant indicators (BIA027 to BIA038) in the Biodiversity Monitoring Plan. Please refer to CCB Biodiversity Monitoring Plan implementation status in Appendix 3.2 for progress on these indicators.
	By 2022 at least 50% of community members with a greater appreciation of biodiversity and	SIA022	Three indicators in Biodiversity Monitoring Plan (BIA039-				Annually. Second Monitoring Report related		Progress reported under relevant indicators (BIA039 to BIA044) in the Biodiversity Monitoring Plan. Please refer to CCB

Activity area – Wetland restoration and conservation									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
	HCVs conservation		BIA044)				preparatory and field work was done from 01 September 2022 to 28 February 2023.		Biodiversity Monitoring Plan implementation status in Appendix 3.2 for progress on these indicators.

Activity area – Sustainable fisheries and marine diversity									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
Sustainable fisheries	By 2025, 15 Fish Stewardship Committees (FSCs) of fisheries dependent communities	SIA023	Participatory development of one set of guidelines and standards for sustainable	Output	Communications and meetings records, Internal progress reports	Community outreach team Forest and Wildlife Department and	Annually. Second Monitoring Report related preparatory	Project Zone	This is a future activity. Therefore, not assessed at the time of this Monitoring Report.

Activity area – Sustainable fisheries and marine diversity									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
	and supporting institutions have been established throughout the Project Zone to work towards sustainable fisheries resource management, marine biodiversity conservation and improved livelihoods		fishing practices			Department of Fisheries	and field work was done from 01 September 2022 to 28 February 2023.		However, discussions have been started with the local fishermen about developing such guidelines and standards for sustainable fishing practices for their future adoption.

Activity area – Sustainable fisheries and marine diversity									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
		SIA024	Development and implementation of a reporting system to ensure compliance with set guidelines and standards	Output	Communications and meetings records, Internal progress reports	Community outreach team Forest and Wildlife Department	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	This is a future activity. Therefore, not assessed at the time of this Monitoring Report. Discussions have been held with the fishermen community about how to ensure compliance with and do reporting on the guidelines and standard about sustainable fishing practices.

Activity area – Sustainable fisheries and marine diversity									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
		SIA025	# of awareness raising and training and capacity building sessions held about coastal and marine biodiversity conservation and adaptive management of Marine Protected Areas	Output	Communications and meetings records, Internal progress reports	Community outreach team Forest and Wildlife Department	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	9 number of awareness raising training and capacity building sessions have been held about coastal and marine biodiversity conservation and adaptive management as part of SBIA workshops which have been held in 3 Talukas in the Project Zone.
		SIA026	# FSCs adhering to agreed terms	Outcome	Surveys, communications and meetings records, Internal progress reports	Community outreach team	Annually.	Project Zone	This is a future activity. Therefore, not assessed at the time of this Monitoring Report.

Activity area – Sustainable fisheries and marine diversity									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
		SIA027	# of fishermen attending awareness raising held	Outcome	Communications and meetings records, Internal progress reports/ Internal report	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	Awareness raising sessions have been held. 378 members of fishermen community have attended awareness raising sessions that have been held in the Project Zone.

Activity area – Sustainable fisheries and marine diversity									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
		SIA028	# of fishermen with a greater appreciation of sustainable fishing practices	Output	Surveys, communications and meetings records, Internal progress reports	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	85% of the above fishermen who have participated in the awareness raising sessions have reported greater appreciation of sustainable fishing practices.
		SIA029	# of nets with proper mesh size distributed	Output	Internal report	Community outreach team	Annually.	Project Zone	This is a future activity. Therefore, not monitored at the time of this Monitoring Report.
		SIA030	# of FSA's linked to microfinance	Output	Surveys, Communications	Community outreach	Annually.	Project Zone	This is a future activity.

Activity area – Sustainable fisheries and marine diversity									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
			schemes		and meetings records, Internal progress reports	team			Therefore, not monitored and assessed at the time of this Monitoring Report.
		SIA031	# of fishermen with decreased debt obligations	Outcome	Household surveys / PRAs / internal report	Community outreach team	Annually.	Project Zone	This is a future activity. Therefore, not monitored and assessed at the time of this Monitoring Report.
		SIA032	# of fishermen able to access open market	Outcome	Household surveys / PRAs / internal report	Community outreach team	Annually.	Project Zone	This is a future activity. Therefore, not monitored and assessed at the time of this Monitoring Report.
		SIA033	# of cold storage facilities in the	Output	Internal report	Community outreach	Annually.	Project Zone	This is a future activity. Therefore, not

Activity area – Sustainable fisheries and marine diversity									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
			Project Zone			team			monitored and assessed at the time of this Monitoring Report.

Activity area – Sustainable fisheries and marine diversity									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
		SIA034	% of fishermen benefitting directly from DBC-1	Impact	Household surveys / PRAs / internal report	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	12,529 fishermen who are 35% of the fishing community (35,797) have been directly or indirectly engaged in different project activities and benefited in various ways from project interventions including the restoration of 83,034 ha of mangroves which has increased fish production due to increased and improved fish spawning sites.

Activity area – Sustainable fisheries and marine diversity									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
		SIA035	% Fishermen reporting increased consistency in catch	Impact	Household surveys / PRAs / internal report	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	35% number of fishing community members have reported increased consistency in fish catch.

Activity area – Women's empowerment and marginal groups									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
Better livelihoods for women	By 2027, increased social and economic empowerment for women leading to better well-being for at least 80% of women in the Project Zone	SIA036	# women organisations (WO) formed	Output	Copies of agreements, Internal progress reports	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Area	13 WOs number of women organizations have been established in M-1 period. They have representation from 43 Project Zone Villages. These women organizations have been supported during M-2 period. These WOs discuss women related issues at the community level. They have been facilitated by the project staff during the monitoring period.
		SIA037	# of women trained in mid-wifery and basic first aid	Output	Internal progress reports	Community outreach team	Annually.	Project Zone	This is a future activity. Therefore, not monitored and assessed at the time of this Monitoring Report.
		SIA038	# of instances of infant and maternal mortality during	Outcome	Internal progress reports, Government	Community outreach team	Annually. Second Monitoring Report	Project Zone	Women in the Project Zone are making use of the ambulance provided by the project. However,

Activity area – Women's empowerment and marginal groups									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
			childbirth		records		related preparatory and field work was done from 01 September 2022 to 28 February 2023.		exact statistics on the number of infant and maternal mortality during childbirth have not been collected in this Monitoring Period. 185 number of people have made use of the ambulance service during the monitoring period.
		SIA039	# of women reporting reduced health related issues	Output	Household surveys, Internal reports	Community outreach team	Annually.	Project Area	This survey is planned for future. Therefore, not assessed, monitored and reported in this Monitoring Period.
		SIA040	# of woman trained in various livelihood skills	Output	Household surveys, Internal reports	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from	Project Zone	215 number of women have been trained in various livelihood skills.

Activity area – Women's empowerment and marginal groups									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
							01 September 2022 to 28 February 2023.		
		SIA041	# of women with access to microfinance	Output	Household surveys, Internal reports	Community outreach team	Annually.	Project Zone	This is future activity. Therefore, not assessed, monitored and reported at the time of this Monitoring Period.
		SIA042	# of WOs linked to design houses for income earning opportunities in clothing manufacture and handicrafts	Output	Household surveys, Internal reports	Community outreach team	Annually.	Project Zone	This is future activity. Therefore, not assessed, monitored and reported at the time of this Monitoring Period.
		SIA043	# of women joining adult literacy classes	Outcome	Internal progress reports	Community outreach team	Annually.	Project Zone	This is future activity. Therefore, not assessed, monitored and reported at the time of this Monitoring Period.

Activity area – Women's empowerment and marginal groups									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
		SIA044	# of women in employment through DBC-1 business linkages	Outcome	Household surveys, Internal reports	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	6 number of women are in employment through DBC-1 project business linkages.
		SIA045	# of women directly employed by the project	Outcome	Household surveys, Internal reports	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01	Project Zone	125 seasonal and 3 permanent via MSAs number of women have been directly employed in various project interventions including restoration of degraded mangrove sites and MSAs.

Activity area – Women's empowerment and marginal groups									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
							September 2022 to 28 February 2023.		
		SIA046	# of women reporting increased social and economic empowerment	Outcome	Household surveys, Internal reports	Community outreach team	Before every verification. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	128 number of women have reported increased social and economic empowerment.
		SIA047	% of women directly benefitting from	Impact	Household surveys, Internal	Community outreach	Annually. Second	Project Zone	4,266 number of women are directly benefiting

Activity area – Women's empowerment and marginal groups									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
			DBC-1		reports	team	Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.		from DBC-1 Project.
Better livelihoods for communities engaged in agriculture	By 2027, up to 50% of the community associated with agriculture trained in climate smart agriculture that helps them prepare for negative impact and sustainable agriculture practices in the face of climate	SIA048	# of trainings held	Output	Training session records, Internal progress reports	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February	Project Zone	3 SBIA, 9 number of trainings have been held on different topics and themes.

Activity area – Women's empowerment and marginal groups									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
	change						2023.		
		SIA049	# of participants at meetings	Output	Training session records, Internal progress reports	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	378 number of people have participated in these meetings. 215 of them are women.
		SIA050	# of agriculturists facilitated with microfinance	Output	Household surveys, Internal progress reports	Community outreach team	Annually	Project Zone	This is a future activity. Therefore, not assessed, monitored and reported at the time of this Monitoring Period.
		SIA051	# of agriculturists	Outcome	Household surveys,	Community outreach	Before every	Project	This is a future activity. Therefore, not assessed,

Activity area – Women's empowerment and marginal groups									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
			adopting new practices		Internal progress reports	team	verification. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Zone	monitored and reported at the time of this Monitoring Period.
Better livelihoods for communities engaged in livestock	By 2027, 50% of this community group is trained for better livestock husbandry	SIA052	# of trainings held in livestock health	Output	Training session records, Internal progress reports	Community outreach team	Annually.	Project Zone	This is a future activity. Therefore, not assessed, monitored and reported at the time of this Monitoring Period.
		SIA053	# of trainings held in herd	Output	Training session records,	Community outreach	Annually.	Project Zone	This is a future activity. Therefore, not assessed, monitored and reported

Activity area – Women's empowerment and marginal groups									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
			management		Internal progress reports	team			at the time of this Monitoring Period.
		SIA054	# of participants at meetings	Output	Training session records, Internal progress reports	Community outreach team	Annually.	Project Zone	This is a future activity. Therefore, not assessed, monitored and reported at the time of this Monitoring Period.
		SIA055	# of livestock vaccinated	Output	Surveys, Internal progress reports	Community outreach team	Annually.	Project Zone	This is a future activity. Therefore, not assessed, monitored and reported at the time of this Monitoring Period.
		SIA056	# of herders facilitated with Microfinance	Output	Household surveys, Internal progress reports	Community outreach team	Annually.	Project Zone	This is a future activity. Therefore, not assessed, monitored and reported at the time of this Monitoring Period.
		SIA057	# of livestock owners deploying better livestock feeding	Outcome	Household surveys, Internal progress reports	Community outreach team	Before every verification.	Project Zone	This is a future activity. Therefore, not assessed, monitored and reported at the time of this Monitoring Period.

Activity area – Women's empowerment and marginal groups									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
			practices						
		SIA058	# of livestock owners practicing better herd management	Outcome	Household surveys, Internal progress reports	Community outreach team	Before every verification.	Project Zone	This is a future activity. Therefore, not assessed, monitored and reported at the time of this Monitoring Period.
		SIA059	% change in income from livestock and livestock products	Impact	Household surveys, Internal progress reports	Community outreach team	Before every verification.	Project Zone	This is a future activity. Therefore, not assessed, monitored and reported at the time of this Monitoring Period.
Better livelihoods for daily wage labourers and the landless poor	50% of these community groups have increased incomes and livelihood earning opportunities	SIA060	# of vocational trainings held	Output	Training session records, Internal progress reports	Community outreach team	Annually.	Project Zone	This is a future activity. Therefore, not assessed, monitored and reported at the time of this Monitoring Period.
		SIA061	# of member attending vocational training	Output	Training session records, Internal progress	Community outreach team	Annually.	Project Zone	This is a future activity. Therefore, not assessed, monitored and reported at the time of this

Activity area – Women's empowerment and marginal groups									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
					reports				Monitoring Period.
		SIA062	# of people in employment	Outcome	Household surveys, Internal progress reports	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	65 % of the daily wage community members have employment in different project related activities.
		SIA063	# of people directly employed by the project	Output	Household surveys, Internal progress reports	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from	Project Zone	150 number of household heads have been directly employed by the project. Each household has about 9 people on average.

Activity area – Women's empowerment and marginal groups									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
							01 September 2022 to 28 February 2023.		
		SIA065	% with enhanced and diversified income and livelihood sources	Impact	Household surveys, Internal progress reports	Community outreach team	Before every verification. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	65 % of community members are now with enhanced and diversified income and livelihood sources.
Community engagement	By 2025, at least 80 percent of the	SIA066	# of multistakeholder	Output	Copies of agreements,	Community outreach	Annually.	Project	10 number of multi-stakeholder village

Activity area – Women's empowerment and marginal groups									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
and participation in resource management	community in the Project Zone organised and trained for participatory coastal and marine resources management		village development committees formed and trained		Internal progress reports	team	Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Zone	development committees (VDCs) have been formed during M-1. They have representation from 37 Project Zone villages. These VDCs discuss different village development related issues. Project staff have facilitated these VDCs in their meetings in this M-2 period.
		SIA067	# of Focal group discussion held with VDCs	Output	Meeting records, Internal progress reports	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28	Project Zone	10 number of Focussed Group Discussions have been held with VDCs.

Activity area – Women's empowerment and marginal groups									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
							February 2023.		
		SIA068	# of VDCS demonstrating greater appreciation of coastal and marine ecosystems and their goods and service	Outcome	PRAs / Internal progress reports	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	10 number of VDCs having representation from 37 villages in the Project Zone have demonstrated continued and greater appreciation of coastal and marine ecosystems and their goods and services.
		SIA069	# of VDCs directly benefiting from DBC-1	Impact	PRAs / Internal progress reports	Community outreach team	Annually. Second Monitoring Report related preparatory	Project Zone	10 number of VDCs who are representing 37 villages in the Project Zone are directly benefiting from DBC-1 project activities.

Activity area – Women's empowerment and marginal groups									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
							and field work was done from 01 September 2022 to 28 February 2023.		
Conservation of historical and heritage sites and cultural artefacts	By 2025, conservation plan for Jhaki Bander Island Fort developed in collaboration with relevant organisations leading to better awareness and increased site visits	SIA070	# of interactions with relevant organisations and site visits undertaken in connection with the preparation of site assessment and conservation plan	Output	Internal report	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	2 number of site visits have been undertaken for the preparation of site assessment and conservation plan. Also, discussions have been held about entering into Memorandum of Cooperation with the relevant agency about future collaborative work in this regard.

Activity area – Women's empowerment and marginal groups									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
		SIA071	# of promotional material and knowledge documents developed and available about Jhaki Bander Island Fort	Output	Internal report and promotional products and knowledge documents about Jhaki Bunder Island Fort	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	This is a future activity. Therefore, not assessed, monitored and reported at the time of this Monitoring Period.
		SIA072	Conservation plan/report on conservation of Jhaki Bander Island Fort	Outcome	Internal report and availability of site assessment and conservation plan	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01	Project Zone	This is a future activity. Therefore, not assessed, monitored and reported at the time of this Monitoring Period.

Activity area – Women's empowerment and marginal groups									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
							September 2022 to 28 February 2023.		
		SIA073	# of Community members and other visitors aware about Project Zone cultural history and significance and visiting the conserved Island Fort Site	Impact	Internal report	Community outreach team	Every three years.	Project Zone	This is a future activity. Therefore, not assessed, monitored and reported at the time of this Monitoring Period.

Activity area – Adaptation benefits for communities									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
Increase in adaptation benefits for communities	By 2027, 100 % of community members are reporting increased adaptation benefits	SIA074	Number of fishermen reporting increased and stable fisheries catch per unit of fishing effort	Impact	PRAs / Internal progress reports	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	35 % of fishing community members in 49 villages have reported increased and stable fisheries catch per unit of fishing effort.
		SIA075	Number of community members reporting reduction in number of hectares of shoreline eroded	Impact	PRAs / Internal progress reports	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from	Project Zone	2,755 number of community members in 16 villages have reported continued and on-going reduction in number of hectares of shoreline erosion.

Activity area – Adaptation benefits for communities									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
							01 September 2022 to 28 February 2023.		
		SIA076	Number of community member reporting reduction in hectares of landscape damaged by flood or tidal water	Impact	PRAs / Internal progress reports	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	2,755 number of people and community members in 16 villages have reported continued and on-going reduction in damages and improved protection from storm surges and other coastal hazards for communities and infrastructure. In addition, 1,994 number of people in 6 villages have reported continued and on-going conservation of historical sites and cultural artefacts and improved aesthetic values and iconic spaces protection (1,421 people in 6 villages) have reported continued and

Activity area – Adaptation benefits for communities									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
									on-going inspiration and knowledge from restoration and conservation efforts has been reported by 2,134 people in 6 villages.
		SIA077	Number of community members reporting reduction in number of hectares of croplands affected by salt water intrusion	Impact	PRAs / Internal progress reports	Community outreach team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	35 % of agriculturists community members have reported reduction in number of hectares of croplands affected by salt water intrusion
		SIA078	Number of community members reporting	Impact	PRAs / Internal progress reports	Community outreach team	Annually. Second Monitoring Report	Project Zone	2,755 number of community members have reported reduction in number of people who

Activity area – Adaptation benefits for communities									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/Outcome
			reduction in number of people who are forced to migrate due to climate change impacts.				related preparatory and field work was done from 01 September 2022 to 28 February 2023.		are forced to migrate due to climate change impacts.

Appendix 3.1.1 Comparison of Baseline Scenario and With Project Scenario in respect of community impacts

Based on discussions with the communities and their various groups during this monitoring exercise, the communities indicated that in the without project scenario, instead of the realization of above-mentioned positive impacts for various groups, the following would have happened:

FOCAL ISSUE 1: Mangrove forests degradation due to unregulated and unsustainable use

Focal Issue Aspect	Projected Status in short to medium term	Reasons for the Projected Status	Community well-being and socio-economic impacts
Mangrove Forests Deforestation	Worsen	Non-availability and non-use of alternative sources of energy sources as solar and other renewable sources of energy are not available and too expensive for the poor local communities Non-introduction of new and more-efficient fuelwood cooking technologies due to poverty Greater demand for fuelwood due to population growth No government investments to extend power supply and infrastructure in the delta area due to political marginalization of the local communities Fuelwood collection and sale as a source of livelihood is pursued by local community members who do not have alternative sources of livelihood There are no large-scale ARR interventions for the restoration of deforested areas due to budgetary constraints with the government and lack of funds as well as incentives with the local communities to restore de-vegetated mangrove areas Due to various ecological barriers no natural regeneration of mangrove is happening	Loss of nursery habitat for fish and shrimps; and hence loss of income and livelihoods No chance to see, study and understand mangrove forests Decreased preparedness and increased vulnerability and exposure to different climate change induced natural disasters Loss of opportunities for development and realization of tourism potential in the area Loss of motivation for collaborative and participatory management of mangroves and other natural resources in the area Unable to collect and benefit from various ecosystem goods and services of mangrove ecosystems and hence deprivation from their benefits

Focal Issue Aspect	Projected Status in short to medium term	Reasons for the Projected Status	Community well-being and socio-economic impacts
		There are technical as well as social barriers to the restoration of deforested areas Deficiencies in Forest and Wildlife enforcement due to lack of funds and budgetary support	
Mangrove Forests Degradation	Worsen	There is continued unregulated and unsustainable free grazing of camels and other livestock Free grazing of livestock pressure increases due to lack of alternative sources of livestock feed and non-practice of stall feeding Poor law enforcement capabilities of Sindh Forest and Wildlife Department Fodder collection and sale becomes a viable livelihood source due to lack of alternative livelihood earning opportunities	

FOCAL ISSUE 2: Poverty and impoverished community well-being

Focal Issue Aspect	Projected Status in short to medium term	Reasons for the Projected Status	Community well-being and socio-economic impacts
High living costs	May go up further	High expenditure levels on purchase of and access to clean drinking water Cost of ensuring personal hygiene goes up due to non-availability of water Higher health related costs due to non-availability of medical facilities at the local and hence incurrence of additional expenditure to access health services due to the extra travel, accommodation and food	Increased health problems and issues due to reduced access to health facilities on account of high costs and time involved in accessing distant and far located health facilities High infant and maternal mortality rates at the time of child birth Increased incidence of preventable and curable diseases

Focal Issue Aspect	Projected Status in short to medium term	Reasons for the Projected Status	Community well-being and socio-economic impacts
		expenses adding to their expenses Extra-expenses on education makes education for children costlier due to which both boys and girls either fail to get education or get it at high cost Due to low economic activities in the area, the cost of doing business in the area goes	Living in poor and unhygienic conditions that pre-dispose the population to various types of diseases Lack of access to nutritious food leading to malnutrition and associated higher morbidity and mortality rates Lack of access to safe and affordable drinking water and hygiene facilities Reduced access to availing educational facilities Lack of availing vocational training and other knowledge and skills building opportunities and hence less chances of getting employed and income earning Low wages due to low skills and inability to negotiate proper wage rates High interest rates charged by creditors leading to poverty Fish spoilage due to non-availability of cold storage facilities Low prices for fish catch and catch weighment issues due to inability to sell the catch in open and competitive markets Getting caught in circular debt trap Increased vulnerability to exploitation by various interest groups Inability to avail diversified income earning opportunities
Low incomes	Income sources and levels will go down	Due to lack of education, knowledge and employable skills, local communities are unable to get gainful employment Non-availability of easily, widely and affordable institutional credit makes the availability of credit for doing business less accessible and costlier due to which the starting and continuation of local businesses becomes difficult Due to population growth there is increased demand for the already scare and further shrinking resource base	

FOCAL ISSUE 3: Continued and accelerated wildlife and habitat loss and fisheries degradation

Focal Issue Aspect	Projected Status in short to medium term	Reasons for the Projected Status	Community well-being and socio-economic impacts
Inability to restore degraded and de-vegetated mangrove lands	Worsen	Lack of funds, other resources and various other investment barriers will continue to come in the way of large-scale restoration of degraded and de-vegetated mangrove lands Institutional constraints and barriers (such as insufficient staff and other institutional capacities to effectively enforce laws and do forest and landscape restoration works) that are limiting the capacities of SFD and local communities to undertake mangrove restoration will remain operative and will not be tackled Different technological barriers to restoration of mangroves such as having access to enough planting material, equipment, infrastructure and other technological requirements for large-scale restoration work will as limiting factors Ecological barriers like the lack of propagules for natural regeneration and the washing away of any available propagules by tide water have led to none or minimal natural regeneration and these barriers are expected to get worse over time. Social barriers include increased demand for mangroves lands for various non-forestry uses and the excessive and unsustainable use and harvesting of mangroves resources as a source of fodder, fuelwood and the practice of open-range grazing in mangrove forests are responsible for continued	Non-restoration, continued fragmentation, loss and decline of various ecosystem goods and services and hence non-availability of ecosystem benefits to the local communities Inability to improve resource management and efficiency Failure to insure against management failures in resource conservation and sustainable management Inability to facilitate stakeholders' involvement in resources restoration and conservation Increased possibilities of further landscape degradation and shoreline erosion thereby increased floods and erosion related damages Greater loss of productive agricultural lands due to increase salt water intrusion Loss of aquatic and terrestrial biodiversity resources including reduced fisheries and decreased availability of biodiversity and biodiversity products for societal benefits Increased human-wildlife conflicts Inability to adopt holistic and integrated approach to various natural resources management Problems in approaching and building partnerships with different stakeholders' groups

Focal Issue Aspect	Projected Status in short to medium term	Reasons for the Projected Status	Community well-being and socio-economic impacts
		deforestation and degradation of mangrove forests. There are also land-tenure barriers that contribute to the inability to restore degraded mangrove lands. All of these mangrove lands and inter-tidal areas are state-owned lands and have been declared as State-owned Protected Forests. Therefore, all their property rights vest in the Provincial Government of Sindh Province. With no ownership rights, the local communities have no incentive and therefore not motivated to invest in their restoration.	Communities and other stakeholders lose confidence in their own and other organizations capacities to protect and restore vanishing resources Decrease in Forest, Wildlife and Fisheries staff motivation and organizational pride Inability to enjoy and study nature due to loss of wildlife and other biodiversity resources Loss of potential for tourism development in the area
Unsustainable fishing	Worsen	Increased demand for fishes and shrimps will lead to excessive, illegal and irregular harvesting of these resources and hence their over-exploitation beyond their re-growing abilities. Decrease in fish stocks of different types of fishes will force the fishermen to fish for longer hours and go deeper into the sea to get a constant level of fish catch. Fishermen will also resort to the use of illegal and environmentally harmful fishing nets and fishing methods. These practices will keep on continuing due to poor and inadequate law enforcement. Higher and rising costs of fishing will push fishing communities into further debt and thus at the mercy of middlemen and creditors who will keep on exploiting these poor fishermen in different ways including charging of higher interest rates. This will further force the fishermen to	

Focal Issue Aspect	Projected Status in short to medium term	Reasons for the Projected Status	Community well-being and socio-economic impacts
		the adoption of unsustainable fishing practices.	
Human-wildlife conflict	Worsen	Growth in human population and loss of wildlife habitat will lead to greater human-wildlife conflict. Due to lack of awareness and inadequate comprehension of the value of biodiversity and wildlife, many community members kill or capture wildlife on account of these being considered dangerous, poisonous and otherwise harmful and damaging to humans, their livestock, poultry, crops and pet animals. Some wildlife is hunted or captured for trade and as a source of livelihood for certain particular segments of society. Increased vehicular traffic and indifferent attitude is killing many crawling wildlife species. Increased poverty levels in the local communities force them to resort to over-exploitation of biodiversity and its various parts. Poor law enforcement means that there will be less prevention, detection, apprehension, investigation and prosecution of wildlife offenders.	

Appendix 3.1.2 Community Groups Identified for CCB Standard Community Impact Monitoring

Purpose		Groups Identified for CCB Standard Community Impact Monitoring	Additional Groups Identified for Community Gold Level Impact Monitoring
Community benefits	For demonstrating	Community and Community Groups:	Community Groups that are marginalized and/or vulnerable and women:

Purpose		Groups Identified for CCB Standard Community Impact Monitoring	Additional Groups Identified for Community Gold Level Impact Monitoring
	"net positive benefits"	• General community • Coastal fishing communities • Coastal communities engaged in agriculture and crop husbandry • Coastal communities engaged in livestock raising • Coastal communities engaged in daily wage labour • Women and Youth • Wildlife poachers and livestock grazers	• Marginalized and poor • Women
	For demonstrating "no harm to stakeholders	Other Stakeholders: • Traders, Middlemen and Employers • Upstream Dwellers	Smallholders/Community Members (households) that are marginalized and/or vulnerable: • Smallholder/Landless Group • Women
	For demonstrating "no harm to High Conservation Values	Communities and Community Groups (for ecosystem services derived at a local level): • General community • Coastal fishing communities • Coastal communities engaged in agriculture and crop husbandry • Coastal communities engaged in livestock raising • Coastal communities engaged in daily wage labour • Women and Youth • Smallholder/Landless Group • Smallholder/Landless Group • Wildlife poachers and livestock grazers	
Stakeholder engagement	For demonstrating full and effective engagement	Communities, Community Groups, Women, Marginalized and Vulnerable Members, Other Stakeholders including relevant Government Departments:	

Purpose		Groups Identified for CCB Standard Community Impact Monitoring	Additional Groups Identified for Community Gold Level Impact Monitoring
		• General community • Coastal fishing communities • Coastal communities engaged in agriculture and crop husbandry • Coastal communities engaged in livestock raising • Coastal communities engaged in daily wage labour • Women and Youth • Smallholder/Landless Group • Smallholder/Landless Group • Wildlife poachers and livestock grazers • Traders, Middlemen and Employers • Upstream Dwellers • Relevant Government Department, such as Forests, Wildlife and Fisheries	

Appendix 3.2. CCB Biodiversity Monitoring Plan

Activity area 1 – Mangrove restoration / Habitat improvement									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When First Monitoring Report Work/ Survey Done?	Where?	This Monitoring Period Result/ Outcome
Increase in habitat area	By 2027, restore 226,378 hectares of degraded and de-vegetated mangrove areas through ARR activities	BIA001	# of hectares of degraded and de-vegetated mangrove lands restored	Output	Satellite imagery analysis and field checking/verification, Internal progress and survey reports	GIS and field operations team	Annually Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Area	9,909 ha of degraded and de-vegetated mangrove lands have been restored during M-2 period. Cumulative restored land so far from project start date is 83,034 ha.
		BIA002	# of hectares of restored forests through natural re-generation	Outcome	Satellite imagery analysis and field checking/verification, Internal progress and survey reports	GIS and field operations team	Annually Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Area	All the 83,034 ha of forests that have been restored so are benefiting from the natural regeneration which in fact is assisted natural regeneration.

Activity area 1 – Mangrove restoration / Habitat improvement									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When First Monitoring Report Work/ Survey Done?	Where?	This Monitoring Period Result/ Outcome
		BIA003	Species coming in through natural re-generation	Outcome	Field flora surveys, Internal progress and survey reports	Field operations team	Annually Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Area	Indigenous mangrove species such as *Avicennia marina, Ceriops tagal* and *Aegiceras corniculatum* are coming at different sites through natural re-generation.
		BIA004	# of hectares of restored forests with crown cover now reaching 50%	Outcome	Satellite imagery analysis and field checking/verification, Internal progress and survey reports	GIS and field operations team	Annually Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Area	28,688 ha of restored forests have their crown cover now reaching 50%.

Activity area 1 – Mangrove restoration / Habitat improvement									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When First Monitoring Report Work/ Survey Done?	Where?	This Monitoring Period Result/ Outcome
		BIA005	List of key threatened species of mammals and birds as given in Table A18.2 and Table A18.5 in PD.	Outcome	Field checking and faunal surveys, Internal progress and survey reports	Biodiversity Impact Assessment team	Every three years. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Area	The following threatened and vulnerable species of mammals and birds are now increasing in number: Indian Ocean Humpback Dolphin Fishing Cat Egyptian Vulture
		BIA006	# and abundance of plant species in restored forests	Outcome	Field checking and vegetation surveys, Internal progress and survey reports	Biodiversity Impact Assessment team	Every three years. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Area	The following 4 mangrove species are now found in restored forests with their respective proportion/ percentage given in brackets in front of each species:

Activity area 1 – Mangrove restoration / Habitat improvement									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When First Monitoring Report Work/ Survey Done?	Where?	This Monitoring Period Result/ Outcome
									Avicennia marina (49.75 %) Rhizophora mucronata (50.00 %) Ceriops tagal (0.15 %) Aegiceras corniculatum (0.10%) Some other shrubby and grass vegetation species have also come in the restored areas.
		BIA007	# of hectares of restored forests with signs of grazing	Outcome	Field checking and survey reports, Internal progress and survey reports	Field operations team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February	Project Area	0 ha of restored mangrove forests have signs of grazing.

Activity area 1 – Mangrove restoration / Habitat improvement									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When First Monitoring Report Work/ Survey Done?	Where?	This Monitoring Period Result/ Outcome
							2023.		
		BIA008	# of hectares of restored forests with signs of damage to vegetation	Outcome	Field checking and survey reports, Internal progress and survey reports	Field operations team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Area	0 ha of restored mangrove forests with signs of damage to vegetation.
		BIA009	# of hectares of forests with invasive and non-native species	Outcome	Field checking and surveys, Internal progress and survey reports	Biodiversity Impact Assessment team	Every three years. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Area	0 ha of forests with invasive and non-native species.

Activity area 1 – Mangrove restoration / Habitat improvement									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When First Monitoring Report Work/ Survey Done?	Where?	This Monitoring Period Result/ Outcome
		BIA010	Presence, abundance and distribution of key HCVs	Impact	Field checking and surveys, Internal progress and survey reports	Biodiversity Impact Assessment team	Every three years. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Area	HCV-1, HCV-2 and HCV-3 Areas have increased. Their presence, abundance and distribution is given in the HCVs mapped provided in this Monitoring Report.
	By 2027, initiatives are undertaken in support of advocacy for release of environmental water flows into the Indus Delta	BIA011	# of advocacy initiatives undertaken to advocate for release of environmental water flows into the Indus Delta	Output	Field checking and surveys, Internal progress and survey reports	Biodiversity Impact Assessment team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	This is a future activity. Therefore, not assessed at the time of this First Monitoring Report.

Activity area 1 – Mangrove restoration / Habitat improvement									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When First Monitoring Report Work/ Survey Done?	Where?	This Monitoring Period Result/ Outcome
		BIA012	# No. of advocacy initiatives undertaken to advocate to monitor and measure by concerned agencies for release of environmental water flows into the Indus Delta	Output	Field checking and surveys, Internal progress and survey reports	Biodiversity Impact Assessment team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	This is a future activity. Therefore, not assessed at the time of this First Monitoring Report.
		BIA013	# of research studies undertaken to assess the economic, social and environmental consequences of reduced release of fresh water into the Indus Delta	Output	Field checking and surveys, Internal progress and survey reports	Biodiversity Impact Assessment team	Annually.	Project Zone	This is a future activity. Therefore, not assessed at the time of this First Monitoring Report.

Activity area 1 – Mangrove restoration / Habitat improvement									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When First Monitoring Report Work/ Survey Done?	Where?	This Monitoring Period Result/ Outcome
		BIA014	# of advocacy initiatives undertaken to advocate for Environmental Fiscal Reforms in the Indus Delta	Output	Field checking and surveys, Internal progress and survey reports	Biodiversity Impact Assessment team	Annually	Project Zone	This is a future activity. Therefore, not assessed at the time of this First Monitoring Report.

Activity area 2 – Habitat security enhancement / Effective enforcement of laws									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
Decrease in direct threats to mangroves, wildlife and fisheries	By 2027, at least 15 Mangrove Stewardship Agreements (MSAs) have been executed for all newly	BIA015	# of Mangrove Stewardship Agreements executed with the communities	Output	Copies of agreements, Internal progress reports	Field operations team	Annually Second Monitoring Report related preparatory	Project Zone	150 (147 male and 3 female) number of Mangrove Stewardship Agreements have been executed with

Activity area 2 – Habitat security enhancement / Effective enforcement of laws									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
	restored mangrove areas						and field work was done from 01 September 2022 to 28 February 2023.		the communities.
	By 2027, Biodiversity and HCVs Conservation Agreements (BHCAs) have been executed with the relevant communities	BIA016	# of BHCAs executed with local communities	Output	Copies of agreements, Internal progress reports	Field operations and biodiversity teams	Annually.	Project Zone	This is a future activity. Therefore, not assessed at the time of this First Monitoring Report.
	By 2027, working relationships have been established by Sindh Forest and Wildlife	BIA017	# of meetings held	Output	Communications and meetings records, Internal progress report of Sindh Forest and Wildlife	Sindh Forest and Wildlife Department	Annually. Second Monitoring Report related preparatory	Project Zone	A meeting has been held by the Sindh Forest Department with the Sindh

Activity area 2 – Habitat security enhancement / Effective enforcement of laws									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
	Department with the Provincial Sindh Fisheries Department/ Marine Fisheries Department and local fishing communities for protecting fish biodiversity				Department		and field work was done from 01 September 2022 to 28 February 2023.		Fisheries Department for better protection of fish species.
	By 2027, initiatives undertaken in support of responsible and sustainable fishing	BIA018	18 indicators in Community Monitoring Plan (SIA022-SIA039)						The Progress report on these indicators (SIA022 to SIA039) has been given in the CCB Community Monitoring Plan in Appendix 3.1
	By 2022, regular mangroves protection, biodiversity and	BIA019	# of patrols, discussion sessions and meetings held	Output	Patrols and discussion sessions records, Internal progress report of Sindh	Sindh Forest and Wildlife Department and Community	Annually. Second Monitoring Report	Project Zone	On average 4 monthly patrols, discussion sessions and meetings with

Activity area 2 – Habitat security enhancement / Effective enforcement of laws									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
	HCVs conservation related patrols, discussions sessions held with local communities				Forest and Wildlife Department	outreach and Biodiversity Impact Assessment teams	related preparatory and field work was done from 01 September 2022 to 28 February 2023.		the locals are held in support of mangroves, biodiversity and HCVs conservation.
	By 2022, regular training and capacity building in effective laws enforcement held with Forest and Wildlife Department staff and local communities	BIA020	# of training and capacity building sessions and meetings held	Output	Training and capacity building sessions records, Internal progress report of Sindh Forest and Wildlife Department	Sindh Forest and Wildlife Department and Community outreach and Biodiversity Impact Assessment teams	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	These meetings and training and capacity building measures are regularly held on a monthly basis with the local communities for effective implementation of laws and improved protection of mangroves, biodiversity and HCVs.

Activity area 2 – Habitat security enhancement / Effective enforcement of laws									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
	By 2027, at least 15 Fish Stewardship Agreements (FSAs) have been executed with communities	BIA021	# of FSAs executed with the communities	Output	Copies of agreements, Internal progress reports	Field operations team	Annually.	Project Zone	This is a future activity. Therefore, not assessed at the time of this First Monitoring Report.
		BIA022	# of offence cases of biodiversity and illegal, unregulated and unsustainable fishing apprehended	Outcome	Internal progress reports of concerned agencies	Field operations team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	Due to effective engagement and participation of local communities as stewards of mangroves and other natural resources, greater number of patrols and better coordination between the different stakeholder

Activity area 2 – Habitat security enhancement / Effective enforcement of laws									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
									groups as well as strict enforcement of laws, there have been no offence cases which needed legal action.
		BIA023	Development and maintenance of a database for data collection and management on biodiversity and sustainable fishing	Output	Internal progress reports of concerned agencies	Field operations team	Annually.	Project Zone	This is a future activity. Therefore, not assessed at the time of this First Monitoring Report.
	By 2027, at least 50 percent of the Personnel and 20 percent of community members	BIA024	# of persons trained and capacitated	Outcome	Trainings and capacity buildings sessions records, Internal progress report of Sindh Forest and Wildlife Department	Sindh Forest and Wildlife Department and Community outreach and Biodiversity	Annually. Second Monitoring Report related preparatory and field	Project Zone	18 number of Sindh Forest Department staff and 378 number of community members have been trained

Activity area 2 – Habitat security enhancement / Effective enforcement of laws									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
	trained in mangroves, biodiversity and HCVs conservation					Impact Assessment teams	work was done from 01 September 2022 to 28 February 2023.		and capacitated on various aspects of project implementation, monitoring and evaluation. These among others have included field safety measures, mangrove biomass carbon assessments, soil carbon assessments, conduct of SBIAs and participatory rural appraisals including household surveys. Training on conducting biodiversity assessments have also been

Activity area 2 – Habitat security enhancement / Effective enforcement of laws									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
									provided to staff members.
	By 2027, the whole of the Project Area boundary is demarcated, protected and properly maintained	BIA025	% of Project Area boundary with boundary pillars erected, maintained and protected	Output	Project Area boundary pillars records register, Internal progress report of Sindh Forest and Wildlife Department	Sindh Forest and Wildlife Department and Field operations team	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Area	100 % of the Project Area boundary has been surveyed, its GPS coordinates have been taken and maps of the Project Area have been prepared. All this information is fully documented properly archived. Regularly monitoring of the Project Area boundary is done as part of the patrol exercises.
	By 2027, 100 % of the HCVs areas are	BIA026	% of HCVs Areas conserved and	Impact	Satellite imagery analysis and field checking/	Sindh Forest and Wildlife Department	Annually. Second	Project Area	100 % of the HCVs Areas have been

Activity area 2 – Habitat security enhancement / Effective enforcement of laws									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
	brought under a proper management system		brought under a sustainable management system		verification Internal progress reports, Biodiversity Impact Assessment study reports	and Biodiversity Impact Assessment team	Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.		conserved and brought under sustainable management system.
	By 2027, Biodiversity and HCVs Conservation Agreements (BHCAs) have been executed with the relevant communities	BIA027	# of BHCAs executed with local communities	Output	Copies of agreements, Internal progress reports	Field operations and Biodiversity Impact Assessment teams	Annually.	Project Zone	This is a future activity. Therefore, not assessed at the time of this First Monitoring Report.
	By 2027, working relationships have been	BIA028	# of meetings held	Output	Communications and meetings records, Internal progress	Sindh Forest and Wildlife Department	Annually.	Project Zone	This is a future activity. Therefore, not assessed at the

Activity area 2 – Habitat security enhancement / Effective enforcement of laws									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
	established by Sindh Forest and Wildlife Department with the Provincial Sindh Fisheries Department/ Marine Fisheries Department and local fishing communities for protecting fish biodiversity				report of Sindh Forest and Wildlife Department	team			time of this First Monitoring Report.

Activity area 3 – Species and habitat conservation / Controlling unsustainable use of resources									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
Reduced incidences of unsustainable	By 2022, unregulated open-range	BIA029	# of families using stall feeding for	Output	Families and household surveys,	Field operations team	Annually.	Project Zone	Livestock related activities are planned for future.

Activity area 3 – Species and habitat conservation / Controlling unsustainable use of resources									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
use of resources	grazing practices are stopped		livestock		Internal progress and families/ household surveys reports				Therefore, the number of families who have reported that they are now also using stall feeding for livestock has not been assessed at this stage.
		BIA030	% of mangrove forests with controlled and streamlined grazing practices	Outcome	Field checking and surveys, Internal progress and survey reports	Field operations team	Annually.	Project Zone	100% of the mangrove forests are now with controlled and streamlined grazing practices.
	By 2022, at least 50% of the creek communities' households are using alternative sources of energy	BIA031	% of households using solar heaters for energy purposes	Output	Household surveys, Internal progress and surveys reports	Field operations and Biodiversity Impact Assessment teams	Annually.	Project Area	This is a future activity. Therefore, not assessed at the time of this First Monitoring Report.

Activity area 3 – Species and habitat conservation / Controlling unsustainable use of resources									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
		BIA032	# of plants planted under agroforestry system to meet fuelwood demand	Output	Field checking and planting records, Internal progress and surveys reports	Field operations and Biodiversity Impact Assessment teams	Annually.	Project Area	This is a future activity. Therefore, not assessed at the time of this First Monitoring Report.
		BIA033	% of households using fuel-efficient cooking stoves	Output	Household surveys, Internal progress and surveys reports	Field operations and Biodiversity Impact Assessment teams	Annually.	Project Area	This is a future activity. Therefore, not assessed at the time of this First Monitoring Report.
	By 2027, 100% of the Project Area Mangrove Forests are managed under an approved management plan	BIA034	% of mangrove forests under approved forest management plan	Outcome	Record of preparation and approval of forest management, Internal progress reports	Field operations and Biodiversity Impact Assessment teams	Annually. Second Monitoring Report related preparatory and field work was done from 01 September	Project Area	100% of the mangrove forests are now under approved forest management plan.

Activity area 3 – Species and habitat conservation / Controlling unsustainable use of resources									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
							2022 to 28 February 2023.		
	By 2022, a monitoring plan is developed and under implementation for monitoring of biological and ecological factors and recovery criteria (such as population, demographics, habitat existence and securement) of rare, endemic, vulnerable, threatened and endangered species found in the Project Area	BIA035	Analysis of data for signs of increasing trend in populations of rare, endemic, vulnerable, threatened and endangered species	Outcome	Field checking and surveys, Internal progress and survey reports	Field operations and Biodiversity Impact Assessment teams	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Area	This has been done as part of the study undertaken by Third Party independent Biodiversity Auditor and Project Biodiversity Impact Assessment Team. They have reported increasing trend in the population of rare, endemic, vulnerable, threatened and endangered species of all categories including bird species (60 more

Activity area 3 – Species and habitat conservation / Controlling unsustainable use of resources									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
									bird species compared to M-1, mammal species (4 more mammal species when compared with M-1), 1 more reptile species and 37 more fish species in comparison to M-1 period assessment. Not only there is increase in the number of species, but the populations of existing faunal species of these categories of wildlife have also increased substantially.
	By 2021, a monitoring plan is developed and under	BIA036	Analysis of data for signs of increasing trend in	Outcome	Field checking and surveys, Internal progress and	Field operations and Biodiversity	Annually. Second Monitoring	Project Area	This has been done as part of the study undertaken by

Activity area 3 – Species and habitat conservation / Controlling unsustainable use of resources									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
	implementation for monitoring of biological and ecological factors and recovery criteria (such as population, demographics, habitat existence and securement) over-time trend of key threatened species		population of keystone and flagship species		survey reports	Impact Assessment teams	Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.		Third Party independent Biodiversity Auditor. They have reported increasing trend in the population of keystone and flagship species as per details in Appendices 9 to 14 of this MR-2 document.
	By 2027, there is at least 50% decrease in incidence of wildlife killing from 2021 levels	BIA037	# of rangers employed	Output	Field checking and surveys, Internal progress and survey reports	Field operations and Biodiversity Impact Assessment teams	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February	Project Area	168 (18 Forest Department and 150 community members) number of Forest Department staff and other community rangers are protecting the restored areas.

Activity area 3 – Species and habitat conservation / Controlling unsustainable use of resources									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
							2023.		
		BIA038	# of wildlife patrols undertaken	Outcome			Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.		Mangrove and wildlife and biodiversity conservation patrols are undertaken in a participatory manner by the staff of Sindh Forest Department and local communities. On average 4 number of patrols are undertaken on a monthly basis.
		BIA039	# of reported cases of Human-Wildlife conflict	Outcome			Annually. Second Monitoring Report related preparatory		There have been no reported cases of human-wildlife conflict during this monitoring period.

Activity area 3 – Species and habitat conservation / Controlling unsustainable use of resources									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
							and field work was done from 01 September 2022 to 28 February 2023.		
		BIA040	% Change in the incidence of wildlife killing	Impact			Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.		There has been 85 % reduction in the incidence of wildlife killing.

Activity area 4 – Awareness raising and advocacy									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
Greater appreciation and awareness of wildlife and biodiversity benefits	By 2022, 50% of households demonstrate a greater appreciation for wildlife, biodiversity and HCVs conservation	BIA041	# of awareness and sensitisation meetings	Output	Proceedings of meetings held, Internal progress reports	Community outreach and Biodiversity Impact Assessment teams	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Area	6 number of awareness and sensitization meetings have been held in the form of SBIA workshops and training in ecological restoration of wetlands and coastal and marine biodiversity conservation
		BIA042	# of community members attending awareness and sensitisation meetings	Output	Proceedings of meetings held, Internal progress reports	Community outreach and Biodiversity Impact Assessment teams	Annually. Second Monitoring Report related preparatory and field	Project Area	378 community members from 52 number of villages have participated in these awareness

Activity area 4 – Awareness raising and advocacy									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
							work was done from 01 September 2022 to 28 February 2023.		and sensitization meetings.
		BIA043	% of households with greater awareness about importance of conservation of biodiversity and HCVs	Impact	Household surveys conducted, Household surveys reports	Community outreach and Biodiversity Impact Assessment teams	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Area	85 % of households have greater appreciation and awareness about the importance of conservation of biodiversity and HCVs.
Advocacy work in support of release of environmental	Liaison and linkages development with academia	BIA044	# of communication events, meetings and	Output	Communications and meetings records, Proceedings of	Community outreach and Biodiversity Impact	Annually. Second Monitoring Report	Project Area	This is a future activity. Therefore, no assessment

Activity area 4 – Awareness raising and advocacy									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
water flows to the delta and declaration of Marine Protected Zone	and other organisations for advocacy regarding release of environmental water flows to the delta area		discussion held		meetings held, Internal progress reports	Assessment teams	related preparatory and field work was done from 01 September 2022 to 28 February 2023.		has been done in this First Monitoring Report.
	Liaison and linkages development with academia, other organisations, policy makers and legislatures held for declaration of Marine Protected Zone	BIA045	# of communication events, meetings and discussions held	Output	Communications and meetings records, Proceedings of meetings held, Internal progress reports	Sindh Forest and Wildlife Department	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	One consultative session has been held between Sindh Forest Department, Wildlife Department and Sindh Fisheries Department and local communities to discuss various

Activity area 4 – Awareness raising and advocacy									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
									options for the declaration of Marine Protected Zone in the Indus Delta Area on a pilot basis.
	By 2027 a declaration of Marine Protected Zone	BIA046	Declaration notification issued	Impact	Notification by competent authority as given in internal progress reports	Sindh Forest and Wildlife Department	Annually.	Project Zone	This is a future activity. Will be assessed after a decision is taken for the establishment of Marine Protected Zone.

Activity area 5 – Adaptation benefits for biodiversity									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
Increase in adaptation benefits for biodiversity	By 2027, 100 % of community members are reporting presence of or increased biodiversity adaptation benefits	BIA047	Number of community members in the Project Zone reporting presence or increased number of endemic, rare, vulnerable, threatened and endangered species	Impact	PRAs, Biodiversity Surveys and reports	Community outreach and Biodiversity Impact Assessment teams	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	6,250 number of community members in the Project Zone have reported presence or increased number of endemic, rare, vulnerable, threatened and endangered species.
		BIA048	Number of community members in the Project Zone reporting presence or increased extent of landscape level ecosystems and mosaics that are	Impact	PRAs, Biodiversity Surveys and reports	Community outreach and Biodiversity Impact Assessment teams	Annually. Second Monitoring Report related preparatory and field work was done from 01	Project Zone	6,250 number of community members in the Project Zone have reported presence or increased extent of landscape level ecosystems and

Activity area 5 – Adaptation benefits for biodiversity									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
			characteristic of wetlands landscapes				September 2022 to 28 February 2023.		mosaics that are characteristic of wetlands landscapes
		BIA049	Number of community members in the Project Zone reporting presence or increased extent of rare, threatened or endangered ecosystems, habitats or refugia	Impact	PRAs, Biodiversity Surveys and reports	Community outreach and Biodiversity Impact Assessment teams	Annually. Second Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.	Project Zone	6,250 number of community members in the Project Zone have reported presence or increased extent of rare, threatened or endangered ecosystems, habitats or refugia
		BIA050	Number of community members in the	Impact	PRAs, Biodiversity Surveys and	Community outreach and Biodiversity	Annually. Second	Project Zone	6,250 number of community members in the

Activity area 5 – Adaptation benefits for biodiversity									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
			Project Zone reporting presence or increased extent of at least one dimension of Key Biodiversity Areas such as increased ecological integrity, biological processes or irreversibility dimension, etc.		reports	Impact Assessment teams	Monitoring Report related preparatory and field work was done from 01 September 2022 to 28 February 2023.		Project Zone have reported presence or increased extent of at least one dimension of Key Biodiversity Areas such as increased ecological integrity, biological processes or irreversibility dimension, etc.
		BIA051	Number of community members in the Project Zone reporting presence or increased extent of trigger species, threatened or geographically restricted biodiversity or	Impact	PRAs, Biodiversity Surveys and reports	Community outreach and Biodiversity Impact Assessment teams	Annually. Second Monitoring Report related preparatory and field work was done from 01 September	Project Zone	6,250 number of community members in the Project Zone have reported presence or increased extent of trigger species, threatened or geographically restricted

Activity area 5 – Adaptation benefits for biodiversity									
Key results	SMART objective	Code	Indicator	Indicator type	Data collection method	Who?	Frequency and When MR-1 Survey Done?	Where?	This Monitoring Period Result/ Outcome
			reduced threat status				2022 to 28 February 2023.		biodiversity or reduced threat status.

Appendix 3.2.1: Monitoring results for various biodiversity and biodiversity adaptation benefits

Project Intervention	Biodiversity Benefit and Biodiversity Adaptation Benefit	Related Biodiversity Monitoring Plan Indicator (s)	Biodiversity Impact Assessment			HCV Impact Assessment			Impact Assessment Method
			Positive Impact	Negative Impact	Net Positive Impact	Positive Impact	Negative Impact	Net Impact	
Upscaled ARR and ANR over an area of 9,909 ha during M-2 period and 83,034 from the project start date	Increase in habitat area: Baseline value = 0 ha First Monitoring Report value = 73,125 ha Second Monitoring Report value =83,034 ha	BIA001 through BIA010	Yes	No	Yes	Yes	No	Yes	Biodiversity Impact Assessment Field Survey and Participatory Community Discussions
	Increase in habitat quality on account of habitat supporting functions of shelter provision, feeding and breeding places: Baseline value: 0 % Monitoring time value = 100%		Yes	No	Yes	Yes	No	Yes	-do-
	Increase in habitat range, character and resilience Baseline value = 0% Monitoring time value = 100 %		Yes	No	Yes	Yes	No	Yes	-do-

	Increase in habitat species diversity: Baseline value: Limited mangrove species at individual sites Faunal diversity also limited Monitoring period Value: Species diversity: Mangrove species diversity at individual sites has substantially increased Avifaunal species diversity increased from 21 species in the baseline, 29 during M-1 to 89 species in M-2 period. Fish and shrimp species diversity increased from 22 species during M-1 to 59 species during M-2. Mammal species diversity increased from 7 species during M-1 to 11 number of species during M-2. Reptiles species diversity increased from 4 species to 5 species during M-2 period as compared to M-1 period		Yes	No	Yes	Yes	No	Yes	-do-

Project Intervention	Biodiversity Benefit and Biodiversity Adaptation Benefit	Related Biodiversity Monitoring Plan Indicator (s)	Biodiversity Impact Assessment			HCV Impact Assessment			Impact Assessment Method
			Positive Impact	Negative Impact	Net Positive Impact	Positive Impact	Negative Impact	Net Impact	
	Contribution to habitats sites diversity: Baseline value = 0% Monitoring time value = 100%		Yes	No	Yes	Yes	No	Yes	-do-
	Contribution to decrease in habitat fragmentation: Baseline value = 0% Monitoring time value = 100%		Yes	No	Yes	Yes	No	Yes	-do-
	Contribution to habitat connectivity improvement: Baseline value = 0% Monitoring time value = 100%		Yes	No	Yes	Yes	No	Yes	-do-
Participatory planning over an area of 83,034 ha	Increase in stakeholders' engagement: Baseline value = 0% Monitoring time value = 100%	BIA011 through BIA014	Yes	No	Yes	Yes	No	Yes	-do-

Project Intervention	Biodiversity Benefit and Biodiversity Adaptation Benefit	Related Biodiversity Monitoring Plan Indicator (s)	Biodiversity Impact Assessment			HCV Impact Assessment			Impact Assessment Method
			Positive Impact	Negative Impact	Net Positive Impact	Positive Impact	Negative Impact	Net Impact	
Habitat security enhancement over an area of 350,000 ha	Maintenance of habitats, sites and landscape area: Increase of 24% compared to baseline value Maintenance of habitats, sites, and landscapes quality: Increase of 24% compared to baseline value Maintenance of habitats, sites and mosaics of landscapes character and integrity: Increase of 24% compared to baseline value	BIA015 through BIA0019	Yes	No	Yes	Yes	No	Yes	-do-
Reduction in human-wildlife conflict over an area of 350,000	Reduction in direct and indirect threats to wildlife, biodiversity and HCVs loss: Human-wildlife conflict reduced by 24% compared to baseline value	BIA020 through BIA 023 and BIA036 through BIA038	Yes	No	Yes	Yes	No	Yes	-do-
Species and habitat conservation through	Reduction in species loss: There is species maintenance as well as	BIA035	Yes	No	Yes	Yes	No	Yes	-do-

Project Intervention	Biodiversity Benefit and Biodiversity Adaptation Benefit	Related Biodiversity Monitoring Plan Indicator (s)	Biodiversity Impact Assessment			HCV Impact Assessment			Impact Assessment Method
			Positive Impact	Negative Impact	Net Positive Impact	Positive Impact	Negative Impact	Net Impact	
controlling unsustainable biodiversity use over an area of 350,000 ha	enhancement as compared to baseline situation								
Awareness raising and capacity building of around 35,000 people	Increase in awareness about the values of wildlife, biodiversity and HCVs and their ecosystem goods and services: Based on surveys conducted in 52 villages out of a total of 60 coastal villages and 233 villages in lying in 20-kilometer radius of Project Zone, which are about 35,000 people amongst the 43,000 Project Zone communities, 85% of the population of these villages have reported increased awareness and capacity with respect to biodiversity and HCVs conservation	BIA020 BIA024	Yes	No	Yes	Yes	No	Yes	-do-

Project Intervention	Biodiversity Benefit and Biodiversity Adaptation Benefit	Related Biodiversity Monitoring Plan Indicator (s)	Biodiversity Impact Assessment			HCV Impact Assessment			Impact Assessment Method
			Positive Impact	Negative Impact	Net Positive Impact	Positive Impact	Negative Impact	Net Impact	
Social mobilization and organization through establishment of 10 VDCs and 13 WOs	Increase in capacity of stakeholders to conserve, restore and sustainably management biodiversity and HCVs areas: As compared to the baseline situation when none of the community members were mobilized for biodiversity and HCVs related conservation action, at the time of this second monitoring a total of 23 community organizations-male (10 no.) and female (13 no.)- in project zone villages have been sensitized and organized to take actions related to biodiversity and HCVs conservation and sustainable management	BIA020 through BIA024	Yes	No	Yes	Yes	No	Yes	-do-

Project Intervention	Biodiversity Benefit and Biodiversity Adaptation Benefit	Related Biodiversity Monitoring Plan Indicator (s)	Biodiversity Impact Assessment			HCV Impact Assessment			Impact Assessment Method
			Positive Impact	Negative Impact	Net Positive Impact	Positive Impact	Negative Impact	Net Impact	
Habitat and HCVs identification, demarcation mapping over an area of 83,034 ha	Sites identified and available for targeted biodiversity and HCVs related interventions: In the baseline situation no HCVs areas were identified, demarcated and mapped. At the time of this second monitoring report, an area of 83,034 ha has been identified, demarcated and mapped for their different HCVs values	BIA025	Yes	No	Yes	Yes	No	Yes	-do-
Preparation and implementation of habitat management plans over an area of 83,034 ha	Sites identified and demarcated for implementation of habitat management activities: In the baseline there was no habitat management plan. At the time second monitoring report, a habitat management plan has been prepared for 83,034 ha	BIA026 through BIA033	Yes	No	Yes	Yes	No	Yes	-do-

Project Intervention	Biodiversity Benefit and Biodiversity Adaptation Benefit	Related Biodiversity Monitoring Plan Indicator (s)	Biodiversity Impact Assessment			HCV Impact Assessment			Impact Assessment Method
			Positive Impact	Negative Impact	Net Positive Impact	Positive Impact	Negative Impact	Net Impact	
Preparation and implementation of species management plans over an area of 83,034 ha	Sites identified and demarcated for species management related activities: At the time of baseline area under species management plan = 0 ha At the time of this monitoring report, area under species management plan is 83,034 ha	BIA039 through BIA043	Yes	No	Yes	Yes	No	Yes	-do-
Preparation and implementation of HCVs management plans over an area of 83,034 ha	Sites identified and available for implementation of HCVs management plans: In the baseline area under HCVs management plan = 0 ha At the time of second monitoring report, area under HCVs management plan = 83,034 ha	Biodiversity Section 5.2.4	Yes	No	Yes	Yes	No	Yes	-do-

Project Intervention	Biodiversity Benefit and Biodiversity Adaptation Benefit	Related Biodiversity Monitoring Plan Indicator (s)	Biodiversity Impact Assessment			HCV Impact Assessment			Impact Assessment Method
			Positive Impact	Negative Impact	Net Positive Impact	Positive Impact	Negative Impact	Net Impact	
Biodiversity and HCVs monitoring and adaptive management over an area of 83,034 ha	Regular availability of information on the status of biodiversity and HCVs and for any changes in management practices and documentation of lessons learnt: Area in the baseline = 0 ha Area at the time of second monitoring report=83,034 ha	Biodiversity Section 5.4	Yes	No	Yes	Yes	No	Yes	-do-
Impacts on Trigger species, especially Indian Ocean Humpback Dolphin, Fishing Cat, Indian Pangolin and Egyptian Vulture	Increase in the population trends of trigger species: In baseline situation: Population of Indian Ocean Humpback Dolphin = 25 % of the total mammals spotted Bottle nosed Dolphin = 12.5 & of the total mammals spotted Fishing cat = 25 % of the mammals spotted Egyptian Vulture occurrence and density %age = 2.13	BIA045 and Biodiversity Section 5.4.1	Yes	No	Yes	Yes	No	Yes	-do-

Project Intervention	Biodiversity Benefit and Biodiversity Adaptation Benefit	Related Biodiversity Monitoring Plan Indicator (s)	Biodiversity Impact Assessment			HCV Impact Assessment			Impact Assessment Method
			Positive Impact	Negative Impact	Net Positive Impact	Positive Impact	Negative Impact	Net Impact	
	Indian Pangolin = 0 Numbers of the above trigger species at the time of second monitoring report have registered increase as follows: Indian Ocean Humpback Dolphin = 60 % Bottle-nosed Dolphin = 25 % Fishing Cat = 32% Egyptian Vulture = 4.0 % Increased numbers reported by locals								
Preparation and implementation of adaptation benefits enhancement plan	Increase in the availability of adaptation benefits for biodiversity: As compared to baseline situation, all the communities surveyed in the 52 project zone villages have reported increase in the following biodiversity adaptation benefits: presence or increased number of endemic, rare,	BIA045 through BIA048	Yes	No	Yes	Yes	No	Yes	-do-

Project Intervention	Biodiversity Benefit and Biodiversity Adaptation Benefit	Related Biodiversity Monitoring Plan Indicator (s)	Biodiversity Impact Assessment			HCV Impact Assessment			Impact Assessment Method
			Positive Impact	Negative Impact	Net Positive Impact	Positive Impact	Negative Impact	Net Impact	
	vulnerable, threatened or endangered species presence or increased extent of landscape level ecosystems and mosaics that are characteristic of wetlands landscapes presence or increased extent of rare, threatened or endangered ecosystems, habitats or refugia presence or increased extent of at least one dimension of Key Biodiversity Areas such as increased ecological integrity, biological processes, or irreversibility dimension, etc.) presence or increased extent of trigger species, threatened or geographically restricted biodiversity or reduced threats status								
Prevention and control of non-	Prevention and control of non-native and alien	Biodiversity Section 5.1.6	Yes	No	Yes	Yes	No	Yes	-do-

Project Intervention	Biodiversity Benefit and Biodiversity Adaptation Benefit	Related Biodiversity Monitoring Plan Indicator (s)	Biodiversity Impact Assessment			HCV Impact Assessment			Impact Assessment Method
			Positive Impact	Negative Impact	Net Positive Impact	Positive Impact	Negative Impact	Net Impact	
native and alien species over an area of 83,034 ha	species: No non-native and alien species observed or reported at the time of monitoring								
Prevention and control of invasive species over an area of 83,034 ha	Prevention and control of invasive species: No invasive species observed or reported	Biodiversity Section 5.1.5	Yes	No	Yes	Yes	No	Yes	-do-
Prevention and control of GMOs over an area of 83,034 ha	Prevention and control of use of GMOs: No use of GMOs observed or reported	Biodiversity Section 5.1.7	Yes	No	Yes	Yes	No	Yes	-do-
Prevention and control of use of harmful chemicals and biological agents over an area of 83,034 ha	Prevention and control of use of harmful chemicals and biological agents: No use of harmful chemicals or biological agents observed or reported	Biodiversity Section 5.1.8	Yes	No	Yes	Yes	No	Yes	-do-
Prevention and control of waste products and pollution over	Prevention and control of pollution due to waste products: No pollution due to waste products		Yes	No	Yes	Yes	No	Yes	-do-

Project Intervention	Biodiversity Benefit and Biodiversity Adaptation Benefit	Related Biodiversity Monitoring Plan Indicator (s)	Biodiversity Impact Assessment			HCV Impact Assessment			Impact Assessment Method
			Positive Impact	Negative Impact	Net Positive Impact	Positive Impact	Negative Impact	Net Impact	
an area of 350,000 ha	from project activities observed or reported								
Offsite biodiversity negative impacts monitoring outside the Project Zone in Korangi and Phitti Creeks	Prevention and control of offsite negative biodiversity impacts: No offsite negative biodiversity impacts observed or reported	Biodiversity Section 5.2.1 and 5.2.2	Yes	No	Yes	Yes	No	Yes	-do-

Appendix 3.3. Projection of Future Conditions in the Baseline and Project Scenarios at the time of Monitoring

The tables below list the key variables determining the future GHG emissions and refer to sections in the PD and MR where results are further elaborated.

Relevant definitions in VMD0019

Types

Process Specific: Variations in the value of the variable are associated with specific actions, ongoing events, or global conditions, rather than with specific locations.

Location Specific: Variations in the value of a variable are tied to a specific location, and typically that the value of the variable changes across the landscape.

Categories

Controlled: Change in a variable is under the control of the project proponent.

Planned: Changes in the value of the variable are under the control of identified agents who are independent of the project proponent.

Systemic. The future value of the variable is systemic if changes in the variable depend primarily on one or more conditions whose future value is not subject to knowable plans, typically because they involve or depend on the actions and influences of unknown actors and/or large-scale systems outside of local control. For instance, cattle grazing intensities in the area may go down if there is a large drop in the price of beef.

Temporal character

Inherent. The variable is an inherent characteristic of the area or the natural processes affecting the area, and therefore the variable existed without human intervention or existed as a result of human actions over a very long period of time in the past (for instance, traditional landscape burning by indigenous peoples).

Caused. The variable is a characteristic which arose as a result of some specific human action at a known time, and therefore has a clear start (for instance, commencement of grazing of domestic sheep in an area).

Projected. The variable is a characteristic which will arise as a result of projected human activities at some time in the future under the baseline scenario (for instance, humans caused deforestation in an area which currently has never been deforested).

Intended. The variable is a characteristic which will arise as a result of the project activities under the project scenario (for instance, emissions from project activities).

Baseline scenario

Step 1: Define the geographic area(s) within which the variable is to be projected

Project Area

Step 2: Identify the scenario under which the variable is to be projected

Baseline scenario

Step 3: Determine the type and category of the variable being projected

See Table A3.3.1

Step 4: Temporal character of the variable

See Table A3.3.1

Step 5: Determination of the steps to be taken to project the future value of the variable

See Table A3.3.1

Table A3.3.1. Type, category and temporal character of variables in the baseline scenario; steps for projections.

Variable	Type	Category	Temporal character	Relevant steps in module[22]
Sediment supply in the Indus Delta	Process specific	Systemic	Caused	Steps 1-6 Step 8-10 Step 13
Freshwater supply in the Indus Delta	Process specific	Systemic	Caused	Steps 1-6 Step 8-10 Step 13
Sea level rise and associated submergence and erosion	Process specific	Systemic	Inherent	Steps 1-6 Step 8-10 Step 13
Natural regeneration	Location specific	Systemic	Inherent	Steps 1-5 Steps 7-10 Step 14
Tree harvesting, grazing	Location specific	Planned	Projected	Steps 1-5 Step 7 Steps 9-10 Step 12

Step 6: Analysis of historic trends for process specific variables

See Table A3.3.2

Table A3.3.2. Historic trends for process specific variables in the baseline scenario.

Variable	Type	Summary and reference to section with elaborated results
Sediment supply in the Indus Delta	Process specific Systemic Caused	Section 3.2.2.2 of PD and Appendix 9 of PD document Extensive engineering works for irrigation purposes between the 1950s and 70s have reduced sediment load of the Indus River. This, together with the extreme levels of wave energy, has caused rapid wave reworking and transgression of the Indus Delta. The end product is a wave-dominated delta, characterised as a transgressive sand body, capped by extensive aeolian dune deposits. The reduced sediment supply has exacerbated the degradation of mangrove habitats.

[22] Following Figure 1 in the module

Freshwater supply in the Indus Delta	Process specific Systemic Caused	See Table A9.1 in Appendix 9 of PD The Indus Delta receives its fresh water and sediment supply from the Indus River, which flows through the delta before reaching the Arabian Sea. The Indus Delta shelf is 150 km wide and receives minimal rainfall during the monsoon season. The reduced supply of freshwater has exacerbated the degradation of mangrove habitats.
Sea level rise and associated submergence and erosion	Process specific Systemic Inherent	Section Table A9.1 in Appendix 9 of PD The historic trend is not relevant, as it has no predictive value for future sea level rise

Step 7: Analysis of historic trends for location specific variables

See Table A3.3.3

Table A3.3.3. Historic trends for location specific variables in the baseline scenario.

Variable	Type	Summary and reference to section with elaborated results
Natural regeneration	Location specific Systemic Inherent	See Table A9.8 in Appendix 9 of PD This variable is directly assessable through remote sensing. Remote sensing footage shows that due various reasons, natural regeneration of vegetation in the Indus Delta after mangrove habitat degradation is insignificant. There are ecological barriers that hinder the natural re-generation process in the Project Area. These include the non-availability/non-reaching of mangrove propagules to certain areas (particularly high lying areas or those without natural vegetation), flushing out of the propagules out of the site with tide water (especially those of *Avicennia marina* which have smaller propagules), and damage to the degenerated areas on account of biotic pressure in terms of grazing, fodder collection, etc..
Tree harvesting, grazing	Location specific Planned Projected	See Table A9.8 in Appendix 9 of PD Over a number of decades, mangrove forests in the Indus Delta have experienced massive-scale deforestation and degradation due to a number of contributing factors. These include their use by the local communities as a source of fuelwood, fodder and open range grazing by livestock.

Step 8: Determine the drivers and agents influencing the variable

See Table A3.3.4

Step 9: Reassess the category of variable being projected

No changes

Step 10 Analysis of constraints to future values of the variable

See Table A3.3.4

Table A3.3.4. Drivers and agents; constraints to future values of the variables in the baseline scenario.

Variable	Type	Step 8: Drivers and agents	Step 10: Constraints
Sediment supply in the Indus Delta	Process specific Systemic Caused	Section A9.9 in Appendix 9 of PD Upstream activities in the Indus River including construction works, irrigation, under government control.	The main constraint has occurred in the past and no future additional constraints are likely to occur
Freshwater supply in the Indus Delta	Process specific Systemic Caused	Section A9.9 of PD Upstream activities in the Indus River including construction works, irrigation, under government control	The main constraint has occurred in the past and no future additional constraints are likely to occur
Sea level rise and associated submergence and erosion	Process specific Systemic Inherent	Section A9.9 of PD document PD Not relevant	No constraints
Natural regeneration	Location specific Systemic Inherent	Section A9.9**Error! Reference source not found.** of PD Ecological barriers including lack of mangrove propagules, and grazing and fodder collection	The driver is likely to continue in line with the historic trend
Tree harvesting, grazing	Location specific Planned Projected	Section A9.9**Error! Reference source not found.** of PD Local communities using mangroves and its habitat as a source of fuelwood and fodder, and area for grazing by livestock	The driver is likely to continue in line with the historic trend

Step 11: Projection of controlled variables

None

Step 12: Projection of planned variables

See Table A3.3.5

Step 13: Projection of process specific systemic variables

See Table A3.3.5

Step 14: Projection of location specific systemic variables

See Table A3.3.5

Table A3.3.5. Projection of variables in the baseline scenario.

Variable	Type	Step	Results

Sediment supply in the Indus Delta	Process specific Systemic Caused	13	Appendix 9 of PD Sediment supply is likely to continue in line with the historic trend
Freshwater supply in the Indus Delta	Process specific Systemic Caused	13	Section/ Appendix of PD Freshwater supply is likely to continue in line with the historic trend
Sea level rise and associated submergence and erosion	Process specific Systemic Inherent	13	Section / Appendix 9 of PD According to IPCC scenario
Natural regeneration	Location specific Systemic Inherent	13	Section /Appendix 9 of PD Natural regeneration is likely to be thwarted completely, in line with the historic trend
Tree harvesting, grazing	Location specific Planned Projected	12, 14	Section / Appendix 9 of PD Tree harvesting and grazing are likely to continue in line with the historic trend

Project scenario at the time of Monitoring Campaign for preparation of First Monitoring Report

Step 1: Define the geographic area(s) within which the variable is to be projected

Project Area

Step 2: Identify the scenario under which the variable is to be projected

Project scenario

Step 3: Determine the type and category of the variable being projected

See Table A3.3.6

Step 4: Temporal character of the variable

See Table A3.3.6

Step 5: Determination of the steps to be taken to project the future value of the variable

See Table A3.3.6

Table A3.3.6. Type, category and temporal character of variables in the project scenario; steps for projections.

Variable	Type	Category	Temporal nature	Relevant steps in module
Sediment supply in the Indus Delta	Process specific	Systemic	Caused	Steps 1-6 Step 8-10 Step 13
Freshwater supply in the Indus Delta	Process specific	Systemic	Caused	Steps 1-6 Step 8-10 Step 13
Sea level rise and associated	Process specific	Systemic	Inherent	Steps 1-6

submergence and erosion				Step 8-10 Step 13
Vegetation development	Location specific	Controlled	Intended	Steps 1-5 Step 7-10 Step 11
Tree harvesting, grazing	Location specific	Controlled	Intended	Steps 1-5 Step 10 Step 11

Step 6: Analysis of historic trends for process specific variables

See Table A3.3.7

Table A3.3.7. Historic trends for process specific variables in the project scenario.

Variable	Type	Summary and reference to section with elaborated results
Sediment supply in the Indus Delta	Process specific Systemic Caused	See baseline scenario
Freshwater supply in the Indus Delta	Process specific Systemic Caused	See baseline scenario
Sea level rise and associated submergence and erosion	Process specific Systemic Inherent	See baseline scenario

Step 7: Analysis of historic trends for location specific variables

See Table A3.3.8

Table A3.3.8. Historic trends for location specific variables in the project scenario.

Variable	Type	Summary and reference to section with elaborated results
Vegetation development	Location specific Controlled Intended	Sections Table A9.9 of Appendix PD. This variable is directly assessable through remote sensing. Historic trends are not relevant for the project scenario. Natural regeneration of mangrove since the start of the ARR programme in 2015 is not part of the baseline scenario and will be included in the monitoring of the project scenario.

Tree harvesting, grazing	Location specific Controlled Intended	Section Table A9.9 of Appendix 9 of PD.

Step 8: Determine the drivers and agents influencing the variable

See Table A3.3.9

Step 9: Reassess the category of variable being projected

No changes

Step 10 Analysis of constraints to future values of the variable

See Table A3.3.9

Table A3.3.9. Drivers and agents; constraints to future values of the variables in the project scenario.

Variable	Type	Step 8: Drivers and agents	Step 10: Constraints
Sediment supply in the Indus Delta	Process specific Systemic Caused	See baseline scenario	See baseline scenario
Freshwater supply in the Indus Delta	Process specific Systemic Caused	See baseline scenario	See baseline scenario
Sea level rise and associated submergence and erosion	Process specific Systemic Inherent	See baseline scenario	See baseline scenario
Vegetation development	Location specific Controlled Intended	Sections **Error! Reference source not found.**Table A9.9 of PD Project developer	Section 2.4.5; 2.1.20 of PD No constraints other than sufficient funding
Tree harvesting, grazing	Location specific Controlled Intended	Section Table A9.9 Project developer	Section Table 9.9 of PD No constraints to implementing the Mangrove Stewardship Agreement other than sufficient funding

Step 11: Projection of controlled variables

See Table A3.3.10

Step 12: Projection of planned variables

None

Step 13: Projection of process specific systemic variables

See Table A3.3.10

Step 14: Projection of location specific systemic variables

None

Table A3.3.10. Projection of variables in the project scenario.

Variable	Type	Step	Results
Sediment supply in the Indus Delta	Process specific Systemic Caused	13	See baseline scenario
Freshwater supply in the Indus Delta	Process specific Systemic Caused	13	See baseline scenario
Sea level rise and associated submergence and erosion	Process specific Systemic Inherent	13	See baseline scenario
Vegetation development	Location specific Controlled Intended	11	Section Table 9.10 of PD Project developer projects the plantation of some 225,000 hectares of mangrove forest
Tree harvesting, grazing	Location specific Controlled Intended	11	Section Table 9.10 of PD Project developer has Mangrove Stewardship Agreement with communities, which stops tree harvesting and grazing in the project scenario

Appendix 3.4. Strategic Project Intervention Areas/Focal Issues addressed as per Project Theory of Change

Strategic project intervention area/focal issue addressed as per project theory of change	Project activity	Implemented activity	Monitoring indicator/ CCB Monitoring Plan Indicator	Year	Date	Beneficiaries	Impact
Preparatory work for laying the foundations for strategic partnership between Government of Sindh and IDC	MoU between Government of Sindh and IDC	Signing of MoU between Government of Sindh and IDC	Copy of signed MoU	2013	18 February, 2013	Local community, ecology and economy	Preparatory work completed to lay out the foundation for improved coastal resources governance and therefore increased socio-economic well-being of local communities and environmental improvement
Planning of project with the Government of Sindh	Development of broad design features of the project	Discussions between the parties on main design features of the partnership agreement and the project	Draft/ Prototype of agreement between project proponents available	2014	January-December, 2014	Local community, ecology and economy	Agreement on main elements of collaborative and Improved governance arrangements for mangroves restoration and conservation
Formalization of partnership arrangements between project proponents	Project agreement between project proponents	Signing of project agreement between Government of Sindh and IDC	Signed copy of agreement between project proponents	2015	18 February, 2015	Local community, ecology and economy	SDG-17 Strengthened partnership with government for realization of climate, community and biodiversity objectives of the project

Strategic project intervention area/focal issue addressed as per project theory of change	Project activity	Implemented activity	Monitoring indicator/ CCB Monitoring Plan Indicator	Year	Date	Beneficiaries	Impact
Mangrove restoration and conservation	Upscaled ARR	Restoration of 73,466 hectares of degraded mangrove lands	Mangrove restoration and conservation works designed, planned and implemented	2015-2021	2015-2021	Local communities and other stakeholder groups as well as local and regional environment	SDG-13 and 15 Reduced GHG emissions and increased removals as well as mangrove forests and habitat restoration and conservation for increased access to other mangrove ecosystem goods and services
Participatory planning and awareness raising	Participatory planning and awareness raising activities	Free, prior and informed consent (FPIC) meetings with local communities	Signed copies of FPICs agreements with local communities	2015	2015-2018	Local communities and other stakeholder groups	SDG-16 Enhanced community participation and role in mangroves restoration, conservation and sustainable management
Improved mangrove and other coastal and marine resources protection and law enforcement	Institution of effective law enforcement mechanisms	Mangrove Stewardship Agreements (MSAs) agreed and executed with local communities	Signed copies of MSAs	2015-2021	2015-2021	Local communities and other stakeholders, coastal and marine ecology	SDG-13 and 15 Strengthened partnerships with coastal communities and improved mangroves protection and conservation and greater availability of mangrove ecosystem goods and services

Strategic project intervention area/focal issue addressed as per project theory of change	Project activity	Implemented activity	Monitoring indicator/ CCB Monitoring Plan Indicator	Year	Date	Beneficiaries	Impact
Capacities enhancement of communities and other stakeholders	Implement training and capacity building activities	Design, development and implementation of training and capacity building activities	Training and capacity modules developed and trainings imparted	2015-2021	2015-2021	Local communities and other stakeholder groups including Sindh Forest Department	SDG-13 and 15 Greater capacities for coastal resources restoration, conservation and sustainable management as well as increased income earning opportunities and diversified income sources
Project boundary demarcation	Demarcate spatial boundaries of project area	Go over project boundary to delineate the extreme north, west, east and south coordinates of project boundary	Project area extreme boundaries demarcated	2019	September, 2019	Local communities, other stakeholders and project proponents	Coordinates and data available to prepare map for incorporation in PD document
Coastal erosion estimation	RTK surveys for elevation and real time tide data collection	Conduct RTK surveys to obtain data on precise elevation and real time tides	Data available for coastal erosion modelling and estimation	2020	September-October, 2020	Local communities, other stakeholders and project proponents	Data available for modelling and estimation of coastal erosion

Strategic project intervention area/focal issue addressed as per project theory of change	Project activity	Implemented activity	Monitoring indicator/ CCB Monitoring Plan Indicator	Year	Date	Beneficiaries	Impact
Clean and sustainable energy development	Promotion of alternative and clean energy sources	Promote alternative and energy sources through enhancing the buying capacities of local communities to invest in solar energy	Number of community members using solar panels as a source of energy	2015-2021	2015-2021	Local communities and Sindh Forest Department	SDG-7, 13 and 15 Access to clean sources of energy, reduced GHG emissions and reduced pressure on restored and existing mangrove forests as well as improved health especially of women and girls
Climate change adaptation benefits for local communities	Restoration and conservation of mangroves for their HCV 4, 5 and 6 benefits	Restore and conserve mangroves for their community adaptation related benefits	SIA074 to SIA078	2015-2021	2015-2021	Coastal communities in the project zone	SDG-11 and 13 Contribution to HCV-4 and 5 Climate Change Adaptation benefits for communities through increasing community resilience
Climate change adaptation benefits for biodiversity	Restoration and conservation of mangroves for their HCV 1,2 and 3 values		BIA047 to BIA051	2015-2021	2015-2021	Coastal and marine biodiversity in the project zone	SDG-13, 14 and 15 Climate Change Adaptation benefits for biodiversity

Strategic project intervention area/focal issue addressed as per project theory of change	Project activity	Implemented activity	Monitoring indicator/ CCB Monitoring Plan Indicator	Year	Date	Beneficiaries	Impact
Improved community health	Enhance and expand access to health facilities	Provide new health facilities and strengthen existing facilitate for improved and expanded access to health facilities	SIA005 to SIA007	2015-2021	2015-2021	Coastal communities including women and girls and other marginalized groups	SDG-3 Improved community health and reduced cost of living
Access to safe and affordable drinking water and hygiene	Increase access to safe and affordable drinking water	Restore non-functional Reverse Osmosis (RO) plants	SIA008 to SIA010	2015-2021	2015-2021	Coastal communities including women and girls and other marginalized groups	SDG-6 Improved community health and reduced cost of living
Literacy and education	Increased access to education for children	Undertake surveys of schools in the project zone to assess their restoration and facilitation requirement for improved access to education by children	SIA001 to SIA004	2015-2021	2015-2021	Children in the coastal communities including girls	SDG-4 Increased literacy and education and reduced cost of living

Strategic project intervention area/focal issue addressed as per project theory of change	Project activity	Implemented activity	Monitoring indicator/ CCB Monitoring Plan Indicator	Year	Date	Beneficiaries	Impact
Employment opportunities creation	Increase and diversify employment and business opportunities for coastal communities	Create job and business development opportunities for local communities through mangrove restoration and conservation related works as well as other such income enhancing activities	SIA012 to SIA016	2015-2021	2015-2021	All coastal communities and their groups including women and other marginalized groups	SDG-1, 2 and 8 Reduced poverty, increased food security through increased and diversified income earning opportunities
Gender equality and development	Increase gender equity within the family and community	Increase gender equity at different levels through implementation of various gender development activities	SIA044 to SIA047	2015-2021	2015-2021	Women in the coastal communities including girls	SDG-5 Improved income, reduced cost of living, social and economic empowerment of women and girls
Civic facilities	Increase access to civic facilities	Provide/ rehabilitate civic and communal meeting facilities	SIA011	2015-2021	2015-2021	All coastal communities and their groups including women and other marginalized groups	SDG-16 Improved social interactions and opportunities for participatory decision making thereby promoting peace and justice

Strategic project intervention area/focal issue addressed as per project theory of change	Project activity	Implemented activity	Monitoring indicator/ CCB Monitoring Plan Indicator	Year	Date	Beneficiaries	Impact
Social organization	Social organization of men and women into village level community organization	Organize men and women into broad-based village development committees and women organizations respectively	SIA036 and SIA066	2015-2021	2015-2021	All coastal communities and their groups including women and other marginalized groups	SDG-17 Local level institutions building, social capital development and social empowerment including reduced inequalities, less marginalization and increased justice and peace
Awareness raising and capacity building	Awareness raising and training and capacity building events	Organize and implement awareness raising and capacity building meetings, workshops and other events	SIA015, SIA 025, SIA067	2015-2021	2015-2021	All coastal communities and their groups including women and other marginalized groups	SDG-1 and 10 Reduced poverty and reduced inequalities, human capital development and increased opportunities for income earning as well as participation in decision making
Conservation of historical and heritage sites and cultural artefacts	Site assessment visits and interactions for preparation of conservation plan	Undertake site assessment visits to see the feasibility of preparing conservation plans by the concerned entities	SIA070	2015-2021	2015-2021	Nearby coastal communities and other stakeholder groups	Contribution to HCV-6 Conservation of historical, cultural artefacts and heritage sites

Strategic project intervention area/focal issue addressed as per project theory of change	Project activity	Implemented activity	Monitoring indicator/ CCB Monitoring Plan Indicator	Year	Date	Beneficiaries	Impact
Biodiversity and HCVs conservation through habitat improvement	Increase in habitat area	Restore degraded and de-vegetated mangrove lands through mangrove planting and promotion of natural regeneration	BIA001 to BIA010	2015-2020	2015-2020	Coastal communities and biodiversity	SDG-14 and 15 Contribution to HCV-1,2 and 3 Maintenance and enhancement of coastal and marine biodiversity through habitat restoration
Biodiversity and HCVs conservation through habitat security enhancement	Effective laws enforcement	Decrease direct and indirect threats to mangroves, wildlife and fisheries	BIA015, BIA019, BIA020 and BIA030	2015-2020	2015-2020	Coastal communities and biodiversity	SDG-14 and 15 Contribution to HCV-1, 2 and 3 Improved habitat protection for coastal and marine biodiversity conservation
Awareness raising and capacity enhancement for biodiversity conservation	Awareness raising and training and capacity building events in support of biodiversity conservation	Organize and implement awareness raising and capacity building meetings, workshops and other events for biodiversity conservation	BIA041 to BIA045				SDG-14 and 15 Contribution to HCV-1,2 and 3 conservation Greater appreciation and awareness of wildlife and biodiversity benefits as well as reduced human-wildlife conflicts

Strategic project intervention area/focal issue addressed as per project theory of change	Project activity	Implemented activity	Monitoring indicator/ CCB Monitoring Plan Indicator	Year	Date	Beneficiaries	Impact
Adaptation benefits for biodiversity	Increase in adaptation benefits for biodiversity conservation	Increase in number of community members in the project zone understanding, supporting and reporting biodiversity adaptation benefits	BIA047 to BIA051	2015-2020	2015-2020	Coastal communities and biodiversity through protection of endemic, rare, vulnerable, threatened and endangered species; protection of landscape level ecosystems and mosaics that are characteristic of wetland landscapes; protection of rare, threatened or endangered ecosystems, habitats or refugia; increased protection of Key Biodiversity Areas (KBAs); and increased protection of trigger species	SDG-14 and 15 Contribution to HCV-1, 2 and 3 Increase in biodiversity adaptation benefits and increased awareness about these benefits

Strategic project intervention area/focal issue addressed as per project theory of change	Project activity	Implemented activity	Monitoring indicator/ CCB Monitoring Plan Indicator	Year	Date	Beneficiaries	Impact
PD preparation and submission to VERRA for validation	Project documentation completion and submission to VERRA for validation	Prepare PD and submit to VERRA for validation	PD document prepared and validated	2021	January-December, 2021	Communities, other stakeholders and project proponents	Validated PD document available
Project web portal for information access	Access to information about project activities and their impacts	Develop project web portal for information dissemination to communities and other stakeholders	Project web portal is developed and is uploaded with relevant information	2021	January 2021. Maintenance is on-going activity	Communities, other stakeholders and project proponents	Project documents, pictures and maps available in English and local languages for easy access by all interested people
PD document and other project related information dissemination to local communities and other stakeholders	Dissemination of information to communities and other project stakeholders	Prepare relevant summary documents in Urdu and Sindhi language for dissemination to local communities and other stakeholders	Project summary documents prepared and disseminated	2021	March, 2021	Communities, other stakeholders and project proponents	Summary project documents available in local languages for easy comprehension
Partnership with Other Entities	Establish co-operation mechanisms with other relevant conservation organizations like IUCN	Enter into co-operation agreements with other entities for increased conservation impact	Signed copy of co-operation agreement	2021	June, 2021	Communities, other stakeholders including conservation organizations	Linkages developed for greater conservation and community development impact creation

Strategic project intervention area/focal issue addressed as per project theory of change	Project activity	Implemented activity	Monitoring indicator/ CCB Monitoring Plan Indicator	Year	Date	Beneficiaries	Impact
Field work and surveys for biomass carbon estimation for first monitoring report preparation	Conduct of field surveys for biomass carbon estimation for monitoring report preparation	Field measurements and surveys in the Project Area for biomass carbon estimation and coastal erosion estimation for the first monitoring report	Biomass carbon data available for preparation of first monitoring report	2021	September-October, 2021	Communities, other stakeholders and project proponents	Real field data available for ex-post estimation of GHG emission reductions and removals
Field surveys for biodiversity impact assessment for first monitoring report preparation	Conduct of field surveys for biodiversity impact estimation for first monitoring report preparation	Field measurements and surveys in the Project Zone for biodiversity impact estimation for the first monitoring report	Biodiversity data available for preparation of first monitoring report	2021	September-October, 2021	Communities, other stakeholders and project proponents	Real field data available for ex-post estimation of biodiversity impacts of the project
Field surveys for community and socio-economic impact assessment for first monitoring report preparation	Conduct of field surveys for community and socio-economic impact estimation for first monitoring report preparation	Field measurements and surveys in the Project Zone for community and socio-economic impact estimation for the first monitoring report	Socio-economic data available for preparation of first monitoring report	2021	September-November, 2021	Communities, other stakeholders and project proponents	Real field data available for ex-post estimation of community and other stakeholders impacts of the project

Strategic project intervention area/focal issue addressed as per project theory of change	Project activity	Implemented activity	Monitoring indicator/ CCB Monitoring Plan Indicator	Year	Date	Beneficiaries	Impact
PD validation and project registration by VERRA	Liaison with VERRA for project validation and its registration	Liaise with VERRA for project PD validation and project registration	Project PD validated and project registered with VERRA	2022	January, 2022	Local communities, other stakeholders and project proponents	Validated PD and its registration number available on VERRA website
Monitoring report preparation and submission to VERRA	First Monitoring Plan implementation to prepare for verification	Liaise with VERRA for Monitoring Report verification	First Monitoring Report submitted to VERRA for verification	2022	February-March, 2022	Local communities, other stakeholders and project proponents	First Monitoring Report available on VERRA website for comments
Monitoring Report and its information dissemination	Compilation of the Monitoring Report, its results and its summary information and translation of the summary information in local languages for ease of access by local communities and other stakeholders	Disseminate the First Monitoring Report, its results and summary information to local communities and other stakeholders	First Monitoring Report, its results and summary information available and uploaded to VERRA website for comments	2022	March, 2022	Local communities, other stakeholders and project proponents	Monitoring Report, its results and its summary information available on VERRA website for comments by interested parties.
Partnership with Other Entities	Establish co-operation mechanisms	Enter into co-operation agreements with	Signed copy of co-operation agreement	2022	June, 2022	Communities, other stakeholders	Linkages developed for greater conservation and community

Strategic project intervention area/focal issue addressed as per project theory of change	Project activity	Implemented activity	Monitoring indicator/ CCB Monitoring Plan Indicator	Year	Date	Beneficiaries	Impact
	with other relevant conservation organizations like SHINE Humanity and LUAWMS	other entities for increased community development and conservation impact				including conservation organizations	development impact creation
Field work and surveys for biomass carbon estimation for second monitoring report preparation	Conduct of field surveys for biomass carbon estimation for monitoring report preparation	Field measurements and surveys in the Project Area for biomass carbon estimation and coastal erosion estimation for the first monitoring report	Biomass carbon data available for preparation of first monitoring report	2022-2023	September-October, 2022 to February 2023	Communities, other stakeholders and project proponents	Real field data available for ex-post estimation of GHG emission reductions and removals
Field surveys for biodiversity impact assessment for second monitoring report preparation	Conduct of field surveys for biodiversity impact estimation for second monitoring report preparation	Field measurements and surveys in the Project Zone for biodiversity impact estimation for the second monitoring report	Biodiversity data available for preparation of second monitoring report	2022-2023	September-October, 2022 to February 2023	Communities, other stakeholders and project proponents	Real field data available for ex-post estimation of biodiversity impacts of the project
Field surveys for community and socio-economic impact assessment for second	Conduct of field surveys for community and socio-economic	Field measurements and surveys in the Project Zone for community	Socio-economic data available for preparation of	2022-2023	September-November, 2022 to	Communities, other stakeholders and	Real field data available for ex-post estimation of community and other

Strategic project intervention area/focal issue addressed as per project theory of change	Project activity	Implemented activity	Monitoring indicator/ CCB Monitoring Plan Indicator	Year	Date	Beneficiaries	Impact
monitoring report preparation	impact estimation for second monitoring report preparation	and socio-economic impact estimation for the second monitoring report	second monitoring report		February 2023	project proponents	stakeholders impacts of the project
Monitoring Report and its information dissemination	Compilation of the Monitoring Report, its results and its summary information and translation of the summary information in local languages for ease of access by local communities and other stakeholders	Prepare and disseminate the Second Monitoring Report, its results and summary information to local communities and other stakeholders	Second Monitoring Report, its results and summary information available for uploading to VERRA website for comments	2023	June, 2023	Local communities, other stakeholders and project proponents	Monitoring Report, its results and its summary information available for comments by interested parties.
Second Monitoring report preparation and submission to VERRA	Second Monitoring Plan implementation to prepare for verification	Liaise with VERRA for Monitoring Report verification	Second Monitoring Report submitted to VERRA for verification	2023	July, 2023	Local communities, other stakeholders and project proponents	Second Monitoring Report available on VERRA website for comments

Appendix 4: DBC-1 Project Contributions to the achievement of SDGs (See Section 2.1.10)

The DBC-1 Project is contributing to achieving a number of sustainable development themes that the Government of Pakistan has committed to attaining (Government of Pakistan – Ministry of Climate Change, 2016). These themes and the provisions for reporting and monitoring are listed below. In particular, the Project has contributed to the achievement of the following SDGs:

SDG	Examples of relevant SDGs targets	Description of project benefits
SDG 1 "No Poverty" End poverty in all its forms everywhere	1.1 By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day 1.2 By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions 1.4 Ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services. 1.5 By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters	M-2 period: Beneficiaries Men = 2,306 Beneficiaries Women = 140 Total Beneficiaries =2,446 Cumulative: Beneficiaries Men = 13,042 Beneficiaries Women = 1,188 Total Beneficiaries =14,230 • One of the fundamental goals of DBC-1 Project is to reduce poverty through decreasing living costs and increasing incomes of the local communities through restoring degraded mangrove lands, conserving coastal and marine biodiversity, undertaking various community development activities besides demonstrating that development can be a means and partner to biodiversity conservation. As most people in the project zone live on less than $1.25 per day, our project actions are structured to improve local livelihoods by facilitating income-generating activities and reducing the cost of living through providing access to different social services and life necessities close by. The communities targeted by the project are dependent on mangroves and other natural resources goods and services from wetlands. The project supports local communities by involving them in the restoration of degraded mangrove lands, alternative

SDG	Examples of relevant SDGs targets	Description of project benefits
		sources of livelihoods and that will help them become more resilient to climate change. Also, by promoting and building capacity in alternative income-streams and as mangroves stewards (e.g., mangrove propagules collection, storage and planting as well as nurseries raising, and protection of planted mangrove areas, etc.), communities gain increased incomes from restoration, protection and sustainable management of mangrove forests and also greater resilience to and more independence from climate-related shocks and disasters. By encouraging and building capacity in alternative income streams, the project also promotes increased access to financial markets and value-chain links for local fish producers. • The project has provided long-term and sustainable sources of income for communities in economically disadvantaged rural areas. • Income diversification has reduced their reliance on the highly climate vulnerable fishing, agricultural and livestock sectors thereby increasing the resilience of local communities to climate change. This, in turn has contributed to improvements in living conditions in economically disadvantaged rural areas.
SDG 2 "Zero Hunger" End hunger, achieve food security and improved nutrition and promote sustainable agriculture	2.1 By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round. 2.2 By 2030, end all forms of malnutrition, including achieving,	M-2 period: Beneficiaries Men =6,390 Beneficiaries Women = 6,139 Total Beneficiaries =12,529 Cumulative: Beneficiaries Men = 10,954

SDG	Examples of relevant SDGs targets	Description of project benefits
	by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons.	Beneficiaries Women = 10,524 Total Beneficiaries = 21,478 Increased fisheries production beneficiaries due to significant increase in spawning places for fishes, shrimps and other marine life. • Most communities in the project area rely on artisanal fishing, subsistence agriculture and livestock farming and therefore have very low to no income, and often face food scarcity. Restoration of degraded mangrove lands for increased spawning of fish and shrimps and protection of farmlands and grazing lands from erosion and salt water intrusion helps support these poor and marginal communities in food and livelihood security. With increased income from different project activities the project also supports these communities in greater procurement of inputs for fishing, agriculture and livestock related activities as well as in crop diversification, and use of improved crop varieties and livestock inputs for increased food production. These inputs are helping communities grow more food and fodder crops on a smaller amount of land, increasing their crop and livestock productivity and overall incomes. The program supports conservation agriculture through reducing soil erosion, sea water intrusion and is also helping them become more resilient to a changing climate. • Providing additional income have helped them improve food security, as majority of farmers in the project area are dependent on small and

SDG	Examples of relevant SDGs targets	Description of project benefits
		subsistence scale fishing, agriculture and livestock, and extreme weather events currently jeopardize food security and have resulted in stunting of children, among other negative impacts.
SDG 3 "Good Health and Well-being" Ensure healthy lives and promote well-being for all at all ages	3.1 By 2030, reduce the maternal mortality ratio to less than 70 per 100,000 live births 3.2 By 2030, end preventable deaths of new-borns and children under 5 years of age, with the aim to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births 3.3 By 2030, end the epidemics of tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases 3.4 By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being.	M-2 period: Beneficiaries Men = 4,700 Beneficiaries Women = 3,600 Total Beneficiaries =8,300 Cumulative: Beneficiaries Men = 12,162 Beneficiaries Women = 11,262 Total Beneficiaries =23,424 • The project has contributed to the reduction of maternal and new born and children mortality through provision of ambulance for carrying emergency cases to nearby specialist health facilities. • Both male and female population in the Project Zone have been vaccinated against COVID-19 pandemic. • It has provided mobile health facility as well as facilitated a rural health centre through provision of equipment, medicines and other supplies to reduce premature mortality from both communicable and non-communicable diseases through prevention, treatment and promotion of mental health and well-being.
SDG 4 "Quality Education" Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.	4.4 By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.	M-2 period: Beneficiaries Boys = 226 Beneficiaries Girls = 161 Total Beneficiaries = 387 Cumulative: Beneficiaries Boys = 451 Beneficiaries Girls = 322

SDG	Examples of relevant SDGs targets	Description of project benefits
		Total Beneficiaries =773 Boys Schools enrolment = 226 Girls Schools enrolment = 161 Total Schools enrolment = 387 • Foundational surveys of schools (both male and female) have been carried out in the Project Zone to assess the repair, restoration, equipment, teachers and other requirements for increasing the number of youth enrolment in schools and improvement of the learning environment. • DBC-1´s and Sindh Forest Department extension services and technical support supports skill development of men and women of diverse ages and backgrounds to increase and diversify their household income through training them in propagules collection, storage, nurseries raising, planting and effective implementation of Mangrove Stewardship Agreements.
SDG 5 “Gender Equality” Achieve gender equality and empower all women and girls	5.1 End all forms of discrimination against all women and girls. 5.4 Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as locally/nationally appropriate. 5.5 Ensure women’s full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life.	M-2 period: Beneficiaries Men = 7,795 Beneficiaries Women = 4,266 Total Beneficiaries =12,061 Cumulative: Beneficiaries Men = 25,336 Beneficiaries Women = 13,479 Total Beneficiaries = 38,815 M-2 period employment: ARR employment for women = 125 MSAs employment for women = 3

SDG	Examples of relevant SDGs targets	Description of project benefits
		Total women employment =128 Cumulative employment for women: ARR employment for women= 1,152 MSAs empowerment = 6 Total women empowerment: 1,158 • Women play a key role in DBC-1 Project's operations. The project has provided employment and income earning opportunities to 11,656 community members, of which 1,158 are women. • DBC-1 Project operations are open to women and women are engaged in all phases of mangrove restoration work including propagules collection, storage, planting and nurseries raising. • Of the 150 MSAs executed by the project with local communities, 3 are with women. This provides them a stable source of income. • The Project strives to ensure women´s full and effective participation and that women are able to positively benefit from various project activities including restoration of degraded mangrove lands.
SDG 6 "Clean Water and Sanitation" Ensure availability and sustainable management of water and sanitation for all	6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all. 6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations. 6.b Support and strengthen the participation of local	M-2 period: Beneficiaries Men = 250 Beneficiaries Women = 150 Total Beneficiaries = 400 Cumulative: Beneficiaries Men = 500 Beneficiaries Women = 300 Total Beneficiaries = 800

SDG	Examples of relevant SDGs targets	Description of project benefits
	communities in improving water and sanitation management.	• The Project has restored one non-functional Reverse Osmosis (RO) plant and increased access to other 5 RO plants in the Project Zone. This has contributed to the achievement of and ensuring universal and equitable access to safe and affordable drinking water for all. • As a result of project interventions, now 250 male and 150 women have access to affordable and safe drinking water which has also contributed to improved sanitation and hygiene. • The project has supported and strengthened the participation of local communities in improving water and sanitation management.
SDG 7 "Clean Energy" Ensure access to affordable, reliable, sustainable and modern energy for all	7.1 By 2030, ensure universal access to affordable, reliable and modern energy services.	M-2 period survey: Beneficiaries Men = 320 Beneficiaries Women = 140 Total Beneficiaries = 460 Cumulative: Beneficiaries Men = 320 Beneficiaries Women = 140 Total Beneficiaries =460 • With increased income as a result of project activities, some of the communities are now able to buy solar energy system for meeting their lighting needs. As a result, clean energy has come to very rural households. • The project also has a program for the provision of solar energy system for those coastal communities who are living inside the creek areas once carbon finance becomes available for implementation of this program.

SDG	Examples of relevant SDGs targets	Description of project benefits
		• Given the fact that the communities in the area have a low electrification rate and there are possibilities of facilitating them in the procurement and purchase of high-quality solar light on easy terms credit under the Provincial Government Renewable Energy Solar Program business model through development of appropriate linkages and network establishment. These solar lights reduce in the use of non-renewable batteries and wood fuel for fire for light. Having household solar light promotes income generating activities that can be done at night while conserving mangrove forest resources. Women are particularly impacted as there is a reduction in fuelwood collection and households save money by not buying non-renewable batteries. This when adopted in an up-scaled manner will also reduce waste when flashlights and batteries are improperly deposed of within the countryside.
SDG 8 "Economic Growth, Employment and Decent Work" Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	8.1 Sustain per capita economic growth in accordance with local and national circumstances. 8.2 Achieve higher levels of economic productivity through diversification, technological upgrades and innovation, including through a focus on high value added and labour-intensive sectors. 8.4 Improve progressively, through 2030, resource efficiency in consumption and production, and endeavour to decouple economic growth from environmental degradation in accordance with the 10-year framework of programs on	M-2 period: Beneficiaries Men = 2,306 Beneficiaries Women = 140 Total Beneficiaries =2,446 Cumulative: Beneficiaries Men = 13,042 Beneficiaries Women = 1,188 Total Beneficiaries =14,230 Employment opportunities creation through up-scaled ARR and MSAs: Men in ARR = 9,247 Women in ARR = 1,027

SDG	Examples of relevant SDGs targets	Description of project benefits
	sustainable consumption and production. 8.5 By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value. 8.8 Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants and those in precarious employment.	Men in MSAs = 147 Women in MSAs =3 Total men = 1,246 Total women = 128 Total = 1,374 • DBC-1 Project through its various Income Generating Activities (IGAs) creates multiple productive employment, decent work and business opportunities for all (men, women, youth, landless and poor, etc.) in the Project Zone. Examples include up-scaled mangrove restoration activities which have also become a source of numerous ecosystem goods and services from these restored lands, Mangrove Stewardship Agreements, and various socio-economic development activities in health sector, drinking water and construction work sectors. These jobs are designed to increase incomes of individuals, while keeping community members safe and with jobs in and around their settlements. These activities also contribute to SDG 1, but they go beyond this by providing opportunities for next generations to live a new and interesting livelihood with income benefits to stay within their rural village. • Different surveys and assessments undertaken by the Project also provides job opportunities as well as through the extension and education program on conservation and antipoaching. • DBC-1 promotes equal opportunity in employment and strives to eliminate discrimination in any employment policy or practice. It does NOT discriminate

SDG	Examples of relevant SDGs targets	Description of project benefits
		directly or indirectly, against an employee or prospective employee or harass an employee or prospective employee on grounds of race, gender, sexual orientation, language, religion, political or other opinion, nationality, ethnic or social origin, disability, pregnancy, or health status. • It has equal opportunity in respect of recruitment, training, promotion, terms and conditions of employment, termination of employment or other matters arising out of the employment. • Women are employed and paid the same as their men counter parts. • The salaries are based on a liveable fair wage and have provided numerous steady job opportunities for individuals in the region. • The program is based on equal employment rights for all employees, including women, youth and underserved/ underprivileged community groups. • The Project is committed to providing a safe and secure working environment. It has an Occupational Safety and Risk Management Policy and Standard Operating Procedures (SOPs). Policies and procedures are in place for workers protection working in different project activities. Community workers for the project follow Standard Operating Procedures for worker safety in the field. These safety procedures help reduce job risk of project workers.

SDG	Examples of relevant SDGs targets	Description of project benefits
SDG 10 "Reduce Inequalities" Reduce inequality within and among countries and societies	10.2 By 2030, empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status. 10.3 Ensure equal opportunity and reduce inequalities of outcome, including by eliminating discriminatory laws, policies and practices and promoting appropriate legislation, policies, and action in this regard.	M-2 period: Beneficiaries Men = 7,796 Beneficiaries Women = 4,266 Total Beneficiaries =12,062 Cumulative: Beneficiaries Men = 25,336 Beneficiaries Women = 13,479 Total Beneficiaries =38,815 • The project promotes the economic empowerment of men and women smallholder fishermen, landless and poor, and disadvantaged group, among others. • It follows and promotes equal opportunities, and inclusive engagement in project interventions for all and has put in place policies and SOPs that eliminate all forms of discrimination, thereby contributing to reduction of inequalities.
SDG 11 "Safe, resilient and sustainable living environment" Make cities and human settlements inclusive, safe, resilient and sustainable	1.1 By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums. 11.3 By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management. 11.4 Strengthen efforts to protect and safeguard the world's cultural and natural heritage. 11.5 By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.	M-2 period: Beneficiaries Men = 1,405 Beneficiaries Women = 1,350 Total Beneficiaries =2,755 Cumulative: Beneficiaries Men = 12,290 Beneficiaries Women = 11,809 Total Beneficiaries =24,099 Safe living conditions for communities through protection from storm surges, flooding, etc. • The Project through its up-scaled restoration work has protected the communities and their settlements, lands and other assets and sources of income and livelihood earnings from the vagaries of climate change through controlling and reducing land loss and soil

SDG	Examples of relevant SDGs targets	Description of project benefits
	11.6By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management. 11.7By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities.	erosion, salt water intrusion into crop lands and fresh water marshes and contamination of sub-soil water aquifer. This is making the human settlements in the Project Zone safe and sustainable and people do not have to migrate out of the area. • DBC-1 has surveyed the Jhaki Bandar Fort Island Site and is working on developing a conservation plan for protecting and safeguarding this cultural and historical heritage site. Besides, it has increased recreational opportunities for 1,837 people living in 3 near-by villages. • Due to improved protection from floods damages and storms surges, project interventions have contributed to the safety of and provided protection to 21,211 people in 35 villages. This has already reduced and will significantly reduce the number of deaths and the number of people affected and thus substantially decrease loss of human life and miseries, reduce damages and losses to property and the need for additional costs which communities have to incur to protect themselves. This directly contributes to protecting the poor and people in vulnerable situations. • Air quality in the area has been improves due to restoration of vegetation and reduction in the use of fossil fuels for energy generation. • The greenery restored by the project has increased access to safe, inclusive and accessible, green and public spaces for all, in particular for women, children, older persons and persons with disabilities. This has been a source of inspiration,

SDG	Examples of relevant SDGs targets	Description of project benefits
		knowledge and entertainment for 5,482 people in 6 villages. • Aesthetics of the iconic landscape and seascape sites have been protected and further enhanced in 3 villages with a resident population of 1,837 people.
SDG 12 "Sustainable Production and Consumption" Ensure sustainable consumption and production patterns	12.2 By 2030, achieve the sustainable management and efficient use of natural resources.	M-2 period: Beneficiaries Men = 6,390 Beneficiaries Women = 6,139 Total Beneficiaries =12,529 Cumulative: Beneficiaries Men = 10,954 Beneficiaries Women = 10,524 Total Beneficiaries = 21,478 Sustainable fishing for 60% fishing communities: Male fishing community = 17,122 Female fishing community = 18, 675 Total fishing community = 35,797 • Sustainability is at the core of DBC-1 work and its approach to mangroves restoration, other natural resources production and consumption, biodiversity conservation and over-all development works in the area. • DBC-1 Project is working with local communities on sustainable production and consumption of various goods and services produced by wetlands and marine ecosystems. Towards this end, it has already established 136 Mangrove Stewardship Agreements and is in the process of establishing Biodiversity and Fish Stewardship Agreements on a similar analogy with the local people in pursuit of

SDG	Examples of relevant SDGs targets	Description of project benefits
		sustainable production and consumption of various natural resource products in the area. • The Project is encouraging local communities to incorporate sustainability in their reporting cycle, and the project will further strengthen this by strengthening data collection and management, including on climate change mitigation, adaptation, and sustainable development benefits of the project. • The project in the coming years will further increase its targets of mangrove restoration work thereby increasing the production and supply of mangrove ecosystem goods and services in the area and the adoption of sustainable practices. This will bring about balance between production and consumption and reduce over-exploitation and resultant degradation of natural resources.
SDG 13 "Climate Action" Take urgent action to combat climate change and its impacts*	13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters. 13.2 Integrate climate change measures into national policies, strategies and planning. 13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning	M-2 period: Beneficiaries Men = 2,306 Beneficiaries Women = 140 Total Beneficiaries =2,446 Cumulative: Beneficiaries Men = 13,042 Beneficiaries Women = 1,188 Total Beneficiaries =14,230 M-2 period carbon sequestration: 1,939,872.30 tCO2e Cumulative carbon sequestration: 5,437,031.84 tCO2e • The DBC-1 Project itself is an integrated strategy/plan which increases the governments

SDG	Examples of relevant SDGs targets	Description of project benefits
		and community's ability to mitigate and adapt to the adverse impacts of climate change, foster climate resilience and create healthy communities. It has already restored 83,034 ha of degraded mangrove lands and will restore an additional about 142,000 ha in the coming years until 2028. These measures have directly contributed to combating climate change and its impacts. • Project's interventions are being replicated in the remaining Indus Delta Area through a sequel DBC-2 Project under which another 200,000 ha of degraded mangroves will be restored. • Given that DBC-1 is the largest and most developed Blue Carbon Project not only in Pakistan but in the region, it provides valuable capacity building related to operational and technical components for Pakistan national REDD+ program and other countries in the neighbourhood. At the country level, other provinces are taking a lead from DBC-1 Project success and are contemplating to start similar initiatives in other terrestrial forest ecosystem. • The project educates community members and other stakeholders on systemic and individual ways to implement adaptation, mitigation through its on-ground demonstration of forest and landscape restoration works. It has explained to them how to reduce emissions from deforestation and degradation of mangrove forests through becoming as stewards of mangroves and increasing carbon removals through ARR activities thereby

SDG	Examples of relevant SDGs targets	Description of project benefits
		helping create resilient communities. • Communities involved in the project understand climate change, and their role in the project. The project mobilizes climate finance to fund the on-going program implementation through the monetization of verified emission reductions for climate change mitigation benefits. • In addition to the sequestration of carbon into living biomass, mangrove tree planting has also increased and will further increase soil organic carbon sequestration. This soil organic will remain stored in the deeper layers of the soil for centuries. • The project is further expected to generate additional adaptation benefits, namely: - Strengthening the resilience of ecosystems: Low-emission and sustainable reforestation/ afforestation practices will be scaled up 225,000 ha. This is a land area prone to erosion, land degradation and desertification on account of salt water intrusion, which is projected to accelerate in the future under increasing temperatures and changes in precipitation regimes. The project has already supported and will help support micro-climate buffering and will contribute to land restoration and erosion protection. This can further help protect productive assets and reduce losses due to climate change. - The project is further expected to increase the resilience of communities by providing alternative livelihood opportunities. • Where possible, Project's training and extension support

SDG	Examples of relevant SDGs targets	Description of project benefits
		will raise awareness on climate change risks, and suitable risk reduction practices through restoration and sustainable management of mangrove forests. Continuous and improved data collection under the on-going monitoring activities of the Project, and feedback systems will further enable DBC-1 Project to provide tailored extension support and services, where climate information, and information on best practices can be effectively identified, assessed, and disseminated to local communities. The project also supports conservation agriculture through preventing and controlling soil erosion as well as sea water intrusion into agricultural landscapes which helps with soil and water conservation as well as reduced fertilizer inputs. Increased incomes to local farmers will encourage them to practice improved agricultural practices such as mulching, crop residue management, manure management, hedgerows, and agroforestry, as well as the use of improved varieties help crops become more resilient to a changing climate.
SDG 14 “Life Below Water” Conserve and sustainably use the oceans, seas and marine resources for sustainable development	14.1 By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution 14.2 By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans	M-2 period: Beneficiaries Men = 6,390 Beneficiaries Women = 6,139 Total Beneficiaries =12,529 Cumulative: Beneficiaries Men = 10,954 Beneficiaries Women = 10,524 Total Beneficiaries =21,478

SDG	Examples of relevant SDGs targets	Description of project benefits
	14.3 Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation. 14.4 By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics. 14.5 By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information.	Increase of Fish Spawning Sites over an area of 83,034 ha. • Mangroves serve as spawning sites for fishes and shrimps on which the livelihoods of most of the Project Zone communities depend. Through restoration and protection of 83,034 ha of de-vegetated and degraded mangrove lands, the project has contributed to the conservation and enhancement of marine resources in the Delta Area. As a result, aquatic species biodiversity has increased in the area. • Project planted mangroves help in reducing marine pollution through controlling nutrient and marine debris pollution. They also protect marine and coastal ecosystems to avoid significant adverse impacts of climate change. • It has mobilized, organized and strengthened local communities and stakeholders to take action for the restoration and sustainable management of coastal wetlands, creeks and oceans. • The project is working on local communities and diversifying their livelihood and income sources so that the fishing communities do not resort to illegal, unregulated and destructive fishing and adopt sustainable fishing practices and limit their catch keeping in view the biological characteristics and growth potential of fisheries in the area. yield • The project is in negotiation with fishing communities and other relevant stakeholders to declare Marine Protected Zones on a pilot basis to see

SDG	Examples of relevant SDGs targets	Description of project benefits
		their impact on marine life conservation. • Due to project interventions the population of Indian Ocean humpback Dolphin has considerably increased on account of increased food sources for the species. It is one of the threatened marine species
SDG 15 "Life on Land" Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	15.1 By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements. 15.2 By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation. 15.3 By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world. 15.5 Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species. 15.6 Promote fair and equitable sharing of the benefits arising from the utilization of genetic resources and promote appropriate access to such resources. 15.7 Take urgent action to end poaching and trafficking of protected species of flora and fauna and address both demand and supply of illegal wildlife products.	M-2 period: Beneficiaries Men = 1,405 Beneficiaries Women = 1,350 Total Beneficiaries =2,755 Cumulative: Beneficiaries Men = 12,290 Beneficiaries Women = 11,809 Total Beneficiaries =24,099 Restoration of mangroves on de-vegetated lands = 83,034 ha • DBC-1 Project is working to ensure the conservation, restoration and sustainable use and management of wetlands and mangrove ecosystem in the Indus Delta Area. • Through working with local communities', it has stopped deforestation and degradation of mangrove forests by making them as stewards of mangroves. • It is working on building the capacities of all relevant key stakeholders for the sustainable management of mangroves and other coastal and marine resources in the area. • The project has contributed to the control of and reduction in soil loss due to enhancing green infrastructure and making use of nature-based solutions against different environmental problems

SDG	Examples of relevant SDGs targets	Description of project benefits
	15.8 By 2020, introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species. 15.9 By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts. 15.a Mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems. 15.b Mobilize significant resources from all sources and at all levels to finance sustainable forest management and provide adequate incentives to advance such management, including for conservation and reforestation. 15.c Enhance global support for efforts to combat poaching and trafficking of protected species, including by increasing the capacity of local communities to pursue sustainable livelihood opportunities.	including soil erosion, land degradation, sea water intrusion, pollution, etc. • DBC-1 is taking urgent and significant actions through habitat restoration to reduce the degradation of natural wetlands habitats and halt the loss of biodiversity. Through its various interventions it has helped protect and prevent the extinction of threatened species like Fishing Cat by enlisting the co-operation of local communities in mangroves and biodiversity conservation. • It is promoting fair and equitable sharing of the benefits arising from the restoration, protection and utilization of coastal and marine resources in the area. • DBC-1 Project in collaboration with its other partners is taking urgent actions to end harvesting, poaching and trafficking of protected species of flora and fauna. • Under the project no introduced, alien or invasive species (floral or faunal) has been used or introduced nor it will do so in the future. It is strictly monitoring such species. The project is actively promoting and making the use of indigenous and local species in its restoration work. • It has sensitized local communities and other stakeholders to go for payments for ecosystem services and use it as a tool for biodiversity conservation and poverty reduction in the area. Now the communities are actively engaged in resources protection, conservation and sustainable management.

SDG	Examples of relevant SDGs targets	Description of project benefits
		• The Project has mobilized international carbon finance to support and further upscale climate change mitigation and adaptation, biodiversity conservation and community development works in the Indus Delta Area. • DBC-1 Project is being show-cased at international levels. This will help in further upscaling of blue carbon initiatives in other parts of the region and the world.
SDG 16 "Peace, Justice and Institution" Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	16.5 Substantially reduce corruption and bribery in all their forms. 16.6 Develop effective, accountable and transparent institutions at all levels. 16.7 Ensure responsive, inclusive, participatory and representative decision-making at all levels. 16.10 Ensure public access to information and protect fundamental freedoms, in accordance with national legislation and international agreements. 16.b Promote and enforce non-discriminatory laws and policies for sustainable development.	M-2 period: Beneficiaries Men = 2,306 Beneficiaries Women = 140 Total Beneficiaries =2,446 Cumulative: Beneficiaries Men = 13,042 Beneficiaries Women = 1,188 Total Beneficiaries =14,230 Establishment of VDCs = 10 Establishment of WOs = 13 Total = 23 • The Project has developed effective, accountable and transparent local level institutions in the form of Village Development Committees (VDCs) and Women Organizations (WOs). • These village level community organizations are broad-based and ensure responsive, inclusive, participatory and representative decision making at the community level. • These village-based organizations are being capacitated and strengthened for their effective participation

SDG	Examples of relevant SDGs targets	Description of project benefits
		in higher level forums at the Taluka and District level. • The Project has shared project related information to the local communities in a number of ways and through a variety of channels. These include during FPIC meetings and SBIA workshops as well as sharing of project documents and their summaries in local language. • DBC-1 Project has been promoting and enforcing non-discriminatory policies and measures for equitable and sustainable development. All the above measures of the project contribute to peace, justice and strong institutions.
SDG 17 "Partnerships for Sustainable Development" Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development	17.1 Strengthen domestic resource mobilization, including through international support, to improve domestic capacity for tax and other revenue collection. 17.3 Mobilize additional financial resources from multiple sources. 17.5 Adopt and implement investment promotion regimes in pursuit of sustainable development. 17.19 By 2030, build on existing initiatives to develop measurements of progress on sustainable development that complement gross domestic product, and support statistical capacity-building.	M-2 period: Beneficiaries Men = 2,306 Beneficiaries Women = 140 Total Beneficiaries =2,446 Cumulative: Beneficiaries Men = 13,042 Beneficiaries Women = 1,188 Total Beneficiaries =14,230 Public-Private Partnership between Government of Sindh and IDC = 1 MoU with IUCN = 1 MoU with SHINE Humanity =1 MoU with LUAWMS =1 Male MSAs = 147 Female MSAs = 3 Total MSAs = 150 • DBC-1 is a long-term public-private partnership arrangement between the Government of Sindh through its Forest Department and

SDG	Examples of relevant SDGs targets	Description of project benefits
		Indus Delta Capital. The partnership is meant to promote climate change mitigation and adaptation, biodiversity conservation and sustainable development through financial resources mobilization, technology transfer, institutional development and organizational strengthening, awareness raising and capacity building. • The project in turn has entered into agreements with local communities under the framework of Mangrove Stewardship Agreements for mangroves restoration, conservation and over-all sustainable development in the area. • IDC and Sindh Forest Department have also entered into co-operation arrangements with IUCN, The World Conservation Union in pursuit of sustainable development, biodiversity conservation and climate change mitigation and adaptation. • In due course of time, it is contemplating to enter into additional such agreements for promotion of sustainable development in the Indus Delta Area. • It is promoting Internationally Transferred Mitigation Outcomes (ITMOs) under Article 6 of the Paris Agreement to enhance trade of carbon credits for the benefit of sustainable development and climate change mitigation. • The Project has contributed to systemic issues related to policy and institutional coherence on forest carbon projects, multi-stakeholder

SDG	Examples of relevant SDGs targets	Description of project benefits
		partnerships, and rigorous data collection, monitoring, verification and accountability. • It has designed, created and implemented a business model that attracts private sector finance that directly supports project activities for climate change mitigation and adaptation, biodiversity conservation and sustainable that works at the policy and operational and is available for replication by other entities. • The program is supported by several international companies that have through their carbon neutrality pledges by purchasing verified emission reductions which finance the program.

Appendix 5: Analysis of potential economic, social, environmental, cultural impacts, on human rights and rights to lands, territories and resources (See Section 2.1.10)

Project Activity	Aspect	Impact	Relevant Monitoring Plan Indicators used in assessment	Relevant Community Group/Other Stakeholders' Group impacted	Effect		Net Impact	Relevant SDG
					Beneficial	Adverse		
Restoration of 83,034 ha of degraded and de-vegetated mangrove lands	Economic	Increase in income and livelihood sources	SIA012 through SIA016 SIA017 through SIA022 SIA060 through SIA065	Coastal general community Coastal fishing community Coastal community engaged in agriculture and crop husbandry Coastal community engaged in livestock raising Coastal communities engaged in daily wage labour Women and youth Landless poor and other marginal groups Borrower and debtors Traders, middlemen and employers	Yes	No	Positive	Links to/synergies with SDGs achievement: SDG-1: No Poverty SDG-2: Zero Hunger SDG-3: Good Health and Well-being SDG-4: Quality Education SDG-5: Gender Equality SDG-6: Clean Water and Sanitation
	Social	Empowerment			Yes	No	Positive	
	Environmental	Improved air and water quality and protection of land from erosion, sub-mergence and salt water intrusion			Yes	No	Positive	
	Cultural	Protection of cultural assets and increase in landscape aesthetics			Yes	No	Positive	
	Human Rights	Less exclusion and more inclusive participation in planning and decision making			Yes	No	Positive	

Project Activity	Aspect	Impact	Relevant Monitoring Plan Indicators used in assessment	Relevant Community Group/Other Stakeholders' Group impacted	Effect		Net Impact	Relevant SDG
					Beneficial	Adverse		
	Rights to land, territories and resources	Customary and de jure rights of communities are respected and protected		Poachers, fuelwood and fodder collectors Upstream dwellers	Yes	No	Positive	SDG-7: Affordable Clean Energy SDG-8: Decent Work and Economic Development SDG-10: Reduced Inequalities SDG-11: Sustainable Communities SDG-12; Sustainable Consumption and Production SDG-13: Climate Action SDG-15: Life on Land SDG-16: Peace, Justice and Strong Institutions SDG-17: Partnerships for SDGs
Participatory planning and awareness raising with members of 10 VDCs and 13 WOs	Economic	Increased access to economic information related to prices, wages, etc.	SIA011 through SIA016 SIA048 through SIA059	Coastal general community Coastal fishing community	Yes	No	Positive	SDG-5: Gender Equality SDG-10: Reduced Inequalities SDG-13: Climate Action SDG-14: Life Below Water
	Social	Empowerment			Yes	No	Positive	

Project Activity	Aspect	Impact	Relevant Monitoring Plan Indicators used in assessment	Relevant Community Group/Other Stakeholders' Group impacted	Effect		Net Impact	Relevant SDG
					Beneficial	Adverse		
	Environmental	Increased awareness about environmental issues	SIA066 through SIA069	Coastal community engaged in agriculture and crop husbandry Coastal community engaged in livestock raising Coastal communities engaged in daily wage labour Women and youth Landless poor and other marginal groups Borrower and debtors Poachers, fuelwood and fodder collectors	Yes	No	Positive	SDG-15: Life on Land SDG-16: Peace, Justice and Strong Institutions SDG-17: Partnerships for Development
	Cultural	Increased awareness about the significance of cultural resources			Yes	No	Positive	
	Human Rights	Increased information about various economic, social and cultural rights of local communities			Yes	No	Positive	
	Rights to land, territories and resources	Increased awareness about rights to lands and resources by the communities			Yes	No	Positive	
Access to education for all wherein discussions have been	Economic	Increased employable skills	SIA001 through SIA004	Coastal general community Coastal fishing community	Yes	No	Positive	SDG-1: No Poverty SDG-2: Zero Hunger SDG-4: Quality Education
	Social	Increased social skills			Yes	No	Positive	

Project Activity	Aspect	Impact	Relevant Monitoring Plan Indicators used in assessment	Relevant Community Group/Other Stakeholders' Group impacted	Effect		Net Impact	Relevant SDG
					Beneficial	Adverse		
held with education sector authorities and local communities for renovation of schools, provision of different educational supplies, facilitating transport of students to schools, students' bursaries program especially for girl students, and ensuring attendance of school teachers through toppling their salaries.	Environmental	Increased awareness about environment and potential negative impacts of climate change		Coastal community engaged in agriculture and crop husbandry Coastal community engaged in livestock raising Coastal communities engaged in daily wage labour Women and youth Landless poor and other marginal groups Borrower and debtors Poachers, fuelwood and fodder collectors	Yes	No	Positive	SDG-5: Gender Equality SDG-8: Decent Work and Economic Development SDG-10: Reduced Inequalities SDG-12: Responsible Consumption and Production SDG-17: Partnerships for Development
	Cultural	Increased awareness about the significance of cultural resources			Yes	No	Positive	
	Human Rights	Increased information about various economic, social and cultural rights of local communities			Yes	No	Positive	
	Rights to land, territories and resources	Increased awareness about rights to lands and resources by the communities			Yes	No	Positive	

Project Activity	Aspect	Impact	Relevant Monitoring Plan Indicators used in assessment	Relevant Community Group/Other Stakeholders' Group impacted	Effect		Net Impact	Relevant SDG
					Beneficial	Adverse		
Access to safe drinking water and hygiene through restoration of a non-functional Reverse Osmosis (RO) plant that supplies of 500 gallons of clean and safe drinking water to 400 community members. Also, relevant authorities have been sensitized and local communities mobilized for efficient and effective functioning of the other RO	Economic	Reduced costs on treating water borne diseases	SIA008 through SIA010	Coastal general community Coastal fishing community Coastal community engaged in agriculture and crop husbandry Coastal community engaged in livestock raising Coastal communities engaged in daily wage labour Women and youth Landless poor and other marginal groups Borrower and debtors Traders, middlemen and employers Poachers, fuelwood and fodder collectors Upstream dwellers	Yes	No	Positive	SDG-6: Clean Water and Sanitation
	Social	Reduced burden on women, girls and elderly due to health issues resulting from use of unsafe and expensive water			Yes	No	Positive	
	Environmental	Decreased water pollution			Yes	No	Positive	
	Cultural	Increased time and resources for participation in cultural and leisure activities			Yes	No	Positive	
	Human Rights	Access to safe and affordable drinking water and hygiene facilities forms part of social, economic and cultural rights			Yes	No	Positive	

Project Activity	Aspect	Impact	Relevant Monitoring Plan Indicators used in assessment	Relevant Community Group/Other Stakeholders' Group impacted	Effect		Net Impact	Relevant SDG
					Beneficial	Adverse		
plants in the Project. Those communities in the Project Zone which are not served by these RO plants will be provided with Hand Water Pumps with filtration facilities for ensuring their access to safe and clean drinking water as well as personal hygiene.	Rights to land, territories and resources	Due to improved health and greater time and resources availability can better exercise their rights to land, territories and resources			Yes	No	Positive	
Access to health facilities through restoration of a mobile health facility, strengthening and renovation of an existing medical	Economic	Reduced costs on availing health services	SIA005 through SIA007	Coastal general community Coastal fishing community Coastal community engaged in agriculture and crop husbandry	Yes	No	Positive	SDG-3: Good Health and Well-being
	Social	Reduced social problems faced by different community groups, especially women, girls and elderly			Yes	No	Positive	

Project Activity	Aspect	Impact	Relevant Monitoring Plan Indicators used in assessment	Relevant Community Group/Other Stakeholders' Group impacted	Effect		Net Impact	Relevant SDG
					Beneficial	Adverse		
facility, provision of medical supplies and medicines as well as an ambulance and a driver		due to health issues		Coastal community engaged in livestock raising Coastal communities engaged in daily wage labour Women and youth Landless poor and other marginal groups Borrower and debtors Poachers, fuelwood and fodder collectors				
	Environmental	Decreased vulnerability to pollution hazards resulting from poor health			Yes	No	Positive	
	Cultural	Improved health status to engage in various cultural and leisure activities			Yes	No	Positive	
	Human Rights	Access to improved health facilities forms part of social, economic and cultural rights			Yes	No	Positive	
	Rights to land, territories and resources	Due to improved health can better exercise their rights to land, territories and resources			Yes	No	Positive	
Sustainable fisheries	Economic	Stability of income and livelihood			Yes	No	Positive	SDG-14: Life Below Water

Project Activity	Aspect	Impact	Relevant Monitoring Plan Indicators used in assessment	Relevant Community Group/Other Stakeholders' Group impacted	Effect		Net Impact	Relevant SDG
					Beneficial	Adverse		
restoration of 83,034 ha of degraded mangrove lands and through engagement with local fishing communities for the establishment of 2 Marine Protected Zones (about 24 kilometre long) for ensuring sustainable management of fisheries. The direct and indirect benefits of these interventions are multiple and include among others reduction of		sources due to sustainable fishing	SIA023 through SIA035	Coastal general community				
	Social	Reduced vulnerability to the exploitative practices of creditors, middlemen and traders		Coastal fishing community Coastal community engaged in agriculture and crop husbandry Coastal community engaged in livestock raising Coastal communities engaged in daily wage labour Women and youth Landless poor and other marginal groups Borrower and debtors Traders, middlemen and employers Poachers, fuelwood and fodder collectors	Yes	No	Positive	
	Environmental	The use of environmentally unfriendly and illegal fishing nets is reduced			Yes	No	Positive	
	Cultural	Due to continuation of sustainable fishing the communities can continue with their cultural norms, values and practices			Yes	No	Positive	
	Human Rights	Non-discrimination equality, participation and inclusion as well as decent work and			Yes	No	Positive	

Project Activity	Aspect	Impact	Relevant Monitoring Plan Indicators used in assessment	Relevant Community Group/Other Stakeholders' Group impacted	Effect		Net Impact	Relevant SDG
					Beneficial	Adverse		
variance in fish catch yields		legal employment opportunities are increased which contribute to the realization of social, economic and cultural rights						
	Rights to land, territories and resources	Improved governance of tenure in small-scale fisheries and their management			Yes	No	Positive	
Improved protection and law enforcement through greater patrols by law enforcing agencies and mobilization of local communities and making them mangroves and biodiversity	Economic	The protection, conservation, restoration and sustainable management of mangroves, fisheries and biodiversity ensures increased availability of the different ecosystem goods and services of these resources	SIA021 through SIA022 SIA023 through SIA035	Coastal general community Coastal fishing community Coastal community engaged in agriculture and crop husbandry Coastal community engaged in livestock raising Coastal communities engaged in daily wage labour	Yes	No	Positive	SDG-13: Climate Action SDG-14: Life Below Water SDG-15: Life on Land
	Social	Social cohesion is increased due to			Yes	No	Positive	

Project Activity	Aspect	Impact	Relevant Monitoring Plan Indicators used in assessment	Relevant Community Group/Other Stakeholders' Group impacted	Effect		Net Impact	Relevant SDG
					Beneficial	Adverse		
custodian communities through establishment of 150 MSAs (147 men and 3 women)		compliance with law and engagement of various community groups in legal activities		Women and youth Landless poor and other marginal groups Borrower and debtors Poachers, fuelwood and fodder collectors				
	Environmental	All human-made, natural and environmental resources (mangrove forests, fisheries, wildlife and biodiversity) on which the livelihoods of these coastal communities very heavily depend are protected, conserved, restored and sustainably managed			Yes	No	Positive	
	Cultural	The cultural, recreational and informational services provided by different coastal and marine			Yes	No	Positive	

Project Activity	Aspect	Impact	Relevant Monitoring Plan Indicators used in assessment	Relevant Community Group/Other Stakeholders' Group impacted	Effect		Net Impact	Relevant SDG
					Beneficial	Adverse		
		ecosystems are protected and become available on sustainable basis for enjoyment by the local communities						
	Human Rights	The rights of women, landless, poor and other marginal groups get protected and their access to the various ecosystem goods and services of coastal and marine ecosystems is increased			Yes	No	Positive	
	Rights to land, territories and resources	Increased protection of the rights of various community members particularly the vulnerable and weaker segments of society to land,			Yes	No	Positive	

Project Activity	Aspect	Impact	Relevant Monitoring Plan Indicators used in assessment	Relevant Community Group/Other Stakeholders' Group impacted	Effect		Net Impact	Relevant SDG
					Beneficial	Adverse		
		territories and resources						
Sustainable energy development through provision of solar energy facilities to communities living inside creeks and planting of multiple purpose tree species to serve as source of fuelwood and animal fodder	Economic Social Environmental Cultural Human Rights Rights to land, territories and resources	Discussions have been held with the different community groups on sustainable energy development in the Project Zone thereby laying the foundation for the realization of benefits related to economic, social, environmental, cultural, human resources and access to resources aspects	SIA036 through SIA047	Coastal general community Coastal fishing community Coastal community engaged in agriculture and crop husbandry Coastal community engaged in livestock raising Coastal communities engaged in daily wage labour Women and youth Landless poor and other marginal groups Borrower and debtors Poachers, fuelwood and fodder collectors	Yes	No	Positive	SDG-7: Affordable Clean Energy
Promotion of various gender development and income	Economic	Increased income and livelihood sources for women and other	SIA036 through SIA047	Coastal general community	Yes	No	Positive	SDG-1: No Poverty SDG-2: Zero Hunger

Project Activity	Aspect	Impact	Relevant Monitoring Plan Indicators used in assessment	Relevant Community Group/Other Stakeholders' Group impacted	Effect		Net Impact	Relevant SDG
					Beneficial	Adverse		
generating activities for women and marginal groups. Local community members are engaged in and employed for various project interventions including mangroves propagules collection, their storage and transportation, raising of nurseries of mangrove plants, planning of mangroves, MSAs implementation undertaking of various other project activities		vulnerable groups due to different project interventions		Coastal fishing community Coastal community engaged in agriculture and crop husbandry Coastal community engaged in livestock raising Coastal communities engaged in daily wage labour Women and youth Landless poor and other marginal groups Borrower and debtors Poachers, fuelwood and fodder collectors				SDG-5: Gender Equality SDG-10: Reduced Inequalities SDG-16: Peace, Justice and Strong Institutions
	Social	Increased social empowerment of women, youth, landless and poor due to their inclusion in women organizations and village development committees			Yes	No	Positive	
	Environmental	Improved ambient environmental quality results in better health and reduced risks (economic, social and other) from degradation of environmental resources			Yes	No	Positive	
	Cultural	Increased participation of women and marginalized			Yes	No	Positive	

Project Activity	Aspect	Impact	Relevant Monitoring Plan Indicators used in assessment	Relevant Community Group/Other Stakeholders' Group impacted	Effect		Net Impact	Relevant SDG
					Beneficial	Adverse		
		groups in different cultural and leisure activities						
	Human Rights	Improved protection of women human rights			Yes	No	Positive	
	Rights to land, territories and resources	Greater access of women and other vulnerable groups to various coastal and marine resources			Yes	No	Positive	
Training and capacity building during M-2 period of 1,246 local community members from various socio-economic groups including 128 women who are engaged for various aspects of	Economic	Increased earnings due to improved skills in ecological restoration of mangrove forests and effective implementation of MSAs	SIA066 through SIA069 SIA070 through SIA073 SIA074 through SIA078	Coastal general community Coastal fishing community Coastal community engaged in agriculture and crop husbandry Coastal community engaged in livestock raising	Yes	No	Positive	SDG-1: No Poverty SDG-2: Zero Hunger SDG-8: Decent Work and Economic Development
	Social	Increased capacity to solve communal problems			Yes	No	Positive	
	Environmental	Greater success in ecological			Yes	No	Positive	

Project Activity	Aspect	Impact	Relevant Monitoring Plan Indicators used in assessment	Relevant Community Group/Other Stakeholders' Group impacted	Effect		Net Impact	Relevant SDG
					Beneficial	Adverse		
mangroves restoration in ecological restoration of mangroves, effective implementation of MSAs and various other vocational skills for increasing their livelihood earning, social and environmental management skills. Cumulative training and capacity building is of 11,656 community members including 1,158 women.		restoration of mangrove forests and sustainable management of coastal and marine resources		Coastal communities engaged in daily wage labour Women and youth Landless poor and other marginal groups Borrower and debtors Traders, middlemen and employers Poachers, fuelwood and fodder collectors Upstream dwellers				
	Cultural	Greater appreciation and management of cultural and leisure resources			Yes	No	Positive	
	Human Rights	Improved understanding of economic, social and cultural aspects of human rights			Yes	No	Positive	
	Rights to land, territories and resources	Increased capacity to exercise communities' rights to resources			Yes	No	Positive	

Appendix 6: Details of Household and Village Surveys carried as part of M-1 and M-2 Reports Preparation (See Section 2.2.1, 2.3.3, 2.3.7 and 2.3.10)

M-1 Surveys:

PRAs & Household Surveys/Meetings				
Date	Village	Meeting Objectives/ purpose	List of participants	Region
15/10/2021	Sumar Shoro (HH-1)	Community Monitoring Impact Assessment	Household Headed By: Mukal & others Zahida, Shahida, Jannat	Bhanbore
15/10/2021	Sumar Shoro (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Benazir & others Havi, Hasseb Khatun, Sukhan	Bhanbore
15/10/2021	Sumar Shoro (HH-3)	Community Monitoring Impact Assessment	Household Headed By: Muhammad Amin & others Anwar Shoro, Almudin Shoro, Saeed Khan	Bhanbore
15/10/2021	Jangi Khan Baloch (HH-1)	Community Monitoring Impact Assessment	Household Headed By: Fatima & others Asma, Nathi, Rahima	Bhanbore
15/10/2021	Jangi Khan Baloch (HH-2)	Community Monitoring Impact Assessment	Household Headed By: Sassi & others Kazbano, Mevlo, Zubaida	Bhanbore
15/10/2021	Jangi Khan Baloch (HH-3)	Community Monitoring Impact Assessment	Household Headed By: Muhammad Usman & others Ghulam Muhammad, Ashrat, Mubarak Kalamati	Bhanbore
15/10/2021	Muhammad Hashim Mirbhar (HH-1)	Community Monitoring Impact Assessment	Household Headed By: Sher Bano & others Haleema, Zainab, Dadli	Bhanbore
15/10/2021	Muhammad Hashim Mirbhar (HH-2)	Community Monitoring Impact Assessment	Household Headed By: Nazeera & others Gulshan, Noor,Jamni	Bhanbore

PRAs & Household Surveys/Meetings				
Date	Village	Meeting Objectives/ purpose	List of participants	Region
15/10/2021	Muhammad Hashim Mirbhar (HH-3)	Community Monitoring Impact Assessment	Household Headed By: Azeem Mirbhar & others Ghulam Haider, Yaqoob Mirbhar, Yousuf	Bhanbore
15/10/2021	Saleh Muhammad Baloch (HH-1)	Community Monitoring Impact Assessment	Household Headed By: Zahida & others Zaibunisa, Shoni, Sajhan	Bhanbore
15/10/2021	Saleh Muhammad Baloch (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Haseena Bano & others Zeenat, Nathi, Khatu	Bhanbore
15/10/2021	Saleh Muhammad Baloch (HH-3)	Community Monitoring Impact Assessment	Household Headed By: Ajeeb & others Sidique Machi, Illyas Machi, Akber Mirbhar	Bhanbore
15/10/2021	Achar Mirbhar (HH-1)	Community Monitoring Impact Assessment	Household Headed By: Razan & others Saran, Allah Dini, Mehrunisa	Bhanbore
15/10/2021	Achar Mirbhar (HH-2)	Community Monitoring Impact Assessment	Household Headed By: Mithan & others Shahida, Zainab, Shazia	Bhanbore
15/10/2021	Achar Mirbhar (HH-3)	Community Monitoring Impact Assessment	Household Headed By: Abdullah Mirbhar & others Bashir Mirbhar, Ejaz Mirbhar, Shabir	Bhanbore
18/10/2021	Natho Goth (HH-1)	Community Monitoring Impact Assessment	Household Headed By: Khatun & others Sakina, Haleema, Shahnaz	Bhanbore
18/10/2021	Natho Goth (HH-2)	Community Monitoring Impact Assessment	Household Headed By: Sher Bano7 others Zara, Sakan, Fatima	Bhanbore
18/10/2021	Natho Goth (HH-3)	Community Monitoring	Household Headed By: Misri Sodani &	Bhanbore

PRAs & Household Surveys/Meetings				
Date	Village	Meeting Objectives/ purpose	List of participants	Region
		Impact Assessment	others Abdul Rehman, Shafee Muhammad, Kareem	
18/10/2021	Ali Muhammad Jatt (HH-1)	Community Monitoring Impact Assessment	Household Headed By: Bibi Shahbana & others Razia	Bhanbore
18/10/2021	Ali Muhammad Jatt (HH-2)	Community Monitoring Impact Assessment	Household Headed By: Bibi	Bhanbore
18/10/2021	Ali Muhammad Jatt (HH-3)	Community Monitoring Impact Assessment	Household Headed By: Wadera Ghulam Jatt & others Abdul Aziz, Hakeem Ali, Muhammad Moosa	Bhanbore
18/10/2021	Gul Hassan Samoo (HH-1)	Community Monitoring Impact Assessment	Household Headed By: Hajra & others Zahida, Fatima	Bhanbore
18/10/2021	Gul Hassan Samoo (HH-2)	Community Monitoring Impact Assessment	Household Headed By: Saira & others Maryam	Bhanbore
18/10/2021	Gul Hassan Samoo (HH-3)	Community Monitoring Impact Assessment	Household Headed By: Abdul Razaq & others Muhammad Ishaq, Manzor, Muhammad Samoo	Bhanbore
18/10/2021	Saifullah Goth (HH-1)	Community Monitoring Impact Assessment	Household Headed By: Mymo & others Zabunisa, Hajra, Sahab Khatun	Bhanbore
18/10/2021	Saifullah Goth (HH-2)	Community Monitoring Impact Assessment	Household Headed By: Zainat & others Bholi, Noor Bano, Najma	Bhanbore

PRAs & Household Surveys/Meetings				
Date	Village	Meeting Objectives/ purpose	List of participants	Region
18/10/2021	Saifullah Goth (HH-3)	Community Monitoring Impact Assessment	Household Headed By: Babu Sodhai & others Lakmeer Sodhai, Abdul Rasheed, Muhammad Ayoob	Bhanbore
18/10/2021	Usman Juman Goth (HH-1)	Community Monitoring Impact Assessment	Household Headed By: Bibi & others Maryam, Yaseena, Khati	Bhanbore
18/10/2021	Usman Juman Goth (HH-2)	Community Monitoring Impact Assessment	Household Headed By: Hajj & others Noor Bano, Khatan	Bhanbore
18/10/2021	Usman Juman Goth (HH-3)	Community Monitoring Impact Assessment	Household Headed By: Muhammad Jumman & others Misri Jatt, Zaheer Ahmed	Bhanbore
18/10/2021	Arab Jatt (HH-1)	Community Monitoring Impact Assessment	Household Headed By: Shahida & others Aziza, Zahida, Bibi	Bhanbore
18/10/2021	Arab Jatt (HH-2)	Community Monitoring Impact Assessment	Household Headed By: Saboli & others Chatan, Sakina, Sahabni	Bhanbore
18/10/2021	Arab Jatt (HH-3)	Community Monitoring Impact Assessment	Household Headed By: Muhammad Arab Jatt & others Younus Jatt, Asif Ali Jatt, Essa Jatt	Bhanbore
21/10/2021	Haji Qasim Jatt (HH-1)	Community Monitoring Impact Assessment	Household Headed By: Hajra & others Zainab, Bachan, Alma Khatun	Near (Garho)
21/10/2021	Haji Qasim Jatt (HH-2)	Community Monitoring Impact Assessment	Household Headed By: Fatima & others Karmani, Kalsoom, Hameeda	Near (Garho)

PRAs & Household Surveys/Meetings				
Date	Village	Meeting Objectives/ purpose	List of participants	Region
21/10/2021	Haji Qasim Jatt (HH-3)	Community Monitoring Impact Assessment	Household Headed By: Ahsan Jatt & others Habibullah, Ghulam Mustafa, Hanif Jatt	Near (Garho)
21/10/2021	Muhammad Hashim Jatt (HH-1)	Community Monitoring Impact Assessment	Household Headed By: Amna & others Bachan, Hajra, Asht	Near (Garho)
21/10/2021	Muhammad Hashim Jatt (HH-2)	Community Monitoring Impact Assessment	Household Headed By: Bachan & others Amna, Hafsa, Baseeran	Near (Garho)
21/10/2021	Muhammad Hashim Jatt (HH-3)	Community Monitoring Impact Assessment	Household Headed By: Raza Muhammad & others Ibrahim Jatt, Haider Ali Jatt	Near (Garho)
21/10/2021	Hayat Jatt (HH-1)	Community Monitoring Impact Assessment	Household Headed By: Aisha & others Hawa, Aziza, Zule Khan	Near (Garho)
21/10/2021	Hayat Jatt (HH-2)	Community Monitoring Impact Assessment	Household Headed By: Satbhae & others Zeenat, Khajat	Near (Garho)
21/10/2021	Hayat Jatt (HH-3)	Community Monitoring Impact Assessment	Household Headed By: Ghulam Jatt & others Javeed Jatt, Misri, Nazeer Ahmed	Near (Garho)
21/10/2021	Ahmed Ali Jatt (HH-1)	Community Monitoring Impact Assessment	Household Headed By: Rehmat & others Hawa Ismail, Rasheeda, Raja	Near (Garho)
21/10/2021	Ahmed Ali Jatt (HH-2)	Community Monitoring Impact Assessment	Household Headed By: Nayamat & others Naseban, Bhanbaro,Karamyan	Near (Garho)

PRAs & Household Surveys/Meetings				
Date	Village	Meeting Objectives/ purpose	List of participants	Region
21/10/2021	Ahmed Ali Jatt (HH-3)	Community Monitoring Impact Assessment	Household Headed By: Muhammad Ibrahim & others Muhammad Aslam, Muhammad Ismail	Near (Garho)
21/10/2021	Mir Jatt (HH-1)	Community Monitoring Impact Assessment	Household Headed By: Khatun & others Asya, Fatima,Ameeran	Near (Garho)
21/10/2021	Mir Jatt (HH-2)	Community Monitoring Impact Assessment	Household Headed By: Fatima & others Changho, Bibal	Near (Garho)
21/10/2021	Mir Jatt (HH-3)	Community Monitoring Impact Assessment	Household Headed By: Sufyan & others Dost Muhammad, Ali Jatt	Near (Garho)
21/10/2021	Sumar Sholani (HH-1)	Community Monitoring Impact Assessment	Household Headed By: Hameeda & others Sara, Jameela, Fatima	Near (Garho)
21/10/2021	Sumar Sholani (HH-2)	Community Monitoring Impact Assessment	Household Headed By: Hajani & others Sehmak, Ruksana	Near (Garho)
21/10/2021	Sumar Sholani (HH-3)	Community Monitoring Impact Assessment	Household Headed By: Umer Sholani & others Peer Muhammad, Sher Muhammad, Muhammad Younus Baloch	Near (Garho)
22/10/2021	Haji Mehar Jatt (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Rashida & others Haleema,	Near Baghan
22/10/2021	Haji Mehar Jatt (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Majida & others Sahabni	Near Baghan

PRAs & Household Surveys/Meetings				
Date	Village	Meeting Objectives/ purpose	List of participants	Region
22/10/2021	Haji Mehar Jatt (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Muhammad Ashraf & others Abdul Sattar Lashari, Javed Ali, Abdul Hakeem	Near Baghan
22/10/2021	Muhammad Khan Jatt (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Bachla & others Sahabdini	Near Baghan
22/10/2021	Muhammad Khan Jatt (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Hanifa & others Iamanat	Near Baghan
22/10/2021	Muhammad Khan Jatt (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Alam & others Kareem Buksh Jatt, Sofan Jatt	Near Baghan
22/10/2021	Muhammad Moosa Jatt (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Bhagle & Hawi	Near Baghan
22/10/2021	Muhammad Moosa Jatt (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Sakina	Near Baghan
22/10/2021	Muhammad Moosa Jatt (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Gul Sheer & others Hakim Ali	Near Baghan
22/10/2021	Ahmed Khan Memon (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Saima & others Razia,	Near Baghan
22/10/2021	Ahmed Khan Memon (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Sughra & others Sheri Memon	Near Baghan
22/10/2021	Ahmed Khan Memon (HH-3)	Community Monitoring	Household Headed By:Haji Muhammad Sidique	Near Baghan

PRAs & Household Surveys/Meetings				
Date	Village	Meeting Objectives/ purpose	List of participants	Region
		Impact Assessment		
22/10/2021	Muhammad Khan Sholani (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Baseeran & others Soomri, Simak, Sher Bano	Near Baghan
22/10/2021	Muhammad Khan Sholani (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Bachal & others Bakhtawr, Nayamat,Hawa	Near Baghan
22/10/2021	Muhammad Khan Sholani (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Khuda Buksh Sholani & others Mashooq Sholani, Nabi Buksh Sholani, Gul Sher Sholani	Near Baghan
23/10/2021	Haji Allah Warayo Bhatti (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Nayamat & others Zainab, Khati, Zule Khan	Shah Bandar
23/10/2021	Haji Allah Warayo Bhatti (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Summy & others Memi, Noori, Pathani	Shah Bandar
23/10/2021	Haji Allah Warayo Bhatti (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Ghulam Ali Bhatti & others Abdul Qayoom Bhatti, Ghulam Mustafa, Qurban Ali Bhatti	Shah Bandar
23/10/2021	Muhammad Ishaq Sarwan (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Wazeera & others Aisha	Shah Bandar
23/10/2021	Muhammad Ishaq Sarwan (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Hajra	Shah Bandar
23/10/2021	Muhammad Ishaq Sarwan (HH-3)	Community Monitoring	Household Headed By:Abbas Sarwan & others Muhammad	Shah Bandar

PRAs & Household Surveys/Meetings				
Date	Village	Meeting Objectives/ purpose	List of participants	Region
		Impact Assessment	Raheem Sarwan, Shokat Sarwan	
23/10/2021	Gul Muhammad Uplano (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Basri & others Lalah, Hoori, Bachal	Shah Bandar
23/10/2021	Gul Muhammad Uplano (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Khatija & others Kazu	Shah Bandar
23/10/2021	Gul Muhammad Uplano (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Noor Muhammad Uplano & others Ghulam Qadr Uplano, Muhammad Hanif Uplano, Muhammad Moosa Uplano	Shah Bandar
23/10/2021	Gul Muhammad Charejo (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Fateh & others Fatima, Maryam,	Shah Bandar
23/10/2021	Gul Muhammad Charejo (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Sughra & others Chatan	Shah Bandar
23/10/2021	Gul Muhammad Charejo (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Ali Akber Charejo & others Ghulam Nabi Charejo, Uroos Charejo, Muhammad Umer Uplano	Shah Bandar
23/10/2021	Haji Rab Nawaz Mallah (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Nasreen & others Farzana, Maria	Shah Bandar
23/10/2021	Haji Rab Nawaz Mallah (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Raziz & others Kazu	Shah Bandar

PRAs & Household Surveys/Meetings				
Date	Village	Meeting Objectives/ purpose	List of participants	Region
23/10/2021	Haji Rab Nawaz Mallah (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Hamzo Mallah & others Qurban Mirbhar,Abdul Shakoor	Shah Bandar
25/10/2021	Bhair Jat(HH-1)	Community Monitoring Impact Assessment	Household Headed By:Rehmat & others Khatu, Fatima	Keti Bandar
25/10/2021	Bhair Jat(HH-2)	Community Monitoring Impact Assessment	Household Headed By:Changan & others Zainab	Keti Bandar
25/10/2021	Bhair Jat(HH-3)	Community Monitoring Impact Assessment	Household Headed By:Misri Jatt & others Suleman Jatt, Gul Sher Jatt, Memon Jatt	Keti Bandar
25/10/2021	Sajan Wari(HH-1)	Community Monitoring Impact Assessment	Household Headed By:Razia & others Mumtaz Ali	Keti Bandar
25/10/2021	Sajan Wari(HH-2)	Community Monitoring Impact Assessment	Household Headed By:Zeenat & others Razia, Mithan	Keti Bandar
25/10/2021	Sajan Wari(HH-3)	Community Monitoring Impact Assessment	Household Headed By:Ali Muhammad & others Ahmed Memon, Gulzar Ali,Qadir Buksh	Keti Bandar
25/10/2021	Ali Bux Jatt (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Musarat & others Sohani, Farzana, Zareena	Keti Bandar
25/10/2021	Ali Bux Jatt (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Allah Bachae & others Abida, Haseena,Peerani	Keti Bandar
25/10/2021	Ali Bux Jatt (HH-3)	Community Monitoring	Household Headed By:Muhammad Talib	Keti Bandar

PRAs & Household Surveys/Meetings				
Date	Village	Meeting Objectives/ purpose	List of participants	Region
		Impact Assessment	Jatt & others Muhammad Ali Jatt, Muhammad Ramzan	
06/11/2021	Bhori Goth (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Bano & others Maryam, Marvi	Keti Bandar
06/11/2021	Bhori Goth (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Usman Jatt & others Al-Hadni	Keti Bandar
06/11/2021	Bhori Goth (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Nazeer Jatt & others Al Hassan Jatt, Hamzo Jatt, Hanif	Keti Bandar
06/11/2021	Mirano Goth (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Fatima & others Bhagbhari,Sabira, Zahida	Keti Bandar
06/11/2021	Mirano Goth (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Namal & others Rabia, Sakina,Rasheeda	Keti Bandar
06/11/2021	Mirano Goth (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Karam Khan Jatt & others Ameer All Jatt, Ali Khan Jatt, Sadique	Keti Bandar
06/11/2021	Haji Wariyo (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Hawa & others Izzat,	Keti Bandar
06/11/2021	Haji Wariyo (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Basra Jannat & others Benzair	Keti Bandar
06/11/2021	Haji Wariyo (HH-3)	Community Monitoring	Household Headed By:Gul Hassan & others Saleem,	Keti Bandar

PRAs & Household Surveys/Meetings				
Date	Village	Meeting Objectives/ purpose	List of participants	Region
		Impact Assessment	Abdul Rehman, Ghulam Qadir	
06/11/2021	Haji Mamo (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Parsan & others Aisha	Keti Bandar
06/11/2021	Haji Mamo (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Jannat	Keti Bandar
06/11/2021	Haji Mamo (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Haji Usman & others Muhammad Usman Dablo, Anwer, Ibrahim Dablo	Keti Bandar
06/11/2021	Haji Sheedi (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Kaz Bano & others Basra	Keti Bandar
06/11/2021	Haji Sheedi (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Fatima	Keti Bandar
06/11/2021	Haji Sheedi (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Mumtaz Ali Dablo & others Rasheed Dablo, Hamzo Dablo, Hassan Dablo	Keti Bandar
06/11/2021	Haji Maro (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Fatima & others Maryam, Dadli	Keti Bandar
06/11/2021	Haji Maro (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Balquees & others Sumeera	Keti Bandar
06/11/2021	Haji Maro (HH-3)	Community Monitoring	Household Headed By:Qasim Dablo &	Keti Bandar

PRAs & Household Surveys/Meetings				
Date	Village	Meeting Objectives/ purpose	List of participants	Region
		Impact Assessment	others Ladho Dablo, Muhammad Dablo	
08/11/2021	Hashim Takro (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Hajra & others Fatima, Zainab	Keti Bandar
08/11/2021	Hashim Takro (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Nabeela & others Bachan	Keti Bandar
08/11/2021	Hashim Takro (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Wiko Sholani & others Yousuf Sholani, Hadano Sholani,	Keti Bandar
08/11/2021	Karo Takro-1 (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Yousuf Sholani & others Hussna	Keti Bandar
08/11/2021	Karo Takro-1 (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Jamb & others Zeena	Keti Bandar
08/11/2021	Karo Takro-1 (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Ibrahim & others Hashim Dablo, Ishaq Hussain Dablo, Muhammad Sumar Dablo	Keti Bandar
08/11/2021	Karo Takro-2 (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Hawa & others Rabica, Fatima	Keti Bandar
08/11/2021	Karo Takro-2 (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Rehmat & others Maryam	Keti Bandar
08/11/2021	Karo Takro-2 (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Jumma & others Muhammad Aisa Dablo, Usman	Keti Bandar

PRAs & Household Surveys/Meetings				
Date	Village	Meeting Objectives/ purpose	List of participants	Region
08/11/2021	Ghulam Dablo (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Zulan & others Razia, Aami	Keti Bandar
08/11/2021	Ghulam Dablo (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Muhammad Ayub & others Umer Dablo, Younus Dablo	Keti Bandar
08/11/2021	Ghulam Dablo (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Gul Sher Dablo & others Khatiaro, Suman Dablo,Abdulah Dablo	Keti Bandar
08/11/2021	Muhammad Sumar Goth (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Safori	Keti Bandar
08/11/2021	Muhammad Sumar Goth (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Rehmatan	Keti Bandar
08/11/2021	Muhammad Sumar Goth (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Meetho Dablo & others Younus Dablo, Ghulam Hussain,Saleh Muhammad Dablo	Keti Bandar
08/11/2021	Muhammad Dablo Goth (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Jilu & others Zehra	Keti Bandar
08/11/2021	Muhammad Dablo Goth (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Jumman Dablo & others Arab Dablo	Keti Bandar
08/11/2021	Muhammad Dablo Goth (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Rehmat	Keti Bandar

PRAs & Household Surveys/Meetings				
Date	Village	Meeting Objectives/ purpose	List of participants	Region
08/11/2021	Ahmed Dablo (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Aisha & others Maryam, Fatima	Keti Bandar
08/11/2021	Ahmed Dablo (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Khati & others Khairi, Zubeeda	Keti Bandar
08/11/2021	Ahmed Dablo (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Abdul Sattar & others Abdullah, Muhammad Ayub, Abdullah Dablo	Keti Bandar
08/11/2021	Sajan Shah (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Khairunisa & others Ghulam Fatima	Keti Bandar
08/11/2021	Sajan Shah (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Saeeda & others Maluqa	Keti Bandar
08/11/2021	Sajan Shah (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Shah Jan & others Mehram, Qurban Ali, Ashraf Shah	Keti Bandar
14/11/2021	Haji Wario (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Fatima & others Amna, Nayamat, Amnat	Shah Bandar
14/11/2021	Haji Wario (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Sannat & others Hajra, Hawa, Rahima	Shah Bandar
14/11/2021	Haji Wario (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Mitha Khan & others Moosa, Hashim Jatt, Sadique Jatt	Shah Bandar

PRAs & Household Surveys/Meetings				
Date	Village	Meeting Objectives/ purpose	List of participants	Region
14/11/2021	Zaman Jatt (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Hussain & others Amna	Shah Bandar
14/11/2021	Zaman Jatt (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Gul Bano & others Sumeera	Shah Bandar
14/11/2021	Zaman Jatt (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Karam Jatt & others, Shafi, Sadique Jatt	Shah Bandar
14/11/2021	Hamzo Zangejo (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Parveen & others Aisha, Sughra	Shah Bandar
14/11/2021	Hamzo Zangejo (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Zahida & others Bushra, Zehra	Shah Bandar
14/11/2021	Hamzo Zangejo (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Ghulam Hussain Zangejo & others Muhammad Salman, Irfan Ali,Shokat Ali	Shah Bandar
14/11/2021	Umer Jatt (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Zubaida & others Satabai, Khajat	Shah Bandar
14/11/2021	Umer Jatt (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Karo & others Sakina,Mumtaz	Shah Bandar
14/11/2021	Umer Jatt (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Muhammad Ibrahim Jatt & others Ali Hussain Jatt, Allah Dino Jatt, Muhammad Hassan Jatt	Shah Bandar

PRAs & Household Surveys/Meetings				
Date	Village	Meeting Objectives/ purpose	List of participants	Region
14/11/2021	Ahmed Baghdo (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Fatima & others Basri	Shah Bandar
14/11/2021	Ahmed Baghdo (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Shabira & others Hawa	Shah Bandar
14/11/2021	Ahmed Baghdo (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Khameso & others Abdul Rehman, Ali Nawaz	Shah Bandar
14/11/2021	Abdullah Mirbhar (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Sajida & others Shahida,Fatima	Shah Bandar
14/11/2021	Abdullah Mirbhar (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Bashal & others Sakina,Ghulam Fatima	Shah Bandar
14/11/2021	Abdullah Mirbhar (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Anwar & others Jumman Mirbhar, Muhammad Mirbhar, Fayaz Mirbhar	Shah Bandar
14/11/2021	Ahmed Patani (HH-1)	Community Monitoring Impact Assessment	Household Headed By:Shenat & others Sughra	Shah Bandar
14/11/2021	Ahmed Patani (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Gul Muhammad & others Muhammad Sumar, Mir Muhammad	Shah Bandar
14/11/2021	Ahmed Patani (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Khera & others Kalsoom	Shah Bandar
14/11/2021	Ibrahim Jatt (HH-1)	Community Monitoring	Household Headed By:Raji	Shah Bandar

PRAs & Household Surveys/Meetings				
Date	Village	Meeting Objectives/ purpose	List of participants	Region
		Impact Assessment		
14/11/2021	Ibrahim Jatt (HH-2)	Community Monitoring Impact Assessment	Household Headed By:Fatima	Shah Bandar
14/11/2021	Ibrahim Jatt (HH-3)	Community Monitoring Impact Assessment	Household Headed By:Sadique Jatt & others Ahmed Jatt, Moosa Jatt,	Shah Bandar

M-2 Surveys:

The details of these surveys are given in two separate folders, one each for the 52 Project Zone villages and the other one for the 233 Villages lying outside the Project Zone within 20-kilometer radius where the communities have dependence on the Project Area.

Appendix 7: Monitoring Protocol/Monitoring Plan for Climate Section Monitoring

Protocol for DBC-1 project biomass and soil organic carbon and soil erosion estimation			
Version	1.0	Date of Issue	10-10-2018
Purpose	This Protocol describes the parameters that will be monitored at each monitoring event and the procedures for making the measurements.		
Responsibilities	It is the responsibility of the senior staff members of Sindh Forest Department and IDC who are professional foresters to ensure that this protocol is followed at the time of taking measurements when collecting, analyzing, compiling, storing, archiving and handling the collected data including QA/QC procedures.		
Prerequisites	Relevant provision of the validated PD Document and the provisions of relevant modules and tools of the VERRA Methodology for Tidal Wetlands Restoration-VM003 Methodology and CDM AR Tool 3 and CDM AR Tool 14.		
Related documents	SOP 1 (SOP related to field safety), SOP 2 (related to biomass sample plots layouts and taking of tree measurements) and SOP 3 (SOP related to soil organic carbon sample plot establishment and measurement taking).		
Scope	This protocol applies to field works that involve data collection in the sample plots that are to be laid out for biomass and soil organic carbon related data collection in the field.		

Appendix 7.1. General

A. Main Parameters to be Monitored

Main parameters that will be monitored and data collected on include the following.

Data/Parameter	ΔCTREE_PRO,i,t
Data unit	tCO2e yr-1
Description	Change in carbon stock in trees in stratum *i* during the period between two points of time *t1* and *t2*.
Source of data	Derived from application of *AR Tool 14* using data collected in the project area
Description of measurement methods and procedures to be applied	See Annex-1-Estimation of tree carbon stocks
Frequency of monitoring/recording	Each monitoring period
Value applied	Variable depending on year and stratum

Monitoring equipment	See Details in this Monitoring Plan
QA/QC procedure to be applied	See Annex-1
Purpose of data	Calculations of project emissions
Calculations method	See Annex-2
Comments	Not Applicable

Data/Parameter	Crown or vegetation cover
Data unit	%
Description	Proportion of the area covered by the crowns of live trees
Source of data	See SOP-2 and Field Inventory Data Sheets.
Description of measurement methods and procedures to be applied	See Annex-1-Estimation of tree carbon stocks
Frequency of monitoring/recording	Each monitoring period
Value applied	Variable depending on year and stratum
Monitoring equipment	See Details in this Monitoring Plan
QA/QC procedure to be applied	See Annex-1
Purpose of data	Calculations of project emissions
Calculations method	See Annex-2
Comments	Provide any additional comments

Data/Parameter	At,i
Data unit	Ha
Description	Area of project stratum *i* (in year *t*)
Source of data	Delineation of strata using Geographic Information System (GIS), integrating GPS data collected in the field

Description of measurement methods and procedures to be applied	See Annex-2-Estimation of tree carbon stocks
Frequency of monitoring/recording	Each monitoring period
Value applied	27 plots per stratum
Monitoring equipment	See Details in this Monitoring Plan
QA/QC procedure to be applied	See Annex-1
Purpose of data	Calculations of project emissions
Calculations method	Equation 2 from CDM AR Tool 3 (Calculation of the number of sample plots for measurements within A/R CDM project activities)
Comments	Not Applicable

Data/Parameter	N
Data unit	Dimensionless
Description	Number of sample plots required for estimation of biomass stocks within project boundary
Source of data	Derived from Equation 2 from CDM AR Tool 3 using field data
Description of measurement methods and procedures to be applied	See SOP-2-Estimation of number of sample plots
Frequency of monitoring/recording	Each monitoring period
Value applied	Variable depending on stratum
Monitoring equipment	See Details in this Monitoring Plan
QA/QC procedure to be applied	See Annex-1
Purpose of data	Calculations of project emissions
Calculations method	Equation 2 from CDM AR Tool 3 (Calculation of the number of sample plots for measurements within A/R CDM project activities)

Comments	Not Applicable

Data/Parameter	$C_{WPS, soil,i,t}$
Data unit	t C ha-1
Description	Carbon stock in the project scenario in stratum *i* in year *t*
Source of data	Equation 99 from VM0033 using data collected in the project area
Description of measurement methods and procedures to be applied	See SOP-3 and Data Collection Sheets for Soil Carbon Analysis-Estimation of soil organic carbon stocks
Frequency of monitoring/recording	Each monitoring period
Value applied	Variable depending on stratum and year
Monitoring equipment	See Details in this Monitoring Plan
QA/QC procedure to be applied	See Annex-1
Purpose of data	Calculations of project emissions
Calculations method	Equation 99 of VM0033
Comments	Not Applicable

Data/Parameter	%OM
Data unit	%
Description	Percentage of soil that is organic matter
Source of data	Calculated from combustion of soil collected at various depths in a given stratum in a given year
Description of measurement methods and procedures to be applied	See SOP-3 and Data Collection Sheets for Soil Organic Estimation -Estimation of soil organic carbon stocks
Frequency of monitoring/recording	Each monitoring period
Value applied	Variable depending on stratum and year

Monitoring equipment	See Details in this Monitoring Plan
QA/QC procedure to be applied	See Annex-1
Purpose of data	Calculations of project emissions
Calculations method	See Annex-2
Comments	Not Applicable

Data/Parameter	$\%C_{soil}$
Data unit	%
Description	Percentage of soil organic carbon
Source of data	Calculated from *%OM* derived from soil cores collected from Project Area
Description of measurement methods and procedures to be applied	See SOP-3- and Data Collection Sheets for Soil Organic Carbon Analysis-Estimation of soil organic carbon stocks
Frequency of monitoring/recording	Each monitoring period
Value applied	Variable depending on stratum and year
Monitoring equipment	See Details in this Monitoring Plan
QA/QC procedure to be applied	See Annex-1
Purpose of data	Calculations of project emissions
Calculations method	See Annex-3
Comments	Not Applicable

Data/Parameter	BD
Data unit	$g\ cm^{-3}$
Description	Dry bulk density
Source of data	Calculated from soil cores collected from Project Area

Description of measurement methods and procedures to be applied	See SOP-3 and Data Collection Sheet for Soil Organic Carbon Estimation-Estimation of soil organic carbon stocks
Frequency of monitoring/recording	Each monitoring period
Value applied	Variable depending on stratum and year
Monitoring equipment	See Details in this Monitoring Plan
QA/QC procedure to be applied	See Annex-1
Purpose of data	Calculations of project emissions
Calculations method	See Annex-2
Comments	Not Applicable

Data/Parameter	NER ERROR
Data unit	%
Description	Total uncertainty for project activity
Source of data	Not Applicable
Description of measurement methods and procedures to be applied	Not Applicable
Frequency of monitoring/recording	Each monitoring period
Value applied	Not Applicable
Monitoring equipment	Not Applicable
QA/QC procedure to be applied	Not Applicable
Purpose of data	Calculations of net GHG emission reductions
Calculations method	Not Applicable
Comments	Not Applicable

B. Teams Constitution, Composition and Training

Formation of Data Collection Teams is an essential step in mangrove biomass and soil organic carbon monitoring. The following guidance needs to be followed in the formation of these teams.

- Before going to the field to start field work and take measurements in the field, form sufficient number of field teams.
- The field teams members shall be provided with this Monitoring Protocol/Manual and properly trained in their respective roles to be performed by different team members, including taking of different measurements in the field; the use of equipment, instruments, tools; units of measurements; recording of data and filling of inventory and other forms; storing and archiving of data; and other aspects related to data collection, analysis, summarization, storage, archiving and QA/QC procedures.
- Each team should have a Team Leader preferably a forestry graduate or a Forest Ranger with basic knowledge of the project area, field measurement and use of equipment. He will be responsible for data entry and coordinating the team's activities and assigns responsibilities to other team members.
- The team should have two enumerators one for measuring diameters (Diameter at Base, Diameter at Breast Height and Crown Diameter) and the other for measuring tree heights. A third enumerator is to take soil samples in selected plots. There should be one helper with each team for carrying the instruments and samples in the field. Vehicle driver and boat crew along with boat are also required.
- The team members should be well-connected to the team leader and each other.
- Field equipment, materials and supplies needed for work of each team should also be ensured before going to the field
- All field equipment and instruments to be used in the filed should be prepared, checked and calibrated in advance.
- The team leader has to ensure that every piece of equipment and instrument is functioning and properly calibrated.
    - A complete checklist of equipment, instruments, materials and supplies should be prepared. This checklist will also be useful during field work as the team moves from one location to the other. A list of field equipment, materials and supplies is given in Table A7-1 under equipment, materials and supplies.
- The field monitoring team shall comprise of a team leader (graduate forestry professional), forestry technicians to help in taking and recording measurements, a helper, a driver and boat crew. Their roles are given below.

Table A7.1. Team members and their roles

Position	Qualification/ Experience	Role
Team Leader	Professional Forester/ Forestry Graduate	▪ Lead the team ▪ Identify and locate forest strata in the field ▪ Identify and locate sample plots ▪ Identify plant species ▪ Identify any wildlife species found in the strata and plot ▪ Give guidance on measuring and recording GPS coordinates and other attributes of area measurement plots ▪ Give guidance on laying out nested circular plots ▪ Give guidance on measuring and recording GPS coordinates and other attributes of biomass measurement plots

Position	Qualification/ Experience	Role
		▪ Give guidance on taking plant measurements ▪ Give guidance on taking soil samples ▪ Give guidance on taking coastal erosion measurements ▪ Give guidance on taking measurement
Enumerators/Measurement Takers	Forestry Technician	▪ Take GPS coordinates and other attributes of the area measurement plots ▪ Layout the nested circular plots in the field ▪ Take GPS coordinates and other attributes of the biomass measurement plots ▪ Take plant measurements including crown diameter, diameter at breast height, diameter at base, height, any defects, etc. ▪ Measure crown density in the plot and strata measurement sample plot
Data Recorders	Forestry Technician	▪ Record GPS coordinates and other attributes of the area measurement plots ▪ Record measurements of the nested circular plots in the field ▪ Record GPS coordinates and other attributes of the biomass measurement plots ▪ Record plant measurements including crown diameter, diameter at breast height, diameter at base, height, any defects, etc. ▪ Record crown density measurements in the plot and strata measurement sample plot
Helper	Knowledgeable about the area	▪ Assist with locating areas in the field ▪ Assist with carrying equipment, materials and supplies
Driver	Knowledgeable about the area	▪ Assist with driving in the field
Boat Crew	Knowledgeable about the creeks	▪ Assist with locating areas via boating in the sea and creeks

C. Equipment, Materials and Supplies

List of equipment, material and supplies that will be needed for biomass and soil samples collection is given in Table A7-2 below.

Table A7.2. List of equipment, materials and supplies

S.No.	Name of Equipment, Instrument or Other Item	Purpose or Use of the Equipment, Instrument and/or Item
1.	Project Area map with locations and details of all biomass sample plots and soil sample plots in the six strata-2015, 2016, 2017, 2018, 2019 and 2020 and other planting cohorts	Location of sample plots in the field
2.	Haglof Vertex, if and when available	Measurement of tree heights and establishment of circular plots
3.	Clinometer	Measurement of angles and heights
4.	Tree Height Measuring Rods	Graduated Rods for measuring heights of smaller trees.
5.	Suunto Clinometer, if and when available	Measurement of tree heights and slopes
6.	Compass	Direction determination
7.	Vernier Caliper	Diameter measurement
8.	Diameter Tape	Diameter measurement
9.	Linear Measuring Tape	Laying out of sample plots
10.	Densitometer, if and when available	Canopy cover measurement
11.	WAAS-enabled GPS-two sets with each team	Navigation and sample plots location determination and recording
12.	Drone along with all its accessories for taking Drone Images	Videography of field work
13.	Camera with geotagging features	Photography of field work, sample plots, and sample trees
14.	Mobile Phones	Communication between team members and base camp
15.	Batteries and Other Supplies of Drone, GPS, etc.	Functioning of Drone, GPS, etc.
16.	Soil Corer	Taking of soil cores for soil carbon assessment
17.	Digital Weighing Machine	Weights measurements
18.	Metal Scale	Measurement of soil depth
19.	Scissors	Cutting of materials

S.No.	Name of Equipment, Instrument or Other Item	Purpose or Use of the Equipment, Instrument and/or Item
20.	Sickles	Clearing of soil surface for soil samples collection
21.	Gunny Bags or Cloth Bags	Vegetation samples collection and storage
22.	Plastic Bags	Soil Samples collection and storage
23.	Hammer	Fixing of Metal Tags
24.	Iron Rods	Marking of Sample Plots
25.	Spray Paint	Marking of Boundaries and Trees
26.	Permanent Markers	Marking of trees and writing information on chits put in bags
27.	Stapler	Sealing of Plastic Bags
28.	Chalk	Marking of trees during measurement in Sample Plots
20.	Inventory and Data Collection Forms	For recording of field data
30.	Diary/Writing Pads	Notes taking and recording of daily events and details of field work
31.	Pens and Pencils	Filling of inventory and data collection forms as well as writing and notes taking
32.	Gloves	Field safety
33.	Long Boots	Field safety
34.	Safety Equipment appropriate for sampling and working in the field	Field safety
35.	Boating safety equipment	Field safety in water bodies
36.	Latex Gloves for hygienic protection	Personal hygiene
37.	Anti-bacterial hand sanitizer or soap	Hygiene and Covid-19 safety precautions and SOPs
38.	Face Masks for Covid-19 protection	Covid-19 safety precautions and SOPs
39.	Tags	Tagging
40.	Polygons Information Sheets	Sheets containing information about each polygon

S.No.	Name of Equipment, Instrument or Other Item	Purpose or Use of the Equipment, Instrument and/or Item
41.	Erosion prone project area sites	Project Area map with locations and details of all polygons which need to be surveyed for the measurement of coastal soil erosion
42.	Unspecified	Any other needed equipment, material and supply item

D. Field Safety Measures

See SOP 1 regarding Field Safety Measures.

E. Biomass Carbon Measurements

See SOP 2 regarding stratification, laying out of biomass sample plots, number, sizes, shape and taking of field measurements in the field.

F. Soil Organic Carbon Measurements

See SOP 3 regarding laying out of sample plots of soil samples collection, taking of soil samples and analysis of soil samples for organic carbon determination.

G. Estimation of Coastal Erosion

Source of data

The coastal erosion monitoring activities will be carried out specifically as part of this project. The analysis will be conducted using GIS and ground-truthed data during field campaigns.

Measurement methods and procedures

The amount of area eroded within the project area will be assessed every 5 years, beginning with the first assessment in the year 2021, which will examine erosion since the year 2015. At a minimum, Landsat Satellite Imagery (30 m resolution) will be procured over the project area. If higher resolution imagery is available, it will be used to enable finer scale erosion delineation. The shoreline within the Project Area will be manually delineated using GPS for each five-year increment. The delineation will be done by the GIS specialist and confirmed by another.

The manual delineation will be ground-truthed for plantations that are closest to the coastline. In conjunction with mangrove and soil sampling, a team member with a GPS unit will walk portions of shoreline within plantations that are closest to the shoreline and that are dispersed across the Project Area with the tracking feature enabled. These data will be downloaded in the GIS laboratory, uploaded to the GIS and compared to the manually delineated shoreline.

The amount of erosion that occurred between image dates will be assessed using GIS.

Annex-1: Quality Assurance and Quality Control (QA/QC)

To assist field inventory personnel, data analysts, and other individuals involved in evaluating the quality of any aspect of the forest inventory data, Quality Assurance (QA) and Quality Control (QC) are a must. These procedures include specific criteria to evaluate the quality of analytical data that have been gathered, entered into datasheets/spreadsheets and made use of in analysis work. The QA/QC procedures will promote the acceptance of analytical data in the marketplace for carbon credits and reduce the need for additional sampling and analysis to support and/or confirm the analytical data and

the professional decisions made. The QA/QC procedures are therefore an absolutely essential part of the Forest Inventory Program of Delta Blue Carbon Project.

Provisions for different aspects of QA/QC will be implemented to ensure that the carbon stocks and carbon credits generated are accurate and reliable, and have been estimated following consistent, transparent, and comparable standards that meet the requirements set for measurement procedures. The QA/QC provisions are an integral part of the standard operating procedures for the conduct of Forest Inventory under Delta Blue Carbon Project and include procedures for: (1) collecting reliable field measurements; (2) verifying laboratory procedures; (3) verifying data entry and analysis techniques; (4) checking data completeness and consistency; and (5) maintaining and archiving data.

H. Field Measurements

Rigorous guidelines and standard operating procedures need to be followed that have each step to be taken in the field work and measurement spelled out in detail. These SOPs and guidelines ensure that measurements taken by different team members or at different times are transparent, consistent and comparable. Those responsible for taking measurements should be extensively trained in these guidelines and SOPs so that they are fully knowledgeable about and cognizant of the importance of all these SOPs and guidelines for collecting accurate data.

During each field visit, a document should be produced and filed with the field documents showing and proving that all steps from the SOPs and guidelines have been followed in their letter and spirit, and all deviations from these guidelines, if any, must be listed and explained. The SOPs and guidelines will be updated and officially notified if significant issues arise with these SOPs and guidelines.

An audit program for field measurements and sampling should be established. This audit program will typically consist of the following three types of checks: hot checks, cold checks and blind checks. In a not check, auditors or technical experts observe members of the field crew during data on a sample plot in the field. This type of check is primarily meant for training of crew members. Cold checks are done later and when field crews are not present when the audit is done. Blind checks represent the complete re-measurement of a sample plot by the auditors. Hot checks allow for the correction of errors in techniques and doing the work, while blind checks allow for calculation of measurement variance.

When field work is completed, about 10% of the plots should be checked independently. Field data collected at this stage can be compared with the original data, and errors should be noted, corrected and recorded. To get an estimate of the measurement errors, errors can be expressed as a percentage of all plots that have been re-checked.

1.2 Laboratory Measurements

Guidelines for any laboratory measurements regarding biomass and soil carbon measurements in the laboratory should be prepared by the concerned laboratory staff and be followed for each part and step of the laboratory analysis. If and when an external laboratory performs the analysis, a record of the procedure (s) must be obtained. A typical crucial step for laboratory measurements, for example, is the calibration of combustion instruments for measuring total carbon or carbon forms using commercially available and certified carbon standards. Similarly, all balances for measuring dry weights should be calibrated periodically against know weights and fine-scale balances should be calibrated by the manufacturer. Where possible 10 to 20 percent of the samples should be re-analysed and/or re-weighed to produce an error estimate.

1.3 Data Entry

Data entry can be done in hard copy form on paper sheets/forms or done immediately in soft form in the field using laptop computers of other digital devices. Data entry done in hard form has to be entered manually on to spreadsheets and/or datasheets. Data entry onto spreadsheets and/or a database is often a significant source of error. Ongoing communication between all personnel involved in measuring and analysing data is critical for resolving apparent anomalies before final analysis. Special attention must be paid to the measurement units used in the field. Typical mistakes are confusion whether the figure is for diameters or circumferences if trees are measured, or the length unit (mm, cm or inches).

Therefore, all measurements contained in the spreadsheets and/or datasheets must have their units clearly indicated.

Errors can be reduced by spot checks of the data entered by independent personnel. In addition, outliers can be identified by checking whether each value is within an expected range or not. If during spot checks or range checks a significant number of errors are found, all data must be re-checked by independent personnel. If there are anomalies that cannot be resolved, the plot data should not be used in the analysis.

1.4 Data Completeness and Consistency Check

These QA/QC procedures evaluate (a) data completeness, and (b) data consistency.

a. Data Completeness Check

One of the important steps related to QA/QC is to ensure that data gathered are complete and stored correctly. A thorough evaluation of the data completeness should be carried out as soon as possible after the field work so that any missing data can be collected and retrieved in a timely manner. Special attention should be paid to the following aspects of completeness.

Completeness of Files

- Are all the stages in the Forest Inventory and each step in a given stage fully documented and the file named correctly as per file naming convention of DBC Project?
- Are all the videos and pictures of each inventory stage and each step in a given inventory stage available and named correctly?
- Are all the digital pictures and electronic scans of the sample sheets available and named correctly?
- Are all digital pictures of the GPS screen indicating the position of a sampling plot available and named correctly?
- Are all the scanned packages of each of the data sheets complete and in the correct order?

Completeness of Data within Electronic Files

Once all the electronic data files are checked, the individual elements within the data files must be checked for completeness.

- Data Cover Sheet
  - Are data for all plots sampled present?
  - Are all plots have been given IDs and IDs named correctly?
  - Are all other attributes related to the plot collected?
  - Are all coordinates for the plot centres available?
  - Are preliminary and baseline inventory data and results reflecting sample design present?
  - Does the number of plots required in the preliminary inventory match or exceed the number of plots in the actual inventory?
- Plot Information
  - Are data present for all the plots sampled?
  - Is strata name/number given for each plot?
  - Is the naming convention of the plot ID followed?
- Above-ground Live Trees
  - Are data present for all the plots sampled?
  - Is the naming convention of the plot ID followed?
  - Are tree species' names provided?

  - Are all tree tag numbers provided?
  - Are all diameter measurements at base (cm; 30 cm from the ground) which need to be taken have been taken?
  - Are all DBH measurements (DBH; 1.3 meter from the ground or directly above the last prop root for Rhizophora mucronate) for trees greater than 5 cm in diameter, if applicable, have been taken?
  - Are all tree height measurements in cm meters taken?
  - Are all canopy width measurements in cm taken?
  - Are all baseline trees in the sample plot measured and information on their different attributes collected?
  - Are data on any relevant information about the tree species in question taken and recorded?

- Standing Deadwood/Trees
  - Is the naming convention of the plot ID followed?
  - Are decomposition classes 1,2, or 3 assigned to each dead tree?
  - Are all baseline trees in the sample plot measured and information on their different attributes collected?

- Fallen Deadwood
  - Is the naming convention of the plot ID followed?
  - Are decomposition classes 1,2, or 3 assigned to each dead tree?
  - Are all baseline trees in the sample plot measured and information on their different attributes collected?

- Canopy Cover Percentage
  - Are data present for all the plots sampled?
  - Is the naming convention of the plot ID followed?
  - Are the total square counts equal t 24 per reading?
  - Are 4 separate readings per sample plot recorded?

- Soil Organic Carbon Sample Plots Information
  - Are data present for all the plots sampled for soil organic carbon determination?
  - Is the naming convention of the plot ID followed?
  - Are the soil cores taken to the needed 100 cm depth and without undue compaction of the soil core?
  - Are the soil cores divided into the required sub-samples of 0-5 cm; 5-10 cm; 10-15 cm; 15-20 cm; 20-25 cm; 25-30 cm; 45-50; 0-50 cm; and 50-100 cm lengths?
  - Have the soil sub-samples been properly weighed and put into proper bags?
  - Do the sub-samples have proper IDs and have been properly labelled?

b. Data Consistency Check

The QA/QC procedures should ensure that the data measured are consistent throughout the scope of the project so that the same analytical approach can be implemented.

- Data Cover Sheet
  - In a spot check with the pictures showing GPS coordinates on the GPS screens, at least 90 % of the coordinates were correct?
  - In a spot check with the scanned datasheets, at least 10 randomly selected values of coordinates were correct?

  - If the plot was not indicated to be "relocated", are the actual coordinates of the plot centre equal to the given coordinates? Calculate the distance between actual plot centre and the recorded plot centre. This distance must be less than 20 meters using the difference method: i.e.,

$$D = \sqrt{(X2 - X1)^2} + \sqrt{(Y2 - Y1)^2}$$

  Where, D is the distance in meters between two plot centres, (X2, Y2) and (X1, Y1) UTM coordinate pairs of two plot centres.

  - If the plot was indicated to be "relocated", was the distance between the relocated and given coordinates smaller than 300 m?

- Above-ground Live Trees Information
  - Are tree tags unique within one plot?
  - In a spot check with scanned datasheets, were the 10 randomly selected values correct?
  - Are minimum and maximum of the DBH within each plot realistic?
  - Are recorded tree height measurements realistic?
  - Is the correct unit of measurement employed in all information recorded?
  - Are counts of trees within each plot realistic?
  - Is the biomass per plot realistic?
  - Are the soil organic carbon estimates realistic?

- Standing Deadwood/Trees
  - Conduct a spot check with scanned datasheets for 10 values.
  - Are minimum and maximum of DBH within each plot realistic?
  - Are decomposition classes 1,2, or 3 assigned to each dead tree consistently?
  - Are all baseline trees in the sample plot measured and information on their different attributes collected consistently?
  - Are the carbon density values calculated consistently?

- Fallen Deadwood
  - Conduct a spot check with scanned data sheets for 10 values.
  - Are the minimum and maximum of the inner and outer DBH within each plot present and realistic?
  - Are the carbon density values calculated consistently?

- Canopy Cover Percentage
  - Are the number of sky squares and number of canopy cover squares everywhere equal to 24 for each plot?
  - Are there 4 densitometer measurements per plot?
  - Is the average canopy cover larger than 0 and smaller than 100?
  - In a spot check with scanned datasheets, were 10 randomly selected values correct?
  - Is the correlation between canopy cover and above-ground live trees realistic?

- Soil Organic Carbon Sample Plots Information
  - Are data for all the plots sampled for soil organic carbon determination collected in consistent manner?
  - Are the soil cores taken to the needed 100 cm depth in consistent manner and without undue compaction?

- Are the soil cores consistently divided into five sub-samples of 0-5 cm; 5-15 cm; 15-30 cm; 30-50 cm; and 50-100 cm lengths?
- Have there been consistency in weighing of packing them into bags?
- Have there been consistency in in proper sub-samples IDs and have been properly labelled?

- Data Naming Conventions
  - Ensure that database files are named correctly and consistently. The efficiency of data analysis as well as error checking can be enhanced by rigorously following a strict and proper naming convention.

1.5 Data Archiving

Because of the long-term nature of DBC-1 Project activities, data archiving (maintenance and storage) is important and would include the following steps:

- Original copies of the field measurements (data sheets or electronic files) and laboratory data would be maintained in original form, placed on electronic media, and stored in a secure location.
- Copies of all data analysis, models, the final estimate of the amount of carbon sequestered, GIS products, and a copy of the measurement and monitoring reports would also be stored in a secure location (preferably offsite).

Given the period for reporting and the pace of production of updated versions of software and new hardware for storing data, electronic copies of the data and report would be updated periodically or converted to a format that can be accessed by new or updated software.

Version Log

Version	Author/s	Material changes from previous version	Release Date
1.0	Alamgir Khan Gandapur	Not applicable	10-10-2021

Appendix 7.2. Biomass Carbon Assessment

(a) Standard Operating Procedure 2 (SOP2): stratification, sample plot lay out, number, size, design and establishment			
Version	1.0	Date of Issue	10-10-2021
Purpose	This SOP describes the methods to be used to determine the locations where sampling will take place along with the sampling layout, number, size and shape of sampling plots. This SOP must be implemented prior to field data collection and requires operations in a GIS environment.		
Responsibilities	It is the responsibility of the senior staff members of Sindh Forest Department and IDC who are professional foresters to determine the sampling design including the sampling layout, number, size and shape of sample plots.		
Prerequisites	Pilot inventory survey results and the provisions of relevant modules and tools of the VERRA Methodology for Tidal Wetlands Restoration-VM003 Methodology and CDM AR Tool 3 and CDM AR Tool 14.		
Related documents	SOP 1 (SOP related to field safety) and SOP 3 (SOP related to soil organic carbon sample plot establishment and measurement taking).		
Scope	These SOPs apply to all sample plots that are to be laid out for biomass and soil organic carbon related data collection in the field.		

(b) Procedure	
Step 1: Key variables for stratification system	Sub-step 1a. The dominant factor in ex-post stratification is the age of vegetation or planting year cohorts. Therefore, the project area will be stratified based on the year of planting in 2015 and ending in the year 2026. Project area land within each stratum should be similar with respect to carbon stocks, with different strata having different carbon stocks. Sub-step 1b. Each stratum may be comprised of one large block of land or several small blocks of land, provided that all of the blocks are similar with respect to carbon stocks. Sub-step 1c. Prior to implementing this stratification approach, the strata must be chosen and a separate shapefile created for each stratum. In addition, the minimum mapping unit (which is 0.1 ha) must also have been determined and all locations within all ARR areas must meet the definition of a forest (e.g., all restored ARR polygons must meet the definition o forest). Sub-step 1d. This SOP must be repeated for each stratum separately. Sub-step 1e. In addition, due to sea level rise, some of the planted arise will be washed away while some inland areas will become intertidal and will be gradually colonized by mangrove species because of the nearby presence of mangrove seeds and propagules and planting by DBC-1 project. Such areas will need to be identified, demarcated and mapped. Sub-step 1f. Thus, additional factors in ex-post stratification include:

	• The loss of planted area due to sea level rise, giving rise to a zone actively reforested with mangrove trees but then submerged/eroded and lost. These lands will be classified as "LOSS". • The new inland areas which have become intertidal due to sea level rise. These pieces of land will be classified as "GAIN".
Step 2: Stratification of salinity for the accounting of methane	Sub-step 2a. The Indus Delta is a marine dominated system. Fresh water flows from the Indus River is very limited due to the upstream damming and only occurs during the monsoon season. Methane emission are not expected to change with the project activity because there is no alteration in fresh water flow and therefore methane emissions with the project are expected to be the same as in the baseline. Any changes, if they occur, to fresh water input from the Indus River will happen regardless of project activity. Sub-step 2b. Therefore, methane emissions from soil in the project scenario are not accounted for, as methane emissions do not increase in the project scenario compared to the baseline scenario.
Step 3: Determining and mapping planting locations in the project area	Sub-step 3a. Prior to commencement of planting activities, suitable islands for planting will be selected and the spatial coordinates of each plantation are recorded with a GPS unit. Sub-step 3b. Mangrove propagules are planted in a 3 X 3 m grid throughout the entire plantation area that is not bifurcated by a channel 3 m or more. If a larger channel is present, it is not included in the area estimates. Sub-step 3c. Once planting is completed on an island, the GIS team along with the field team measure the area by traversing the plantation perimeter with a WAAS-enabled GPS unit. Sub-step 3d. Within GIS laboratory, the field team will sit with and help the GIS laboratory staff to hand delineate the plantation area using GIS software. The GPS data are uploaded to a computer and GIS software is used to delineate the plantation area and calculate the extent of planted area. Sub-step 3e. Shapefiles of all these planted areas are prepared. Sub-step 3f. The total area planted each year, A_{WPS}, i, t, is the sum of all plantations established in that stratum in year t. Sub-step 3g. All these planted area polygons are entered into the project database along with the associated attributes which include a unique identifier, species planted, percent representation of each species in the planted area, area of the plantation, date (s) of planting, and plantation strata. Sub-step 3h. The boundaries of each plantation will be delineated by walking the perimeter with a handheld GPS unit with tracks enabled.
Step 4: Determining number of sample plots	Sub-step 4a. Tree carbon stocks will be sampled according to the stratum, which is defined by the year that the area was planted. Sub-step 4b. Equation 2 from CDM AR Tool 3 (Calculation of the number of sample plots for measurements within A/R CDM project activities) will be used to calculate the number of sample plots per stratum as follows: $$n = \left(\frac{tVAL}{E}\right)^2 * \sum_{i=1}^{m} (wi * si)^2$$ Where:

n Number of sample plots required for estimation of biomass stocks within the project boundary;

t_{VAL} *Two-sided Student's t-value at indefinite number of degrees of freedom for the required confidence interval;*

E *Acceptable margin of error (i.e., one-half of the confidence interval) in estimation of biomass stock within the project boundary; t d.m. (or t d.m. ha-1), i.e., in units used for si;*

Wi *Relative weight of the area of stratum i (i.e., the area of the stratum i divided by the Project Area);*

si *Estimated standard deviation of biomass stock in stratum i, t d.m. (or t d.m. ha-1);*

i *1,2,3, …biomass stock estimation strata within the project boundary;*

m *Number of strata*

The number of sample plots allocated to each stratum is calculated as:

$$ni = n * \frac{(wi * si)}{\sum i\ wi * si}$$

ni Number of sample plots allocated to stratum i; dimensionless;

n Number of sample plots required for estimation of biomass stocks within the project boundary;

wi Same as above;

si Same as above;

i Same as above;

Sub-step 4c. Assuming a 90% confidence interval and margin of error of 10%, a total of 163 plots are needed to be sampled at each monitoring event, although this total will not be reached until areas are planted. This total is based on a standard deviation of mature mangrove biomass based on a survey conducted by the Pakistan Forest Institute: 31.5 t d.m. ha^{-1}.

Sub-step 4d. Using the above formula, the number of plots that need to sampled in each stratum are given in the following table. However, keeping in view the fact that we need to take soil samples in at least 10 sample plots in each stratum, we will take measurements in at least 10 sample plots in each stratum.

Year Planted (Stratum)	Required number of sample plots	Actual number of sample plots in which measurements will be undertaken
2015	7	7
2016	14	14
2017	11	11
2018	8	8
2019	7	7
2020	7	7
2021	8	8
2022	18	18

	2023 | 18 | 18 2024 | 18 | 18 2025 | 18 | 18 2026 | 20 | 20 2027 | 9 | 9 Total | 163 | 163
Step 5: Laying out of sample plots	Sub-step 5a. Plot locations will be randomly located within each stratum using GIS, following CDM AR Tool 14 section 8.1.1 (Stratified random sampling). Sub-step 5b. A 10 m spatial buffer will be created around the edge of each plantation to guarantee that plots are located fully within a given plantation. Sub-step 5c. Upon the field visit, if any plots fall in a channel or mudflat (i.e., a location that was not originally planted within an area), the plot will be relocated to be 20 m away in the direction of where planting occurred. The coordinates of the plot centre will be recorded using the GPS unit.
Step 6: Determining size and shape of sample plots and measurements to be taken in each sample plot	Sub-step 6a. Each plot will consist of an 8.92 m radius circular plot, which equates to a sampling area of 250 m^2. Sub-step 6b. An initial survey will occur to determine the canopy cover within a plot. Until total tree canopy is greater than 50%, all trees with more than 50% of the basal area falling within that plot will be measured. Sub-step 6c. For all trees, the following measurements will be made: ▪ Tree height (cm) ▪ Canopy width (cm) ▪ Diameter at base (cm; 30 cm from the ground) ▪ Diameter at breast height, if applicable (DBH; 1.3 m from the ground or directly above the last prop root for Rhizophora mucronate) Sub-step 6d. If a tree has two or more dominant stems below DBH height, each stem will be treated as if it is a separate tree and DBH and canopy width will be measured for all such stems Sub-step 6e. Once total tree canopy is greater than 50%, all trees with a height greater than 1.3 m will be measured within the 8.92 m radius circle. Another nested plot with a radius of 5.64 m will be established within the larger plot. This inner nested plot will have an area of 100 m2. All trees with a height of 1.3 m or less will have the following measurements recorded in this inner plot: Tree height (cm) Canopy width (cm) Diameter at base (cm; 30 cm from the ground)
Step 7: Plot Laying out, Measurement and Monitoring Equipment	Sub-step 7a. In the field, a WAAS-enabled GPS unit will be used to navigate to the plots and to record plot locations. Sub-step 7b. Linear Measuring Tape will be used to delineate the circular plot.

	Sub-step 7c. Callipers or diameter tapes will be used for taking diameter measurements. For measuring height of trees, depending on the height of the tree in question, any suitable equipment (tree height measuring rod, clinometer, Vertex IV and transponder) will be used. Sub-step7d. All measurement readings will be repeated by the recorders to the measurement takers so that there is no error in recording the reading. Sub-step 7e. Digital camera will be used to document each plot. Sub-step 7f. Videography of each and every step in the whole process will be done including the equipment used in taking measurements. Sub-step 7g. In the laboratory, GIS software ARC GIS version 10.7.1 or greater will be used. Sub-step 7h. All the equipment to be used for measurements will be properly calibrated before use.

(c) Quality management	
QA / QC procedures	Sub-step Q1. The field team leader checks and ensures that each field crew member is aware of, understands and complies with these SOPs regarding stratification of project area, sample plots lay out, number, size, design, establishment and measurements taking and recording. Sub-step Q2. The field team leader further ensures that each step in the process is properly documented and recorded in notes form, photographic form and videographic form. Sub-step Q3. The field team leader further ensures that data recorders repeat the readings that are said to them by the measurement takers so that there is no misunderstanding of the measurement reading. Sub-step Q4. Additionally, it is also ensured that the different measurements are reasonable according to the prevailing ground situation and that there are no outliers due to mis-recording of data.

Version Log

Version	Author/s	Material changes from previous version	Release Date
1.0	Alamgir Khan Gandapur	Not applicable	10-10-2021

Appendix 7.3. Soil Carbon Assessment

a. Standard Operating Procedure 3 (Sop3): standard operating procedure for soil samples collection and soil organic carbon analysis			
Version	1.0	Date of Issue	16-10-2021
Purpose	This SOP describes the methods to be used to determine the locations where sampling will take for soil organic carbon determination, the sample plots layout, number, splitting of soil cores into sub-samples and laboratory analysis. This SOP must be implemented prior to and during field data collection.		
Responsibilities	It is the responsibility of the senior staff members of Sindh Forest Department and IDC who are professional foresters to determine the sampling design including the sampling layout, number, taking out of samples in the field, splitting of the soil samples into sub-samples, and preparation of the soil samples for laboratory analysis.		
Prerequisites	Pilot inventory survey results and the provisions of relevant modules and tools of the VERRA Methodology for Tidal Wetlands Restoration-VM0033 Methodology and CDM AR Tools A/R Methodological Tool. Calculation of the number of sample plots for measurements within A/R CDM project activities. Version 02. http://cdm.unfccc.int and A/R Methodological Tool. Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities. Version 02.1.0. EB 60 Report Annex 13. http://cdm.unfccc.int.		
Related documents	SOP 1 (Field safety SOPs) and SOP 2 (SOP related to biomass data collection for carbon accounting) and other SOPs related data collection, data entry, data storage, and QA/QC.		
Scope	These SOPs apply to all sample plots that are to be laid out for soil organic carbon related data collection in the field.		

b. Procedure	
Step 1: Stratification of Project Area Landscape	Sub-step 1a. The dominant factor in ex-post stratification is the age of vegetation or planting year cohorts. Therefore, the project area will be stratified based on the year of planting in 2015 and ending in the year 2026. Project area land within each stratum should be similar with respect to carbon stocks, with different strata having different carbon stocks. Sub-step 1b. Each stratum may be comprised of one large block of land or several small blocks of land, provided that all of the blocks are similar with respect to carbon stocks. Sub-step 1c. Prior to implementing this stratification approach, the strata must be chosen and a separate shapefile created for each stratum. In addition, the minimum mapping unit (which is 0.1 ha) must also have been determined and all locations within all ARR areas must meet the definition of a forest (e.g., all restored ARR polygons must meet the definition o forest). Sub-step 1d. This SOP must be repeated for each stratum separately.

	Sub-step 1e. In addition, the canopy cover of biomass plots in each stratum will be used to determine whether a given plot has at least 15 % canopy cover or at least 50 % canopy cover. This is assessed by calculating the crown cover area of each tree in a plot, summing cover from all trees, and dividing that by the total plot area (250 m^2).
Step 2: Determine the number of sample plots	Sub-step 2a. Ten soil samples will be collected from the field in each of the different strata keeping in view the crown or vegetation cover in the sample plot. Sub-step 2b. Equation 2 from CDM AR Tool 3 (Calculation of the number of sample plots for measurements within A/R CDM project activities) will be used to calculate the number of sample plots per stratum as follows: $$n = \left(\frac{tVAL}{E}\right)^2 * \sum_{i=1}^{m} (wi * si)^2$$ Where: *n* Number of sample plots required for estimation of biomass stocks within the project boundary; t_{VAL} Two-sided Student's t-value at indefinite number of degrees of freedom for the required confidence interval; *E* Acceptable margin of error (i.e., one-half of the confidence interval) in estimation of biomass stock within the project boundary; t d.m. (or t d.m. ha^{-1}), i.e., in units used for s_i; w_i Relative weight of the area of stratum *i* (i.e., the area of the stratum i divided by the Project Area); si Estimated standard deviation of biomass stock in stratum *i*, t d.m. (or t d.m. ha^{-1}); *i* 1,2,3, biomass stock estimation strata within the project boundary; *m* Number of strata The number of sample plots allocated to each stratum is calculated as: $$ni = n * \frac{(wi * si)}{\sum i\ wi * si}$$ *ni* Number of sample plots allocated to stratum i; dimensionless; *n* Number of sample plots required for estimation of biomass stocks within the project boundary; *wi* Same as above; *si* Same as above; *i* Same as above; Sub-step 2c. Assuming a 90% confidence interval and margin of error of 10%, a total of 163 plots are needed to be sampled at each monitoring event, although this total will not be reached until areas are planted. This total is based on a standard deviation of mature mangrove biomass based on a survey conducted by the Pakistan Forest Institute: 31.5 t d.m. ha^{-1}.

<table>
<tr><td></td><td>Sub-step 4d. Using the above formula, the number of plots that need to sampled in each stratum are given in the following table. However, keeping in view the fact that we need to take soil samples in at least 10 sample plots in each stratum, we will take measurements in at least 10 sample plots in each stratum.

<table>
<tr><th>Year Planted (Stratum)</th><th>Required number of sample plots</th><th>Actual number of sample plots in which measurements will be undertaken</th></tr>
<tr><td>2015</td><td>7</td><td>7</td></tr>
<tr><td>2016</td><td>14</td><td>14</td></tr>
<tr><td>2017</td><td>11</td><td>11</td></tr>
<tr><td>2018</td><td>8</td><td>8</td></tr>
<tr><td>2019</td><td>7</td><td>7</td></tr>
<tr><td>2020</td><td>7</td><td>7</td></tr>
<tr><td>2021</td><td>8</td><td>8</td></tr>
<tr><td>2022</td><td>18</td><td>18</td></tr>
<tr><td>2023</td><td>18</td><td>18</td></tr>
<tr><td>2024</td><td>18</td><td>18</td></tr>
<tr><td>2025</td><td>18</td><td>18</td></tr>
<tr><td>2026</td><td>20</td><td>20</td></tr>
<tr><td>2027</td><td>9</td><td>9</td></tr>
<tr><td>Total</td><td>163</td><td>163</td></tr>
</table>
</td></tr>
<tr><td>Step 3: Randomize/locate the measurement plots within the strata and target areas in the project area</td><td>Sub-step 3a. Once the number of sample plots per strata has been determined in step 2 above, a sampling grid will be used to systematically layout the sample plots on the map of the project. This is important to provide unbiased estimates of carbon stocks.

Sub-step 3b. To avoid subjective choice of plot locations (plot centers, plot reference points, movement of plot centers to more “convenient” positions), the permanent sample plots must be located randomly or systematically with a random start within each identified stratum.

Sub-step 3c. Random location of plots can be accomplished in one of two ways:

• Locate plots systematically with a random start. In this case the plots are located using a systematic method-usually on a grid, with the location of the first points on the grid determined randomly. This must be undertaken prior to field work, with the plot locations specified on the, and locations specified either as distance and direction from a known point or as a GPS coordinate.
• Locate individual plots randomly, using a randomization procedure in a GIS to specify the coordinates of each plot.

Sub-step 3d. Since each stratum consists of sites that are geographically separated; therefore, the plots to be allocated to each site would be in proportion of the site area to the total stratum area with rounding of the fractions. For</td></tr>
</table>

	example, if one stratum consists of three geographically separated sites, then it is proposed to: a. Divide the total stratum area by the number of plots, resulting in the average area represented by each plot b. Divide the area of each site by this average area per plot, and assign the integer part of the result to this site, e.g., if the division results in 6.3 plots, then 6 plots are assigned to this site, and 0.3 plots are carried over to the next site, and so on. Sub-step 3e. Once the randomization is completed, the GPS coordinate, administrative location, and stratum of each plot must be recorded and archived. Sub-step 3f. In addition to random location of the plots, it is critical that plot sampling is undertaken at the same time of year each time repeat sampling at permanent sample plots is undertaken. The goal is to sample the plots under, to the greatest degree possible, the same ecological and treatment conditions with each repeat sampling. Thus, the day and month of establishment of permanent sample plots, and the ecological conditions existing at that time, must be recorded. Future samples at these plots should be established within 15 days of the same day and month in the year in which the plots are resampled, unless significantly changed ecological or treatment conditions mandate a greater gap between the initial sampling date and a specific later repeat sampling date.
Step 4: Size and shape of sample plots	Sub-step 4a. Soil samples will be taken within the centre of each biomass plot, which are of circular shape and have a radius of 8.92 m. Sub-step 4b. An initial survey will occur to determine the canopy cover within a plot. Until total tree canopy is 50% or less, there is one circular plot where the different biomass related and soil sample are taken. Sub-step 4c. Once total tree canopy is greater than 50%, another nested plot with a radius of 5.64 m will be established within the larger plot of 8.92 m radius. Soil samples in this case will be collected from within the centre of this inner circular plot.
Step 5: Soil samples collection and division into sub-samples	Sub-step 5a. The first step in mangrove soil sampling is to measure (organic) soil depth to parent material, bedrock, or coral sands with a probe such as bamboo pole, soil augur, or steel pole. Sub-step 5b. At the sampling location, remove the organic litter from the surface. Then steadily insert the augur vertically into the soil until the top of the sampler is level with the soil surface. If the augur will not penetrate to full depth, do not force it, as it may be obstructed by a large root or some other hard material; instead try another location. Once at depth, twist the augur in a clock-wise direction a few times to cut through any remaining fine roots. Gently pull out of the soil while continuing to twist it, to assist in retrieving a complete soil sample. If an undisturbed sample has not been obtained, clean the augur and try another location. Sub-step 5c. One-meter long soil soils samples (loose and uncompacted soil) are taken. Sub-step 5d. Once an undisturbed soil core has been extracted, a ruler or tape measure can be used to determine the depths from which the samples are collected.

	Sub-step 5e. These are split into nine sub-samples of 5 cm intervals as follows: 0-5 cm, 5-10 cm, 10-15 cm, 15-20 cm, 20-25 cm, 25-30 cm, 37-42 cm, 45-50 cm, and 72-77 cm. Sub-step 5f. A single sample will also be collected for determination of both dry bulk density and carbon analysis in addition to the determination of dry bulk densities of the above given sub-samples and their carbon content analysis. Sub-step 5g. Upon collection, these soil samples are carefully placed in sealed plastic bags which are properly labelled with information such as strata, site, plot number, soil depth, date, etc. and any other information and relevant important. Sub-step 5h. The soil samples are collected from the centres of biomass plots and effort is made that these sites are not disturbed by monitoring activity. GPS coordinates of all soil samples locations are taken and recorded. Sub-step 5i. Samples will be kept cold and air-tight until transported to the laboratory. This is important to minimize any microbial activity takin place in the samples.
Step 6: Over drying of soil samples	Sub-step 6a. After collection in the field, samples should be oven dried as soon as possible. If possible, place samples in a drying oven on the day of collection. If this is not possible, it is recommended that samples be air dried to slow microbial activity and then stored in sealed vacuum bags to protect and preserve them. Sub-step 6b. Soil samples should be oven-dried to a constant mass at 60 ^{0}C or 70 ^{0}C to avoid reducing carbon contents in higher temperatures (e.g., 105 ^{0}C). Typically, it requires at least 48 hours for samples to attain a constant dry mass when dried at 60 ^{0}C. Sub-step 6c. Caution should be taken to ensure that samples are thoroughly dried before bulk density determination and carbon analysis is done. Carefully breaking up the samples into smaller pieces improves the drying process. Sub-step 6d. The sub-samples are at least 30-50 g of sample mass.
Step 7: Determination of Dry Bulk Density and presence of any carbonates	Sub-step 7a. Bulk density will be determined by taking the dry weight of each sample and dividing it by sub-sample volume. Sub-step 7b. Each soil sub-sample will be ground and homogenized. To determine if carbonates are present in a sample, a few drops of hydrochloric acid will be placed on a sub-sample of the dry
Step 8: Determination of % Organic Matter	Sub-step 8a. The dried sub-samples will be weighed and their weights recorded. Sub-step 8b. These sub-samples will then be combusted at 450 0C for 8 hours and weighed again to determine the % organic matter by loss of ignition method.
Step 9: Documentation of the process	Sub-step 9a. Digital camera will be used to document each step in the soil sample collection and analysis process. Sub-step 9b. Videography of each and every step in the whole process will also be done including the use of augur in soil samples collection, the use of knives in samples sub-division, and digital balance for taking weight measurements and other measurements as well as labelling of soil samples, their air drying, over-drying etc. Sub-step 9c. All the equipment to be used for measurements will be properly calibrated before use.

Step 10: Equipment to be used in the field and laboratory	Sub-step 10a. In the field, a WAAS-enabled or higher accuracy GPS unit will be used to record the locations of sites from which soil cores are collected. An open-faced gouge corer, measuring tape, knife, spatula, containers and bags for securely transporting soil samples to the laboratory will be used. Sub-step 10b. In the laboratory, for the LOI method of carbon determination, the equipment to be used include among others mortar and pestle for homogenization, petri dishes, beakers, desiccator, digital balance, a muffle furnace and ceramic crucibles.

c. Quality management	
QA / QC procedures	Sub-step Q1. The field team leader checks and ensures that each field crew member is aware of, understands and complies with these SOPs regarding soil samples collection in the field and measurements taking and recording. Sub-step Q2. The field team leader further ensures that each step in the process is properly documented and recorded in notes form, photographic form and videographic form. Sub-step Q3. The field team leader further ensures that the soil samples are properly handled at each step of the process from collection until their final laboratory analysis. Sub-step Q4. Additionally, it is also ensured that the different measurements are reasonable according to the prevailing ground situation and that there are no outliers due to mis-recording of data.

Version Log

Version	Author/s	Material changes from previous version	Release Date
1.0	Alamgir Khan Gandapur	Not applicable	16-10-2021

Appendix 7.4. Field Safety SOP

Standard Operating Procedure: Field Safety SOP			
Version	1.0	Date of Issue	10-10-2021
Purpose	This SOP provides for assessment of any hazards and safety conditions that need to considered when undertaking field work so as to ensure that any unnecessary risks to humans are avoided and field work is undertaken in a safe manner.		
Responsibilities	Adherence to proper field safety measures is the responsibility of any personnel who has to undertake field work. The team leader for the field work will ensure that all staff who are involved in and undertake field works observe and comply with the needed precautionary measures when they engage in any field work.		
Prerequisites	Field staff has received training in general first aid and over-all field safety including safe use of any field equipment.		
Related documents	General first aid and field safety manual.		
Scope	The guidelines and procedure given below applies to all field-based activities.		

Procedure	
Step 1: Instituting mandatory buddy system	Sub-step 1a. Field crews will include no less than two people who must be directly accompanying each other for the entire duration of field work. Ideally, field crews should include a minimum of three people. Sub-step 1b. In case of an accident resulting in injury one person may leave to seek help while another person stays with the injured crew member.
Step 2: Logging in of specific location and scheduling information	Sub-step 2a. For each day in the field, specific location and scheduling information must be logged in advance with a point person who can be reached at any time during the anticipated duration of field work. Sub-step 2b. While in the field, crew should check in with their designated point person once a day
Step 3: Carrying of effective communication tools	Sub-step 3a. Each independent crew must carry a cell phone to be able to communicate in case there is need for communication. Sub-step 3b. Crews should make sure to check batteries each time before entering the field.

Procedure	
Step 4: Trip Planning	Sub-step 4a. Trip planning will include identification of the nearest medical facility and specific directions to reach that facility. Sub-step 4b. Since there are poisonous snakes in the vicinity of the project area; therefore, arrangements need to be made for the availability of antivenins. Sub-step 4c. Protective measures also need to be taken against scorpions bites, mosquitoes, bites and organisms that may pose problems for human health.
Step 5: Carrying of identification and service cards as well as health insurance cards	Sub-step 5a. Crew members need to carry their computerized national identity cards (CNIC) with them all the time. Sub-step 5b. Institutional business cards and service cards are needed in certain restricted access areas in the proximity of project area; therefore, it is advisable to also carry the business and service cards issued to the project staff. Sub-step 5c. Personnel will carry personal and institutional insurance cards with them all the time.
Step 6: Carrying of first aid kit	Sub-step 6a. Field crew members will carry a first aid kit with them all the time. First aid kits should contain Epinephrin/Adrenalin or an antihistamine or allergic reactions (e.g., bee/wasp stings). Sub-step 6b. Since there is intense solar radiation and many insects' pests in the project area and most of its surrounding areas; therefore, sun block and insect repellents should be carried in the field. Sub-step 6c. Personnel will carry other protective materials and supplies with them at all times.
Step 7: Observance of general directions, guidelines and protection measures against Covid-19	Sub-step 7a. All field crew members will follow the general directives and guidelines issued by the Government of Pakistan and Government of Sindh with regard to covid-19. Sub-step 7b. Wearing of masks is mandatory in all public places. Sub-step 7c. Keeping and maintaining the prescribed social distance is also required to be observed while undertaking field activities in groups form. Sub-step7d. Field staff shall have Personal Protective Equipment (PPE) that may be a combination of the different items. As a minimum face masks (surgical or N95), gloves, disinfectant gels or access to washing station. Sub-step 7e. All field staff shall be trained on basic rules on how to put on/take off PPE against covid-19.
Step 8: Seeking medical help in case of emergency	Sub-step 8a. In the event of a snake-bite, injury or other health condition that requires emergency medical attention, the victim should be taken immediately to a medical facility where the needed emergency related treatment is available and can be provided. Sub-step 8b. After availing the emergency medical help, if there is need for additional medical help and referral to a specialist medical facility, it needs to be done.

Procedure	
	Sub-step 8c. The injured field member/sick person will not resume field work until he/she has fully recovered and is fit to resume the field work.
Step 9: Field clothing and other protective equipment	Sub-step 9a. Basic field clothing should be appropriate for the range of field conditions likely to be encountered. This will include: sturdy boots with good ankle support or rubber boots, long sleeves shirt and shalwar/pants, rain gear, and gloves. Sub-step 9b. Where a change of clothing is necessitated due to work in the filed by the end of the day, a change of clothes should be made. Sub-step 9c. The use of all other needed protective equipment and measures is mandatory when undertaking field work.
Step 10: The need to stay hydrated and carrying of clean drinking water	Sub-step 10a. Each field crew member shall ensure to stay sufficiently hydrated and carry enough clean water for the intended activity. Sub-step 10b. Carry iodine tablets or other water purification tablets in case there is a need to use water from an unpurified source.
Step 11:	Sub-step 11a. While on boat, make sure every-one wears a life jacket. Sub-step 11b. Use the right kind of life jackets for the situation. Sub-step 11c. Observe all boating safety measures. Sub-step 11d. Put down the cell phone when on boat. Sub-step 11e. Ensure that the boat is driven at the right and safe speed and follow all boating safety and navigational rules. Sub-step 11f. Check the weather forecast and be prepared for it to change. Sub-step 11g. Take action before a storm hits. Sub-step 11h. Ensure that the boat is in working condition and suitable for use.
Step 12: Operating motor vehicles for access to and reaching project site	Sub-step 12a. Heightened caution should be given to the motor vehicle driver while operating motor vehicles, particularly on backcountry roads where conditions are unreliable and rights-of-way are often not designated or adhered to. Sub-step 12b. All terrain vehicle should be operated at low and permissible speed limits only. Sub-step 12c. Observe all motor vehicle driving safety measures. Sub-step 12d. Take action before a road accident happens. Sub-step 12e Ensure that the motor vehicle is in working condition and suitable for use.

Procedure	
Step 13: Avoid or relocate sample plots that are located in situations where work conditions can be too hazardous	Sub-step 13a. Some plots may be too hazardous to sample at a particular time. Sub-step 13b. In such a situation, a discussion should be conducted among the team members to assess the situation. Sub-step 13c. If there is a need to relocate the sample plot, or skip the plot, that decision may be taken by the field crew members keeping in view the prevailing conditions at the time. Sub-step 13d. Make a note of the situation encountered at the site and the decision taken so that everything is properly documented.

Quality management	
QA / QC procedures	Sub-step Q1. The field team leader checks and ensures that each field crew member is aware of, understands and complies with these field safety SOPs. Sub-step Q2. The field team leader further ensures that each field worker has not health issues and is fit to do the intended field work. Sub-step Q3. The field team leader further ensures that field work members are vigilant and always avoid unnecessary risks.

Version Log

Version	Author/s	Material changes from previous version	Release Date
1.0	Alamgir Khan Gandapur	Not applicable	10-10-2021

Appendix 7.5. Field Data Collection Sheet

DBC-1 BIOMASS AND SOIL FIELD INVENTORY FORM

A. Date and Field Crew Information

Date	Team Leader	Plot Layer	Diameter Data Measurements Taker	Height Measurements Taker	Data Recorder	Soil Augur Digger	Soil Samples Collector	Soil Samples Packer and Labeller	Helper in Biomass Measurements Taking	Helper in Soil Samples Taking

B. QA/QC Information

Field Measurements Data Checker	Data Enterer into the Database	Data Entry Verifier	Data Completeness Checker	Data Consistency Checker	Data Archiver	Over-all QA/QC Responsibility	Equipment Calibrator	Dates on which QA/QC Operations performed

C. Documentation of Plot Information and Data Taking Process

Notes Taking and Processes Documentation	Photography of various steps in Plots Laying out and Data Collection	Videography of various steps in Plots Laying out and Data Collection	Notes and Documents of Labelling and Archiving Processes	Photography of Labelling and Archiving Processes	Videos of Labelling and Archiving Processes	Uploading of Documentation to Project Website	Any Other Action Taken

D. Biomass and Soil Sample Plot Information

Plot Stratum Name	Plot Number	Plot ID	Plot Geographic Information: X Coordinate: Y Coordinate: Z Value:	Plot Radius Size: Outer Plot: Inner Plot:	Plot Microsite Information: Plot lying in High lying Area Plot lying in frequently sub-merged and flooded zone Plot area prone to soil erosion due to high wave and tidal action Plot lying in area with high soil salinity levels Plot lying in area where the underlying substratum is hard and compacted Other (specify)	Coastal Erosion at Plot Site	Plot Baseline Vegetation Information	Plot Crown or Canopy Cover	No. of Tree Seedlings/ Saplings and Regeneration present in the plot	Dead and fallen wood found in the plot

E. Trees and Biomass Information

Tree No.	Tree ID	Tree Species	Diameter at 30 cm from Base or diameter at 30 cm above last prop root in case of *Rhizophora mucronata*	DBH or Diameter at 1.3 m in cm	Tree Height in cm	Tree Crown Diameter in cm	Tree Stem Forking below 1.3m height	Tree Stem Leaning	Tree Top Breaking	Tree Form	Live or Dead	Any signs of insect attack	Any signs of disease	Any Other information

F. Soil Sample Information

Main Soil Core Length (cm)	Sub-samples Lengths (cm)	Wet weight of sub-samples (g)	Air dried weight of sub-samples (g)	Laboratory: This data will be available after laboratory analysis is done and will not be available at the field stage			Bulk density in g per cm^3 estimated by dividing dry mass of sample (g) by volume of sample (cm^3)
				Oven-dried weight (g)	% Organic Matter (%OM)	% Organic Carbon estimated by dividing %OM by 1.724	
	0-5 cm						
	5-10 cm						
	10-15 cm						
	15-20 cm						
	20-25 cm						
	25-30 cm						
	37-42 cm						
	45-50 cm						
	72-77 cm						
	0-50 cm						
	0-100 cm						

Appendix 7.6. Location of sampling plots in the monitoring campaign

Selection of sample plots and laying out of sample plots to ensure randomness and avoid bias

To avoid subjective selection of polygons within a stratum for taking biomass measurements in the stratum and to further ensure randomness in plot (s) layout, the following multi-step process was followed keeping in view considerations related to accessibility, time and cost:

- Sub-division of the project area into left bank zone and right bank zone in line with the administrative sub-division of the project area boundary;
- Random allocation by drawing lots of the sample plots for different polygons within each stratum on the left bank zone as well as the right bank zone;
- Assessment of accessibility of the randomly chosen polygon;
- Replacement/substitution procedure for an inaccessible polygon/sample plot (described below);
- Random laying out of sample plot within the polygon;
- Procedure to follow in case two or more sample plots are to be laid out in the same polygon

Using the above multi-step process, the 54 sample plots were allotted to and laid out in the field during this first monitoring campaign as follows:

1. Allocation of number of sample plots to left bank zone and right bank zone

The number of sample plots allotted to left bank zone and right bank zone was done based on the planted area in each of the two zones. Keeping in view the total planted area of 73,465 ha and its location in the two zones, out of the total number of 54 sample plots, 31 plots were allotted to the left bank zone and 23 sample plots to the right bank zone. Using this approach, the following distribution of sample plots in the different strata was done to the left bank zone and right bank zone:

Stratum/ Planting Year	No. of sample plots allotted to left bank zone	No. of sample plots allotted to right bank zone	Total number of sample plots	Remarks
2015	4	3	7	Distribution of sample plots of the stratum to the left bank zone and right bank zone was done based on considerations of accessibility, covid prevalence and cost.
2016	9	5	14	-ditto-
2017	8	3	11	-ditto-
2018	4	4	8	-ditto-
2019	4	3	7	-ditto-
2020	2	5	7	-ditto-
2021	4	4	8	-ditto-
Total	**35**	**27**	**62**	

2. Allocation of sample plots within a stratum to a particular polygon

The allocation of sample plots within a stratum to a particular polygon was determined by making random draws from amongst the total number of polygons in each stratum in the left bank zone and right bank zone. Using this approach, the 54 number of sample plots were determined out of the 320 different polygons in different strata in the two project zones as shown below.

Stratum/Planting Year	Total number of polygons in the stratum	Number of polygons on Left bank zone side	Number of polygons on Right bank zone side
2015	107	87	20
2016	77	34	43
2017	54	20	34
2018	34	15	19
2019	27	10	17
2020	21	4	17
2021	20	10	10
Total	**340**	**180**	**160**

Once allotted to the different polygons in the stratum, the sample plots had to be laid out in the field based on considerations of accessibility, prevalence of covid in the area and cost considerations as described below.

3. Assessment of accessibility of polygons for laying of sample plot

Because of difficulties in accessibility, covid prevalence at the time and cost considerations, it was not possible to lay out a sample plot in certain polygons as per the random draw process cited above. Accordingly, these polygons had to be replaced/ substituted with other polygons which were again randomly chosen.

4. Replacement/substitution procedure for an inaccessible polygon/sample plot

In case the polygons randomly chosen in the second round were inaccessible too, then keeping in view the cost considerations and synchronisation of work with tide timings at the site, the principle used for plot selection was to lay out the plot in one of the nearby/accessible polygon(s) as per procedure given for establishing multiple random plots in a polygon.

5. Random laying out of sample plot within the polygon

To avoid subjective choice of plot locations within a polygon, the principle used was to walk to the centre of the polygon and locate the plot in the centre of the polygon. In case it was not possible to reach to the centre of the polygon, then the procedure adopted was to walk as far towards the centre of the polygon as was possible to walk and then lay out and establish the plot there.

The GPS coordinates of these plot locations have been taken and archived.

6. Procedure followed in case two or more sample plots were to be laid out in the same polygon

In case two or more sample plots had to be laid out in the sample plot, the procedure used was to locate the first plot in a random manner as described above and re-navigate to the polygon from another direction for the laying out of the other plots and again walk towards the centre of plot till the point walking is possible. This is necessitated by the fact as there are multiple channels in the polygons which are difficult to traverse especially with equipment.

Appendix 7.7. Analysis of Distance to Plantation Edge and Biomass Carbon Estimation using NDVI and Pictorial Analysis

That distance to plantation edge has no effect on biomass carbon content in the planted areas of DBC-1 project and therefore has not affected biomass estimation during the first monitoring campaign. This can be and therefore has been shown in either of two ways: either through pictures/photographs taken in the field which show that there is uniformity of vegetation density and growth in the planted areas, or the remote sensing based NDVI analysis. DBC-1 project has used both methods and presented its results in this Appendix 7.6. The purpose of the dual analysis is basically triangulation for more strongly establishing the point.

Taken together, the two types of analyses clearly establish the fact that except for some differences on account of inherent variability in biological organisms/plants and microsite conditions there is indeed uniformity of vegetation and growth throughout the polygon in the planted areas of 2015 to 2020. While the field-based pictures are not affected by any external factors and therefore are true representation of the ground situation, the NDVI analysis can potentially be affected by the season of the year (active plant growth season or dormant growth season) and the stage of plant life cycle (young saplings not having so much green matter vis-à-vis background or fully grown and established plants). For this reason, NDVI values vary according to the season of the year and the stage of plant life cycle.

The two types of analyses done are described and explained below.

1. NDVI analysis for showing uniformity of vegetation density and growth in planted areas

Purpose

During the first monitoring campaign, access to the interior areas of the larger plantation areas was restricted. This analysis provides justification for the assumption that the biomass levels in sample plots located closer to the plantation edge are representative of the entire plantation area.

Methods

To show this, a Landsat-derived normalised difference vegetation index (NDVI) has been used as a proxy for biomass and its trends analysed across the 7 largest plantation polygons of the 2015-2020 strata (Table A7-3. Map A7-1). The NDVI was derived from a Landsat 8 image captured on 24th January 2022.

With the exception of the 2019 stratum, the largest plantation polygon in each stratum was chosen. Two plantation polygons were chosen for 2019 - Juman Goth in the northwest of the project area and Nawaz Machi in the southeast - in order to include plantations from across the project area in the analysis.

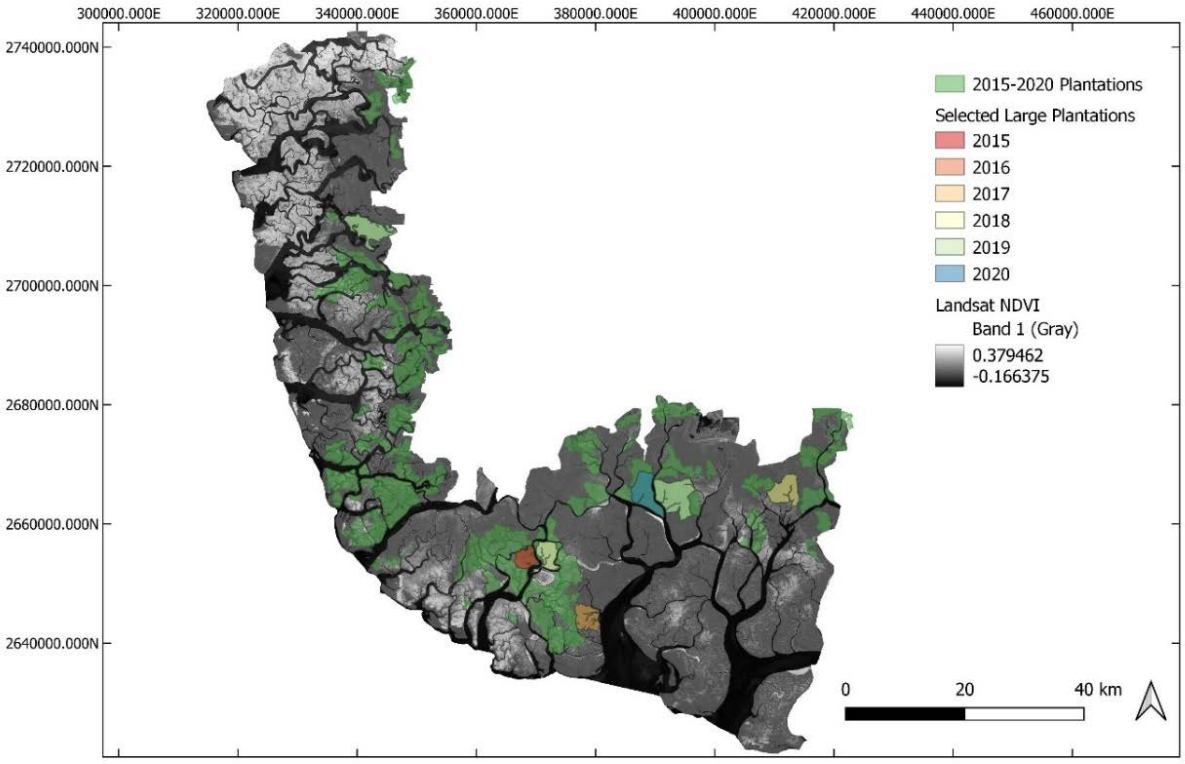
Using QGIS, a grid of sample points, 200 m apart, were generated across the selected plantations (Map 2). The Landsat NDVI values were sampled at each of these plots. It was apparent from the NDVI image that small areas around channel edges of the plantations were flooded due to the tide level. The presence of water has a strong spectral effect, causing NDVI values in these pixels to be artificially lower compared to non-flooded area with equivalent tree biomass. To prevent these areas artificially decreasing the NDVI values close to the channels, these flooded areas were masked using an NDVI threshold of < -0.05.

The distance to plantation edge was also calculated for each of these points, to enable analysis of trends between NDVI and distance to polygon edge.

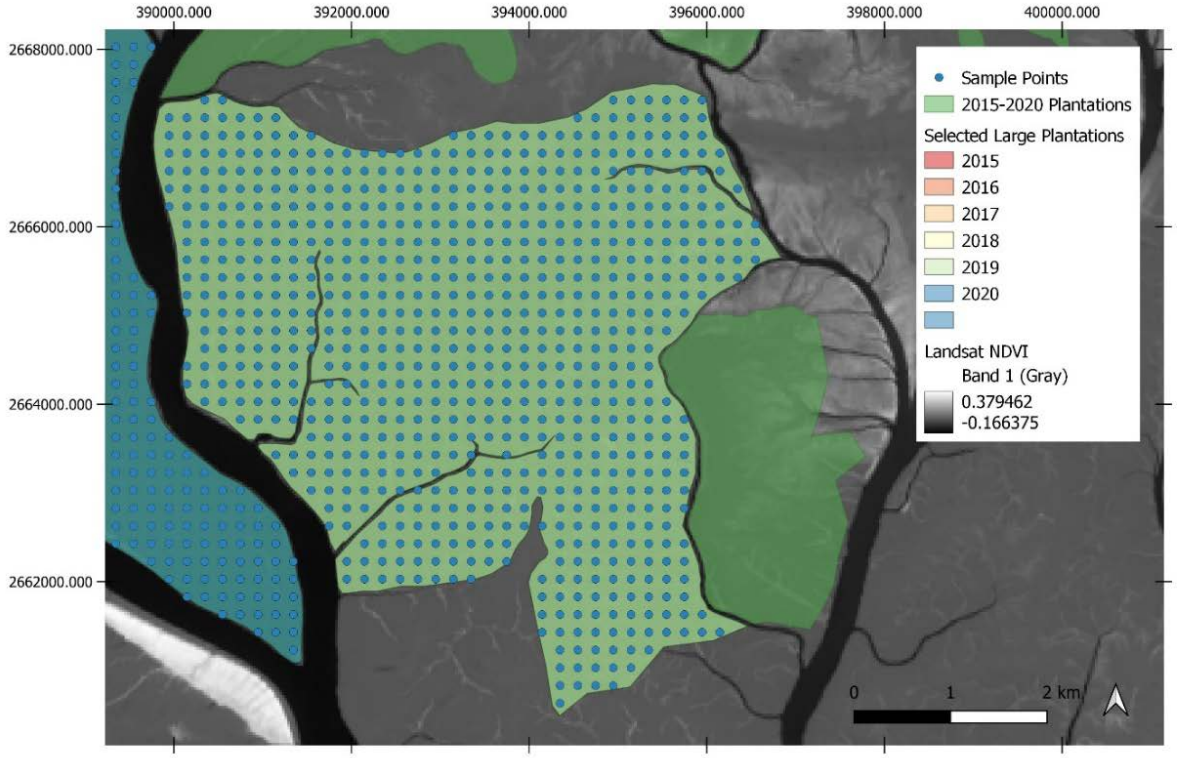
The conclusions of this analysis rely on the assumption that the Landsat NDVI can be used as a proxy for mangrove carbon stocks. In order to test this assumption, NDVI values were also extracted and analysed for each of the field sample plot locations from the 2021 monitoring campaign.

Table A7.6. Plantations used in this analysis.

Plantation name	Area (ha)	Species	Year	Latitude (degrees)	Longitude (degrees)
Majeed Miran	988.26	*Rhizophora mucronate*	2015	23.9954	67.7060
Gogaran Wali	1453.79	*Rhizophora mucronata, Avicennia marina*	2016	23.9055	67.8072
Haji Fazio/Majeed Plot	1859.69	*Rhizophora mucronata, Avicennia marina*	2017	24.0999	68.1311
Gogran Wari Plot	1212.79	*Rhizophora mucronata, Avicennia marina*	2018	24.0000	67.7413
Nawaz Machi Plot	3055.73	*Rhizophora mucronata, Avicennia marina*	2019	24.0879	67.9505
Juman Goth Plot	2114.13	*Rhizophora mucronata, Avicennia marina*	2019	24.489	67.4415
Miyon Laal Plot	2057.70	*Rhizophora mucronata, Avicennia marina*	2020	24.0944	67.9034



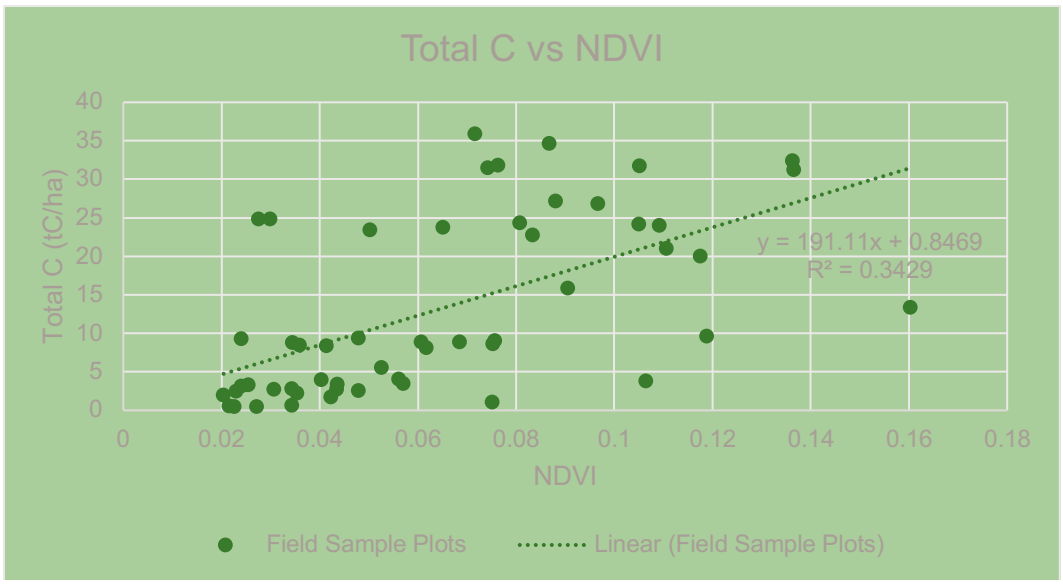
Map A7.6.1. All 2015-2020 plantation areas together with the selected large plantations and the NDVI image.



Map A7.6.2. An illustration of the point sample grid used for this analysis, with a 200 m sampling distance.

Results

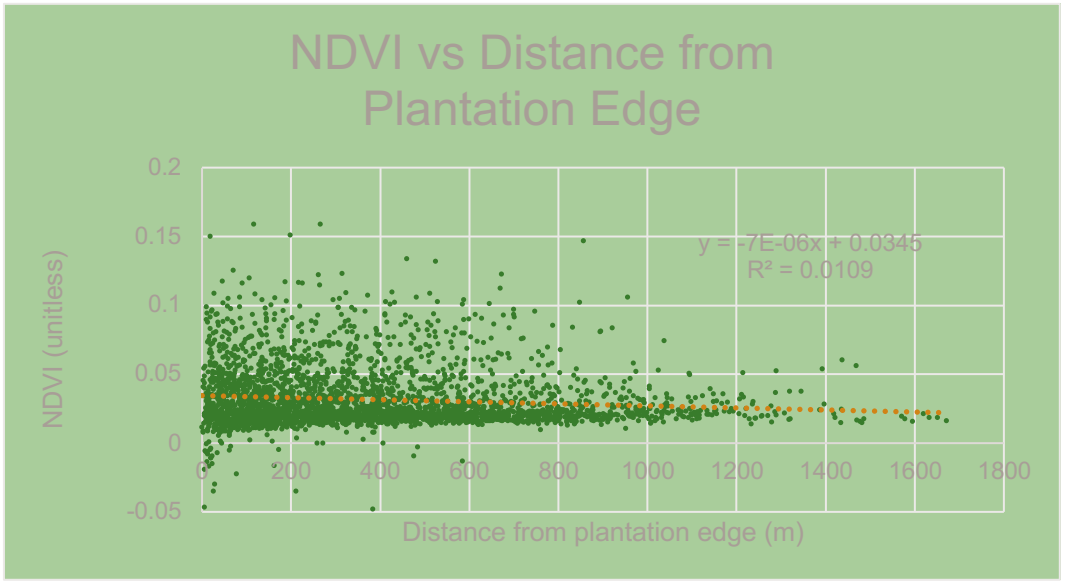
A reasonable correlation (R^2 = 0.3429) was found between NDVI and Total tC/ha (carbon data from final biomass monitoring database) (Graph 1). Suggesting that Landsat NDVI does serve as a good proxy for mangrove carbon stocks within the DBC-1 project area.



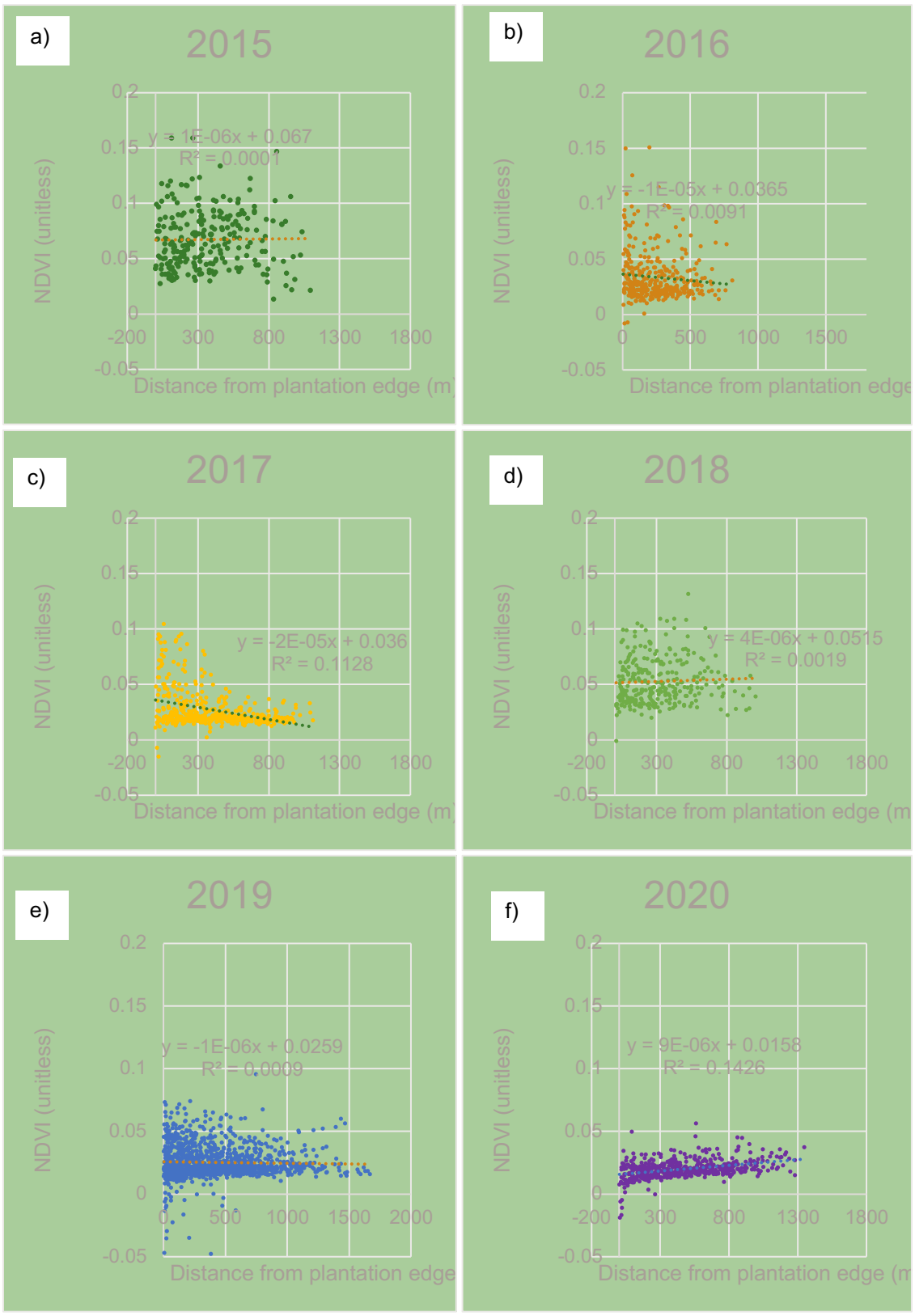
Graph 1: Positive correlation between Landsat-derived NDVI values and Total C (tC/ha).

However, conversely, no significant correlation was found between NDVI and distance to plantation edge, either for all strata data combined (Graph 2) or when the strata were analysed individually (Graphs 3 a-f).

This suggests that field data collected near to the plantation edge is indeed representative of carbon stocks throughout the plantation area.



Graph 2: No correlation between the NDVI values of all sample points across all strata.



Graph 3 a-f: No significant trends found between NDVI and distance to plantation edge within each of the individual strata (2015-2020).

Justification for NDVI Analysis and its reported results

The estimation of biomass carbon stock per hectare from NDVI is now standard practice in all forest types including mangrove forests. This is due to the fact that there exists positive correlation between

biomass carbon and NDVI. The correlation value range as shown by R^2 can vary anywhere between 0 to 1. An important question in the instant NDVI analysis is what is a good or reasonable value for R^2? The statistical answer to this question depends on the objective for the regression model; namely:

1. Are we interested in explaining the existence of relationship between the predictor and the response variable?

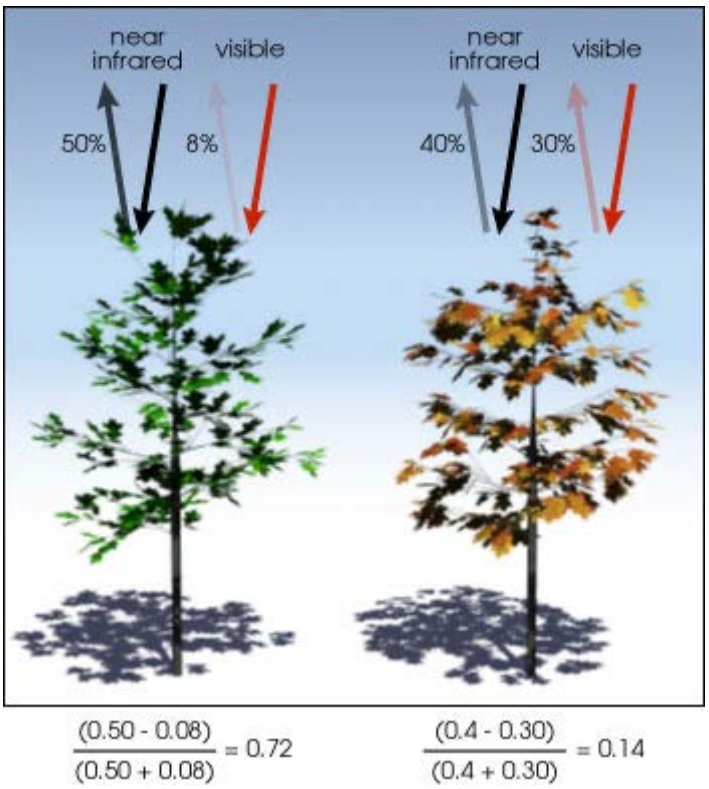
OR

2. Are we interested in predicting the response variable?

Depending on the objective, the answer to "What is a good value for R^2?" will be different. In our case, we are interested in answering the first question that is to say that there exists relationship between NDVI and biomass carbon stocks. This is all that is relevant in our case and this all that we are interested in, fully cognizant of the fact that the R^2 value of NDVI analysis does get affected by the season of the year and the age and chlorophyll content of plants. Our point and objective that there is indeed correlation between NDVI and biomass carbon stock gets established once the R^2 is not zero and is instead a positive value. This is because for statistical reasoning purposes, when the main objective for the regression model is to show the relationship between the predictor and the response variable (which is the case in our situation), although reported, the value of the R^2 is not so much relevant. What is important is that there is a positive correlation between the two variables and that the error terms are randomly distributed so that there is no systematic bias. Once the two variables (NDVI and amount of biomass carbon stock in our case) move in the same direction together and the error terms are randomly distributed (which is indeed the case in our situation), the relationship between the two variables gets established and there is no requirement for R^2 to be high. Whether the R^2 value for this regression model is 0.1 or 0.9 doesn't change this interpretation of correlation between our two variables. This is because we are simply interested in the relationship between NDVI and the biomass carbon stocks, we do not have to be overly concerned with the R^2 value of the model. Given the fact that the value of R^2 =0.3429 in our case is a positive value and is greater than zero; therefore, the point gets established that NDVI does serve as a proxy for mangrove carbon stocks within the DBC-1 project area.

Moreover, as already said that the NDVI value will vary with the season of the time when it is estimated and the age of the plants/stage of life cycle. This is on account of the fact how NDVI is calculated. The NDVI is a quantitative index of greenness ranging from 0-1, where 0 represents minimal or no greenness and 1 represents maximum greenness. Therefore, NDVI is often used as a proxy measure of vegetation health, cover and phenology (life cycle stage) over large areas.

The following picture and their values clearly make the point that the NDVI values can vary with the season of the year (whether it is a growth season or dormant season).



NDVI is calculated from the visible and near-infrared light reflected by vegetation. Green vegetation (left) absorbs most of the visible light that hits it, and reflects a large portion of near-infrared light. Pale or sparse vegetation (right) reflects more visible light and less near-infrared light. Source: NASA Earth Observatory)

As is clear from the above picture, while there exist vegetation in both instances, the NDVI value is higher when it is growing season.

2. Pictorial Analysis of Plantation Sites to show that there is uniformity of vegetation and growth throughout the planted areas polygons

The pictures of different planting cohorts given below clearly show that there is uniformity of vegetation density and growth in the planted areas and therefore taking of measurements near the edge have not affected the biomass estimates during this first monitoring campaign.



Picture 1: Showing uniformity of vegetation density and growth in the planted area (2015) throughout the Polygon and no edge effect observed.



Picture 2: Showing uniformity of vegetation density and growth in the planted area (2015) throughout the Polygon and no edge effect observed.



Picture 3: Showing uniformity of vegetation density and growth in the planted area (2015) throughout the Polygon and no edge effect observed.



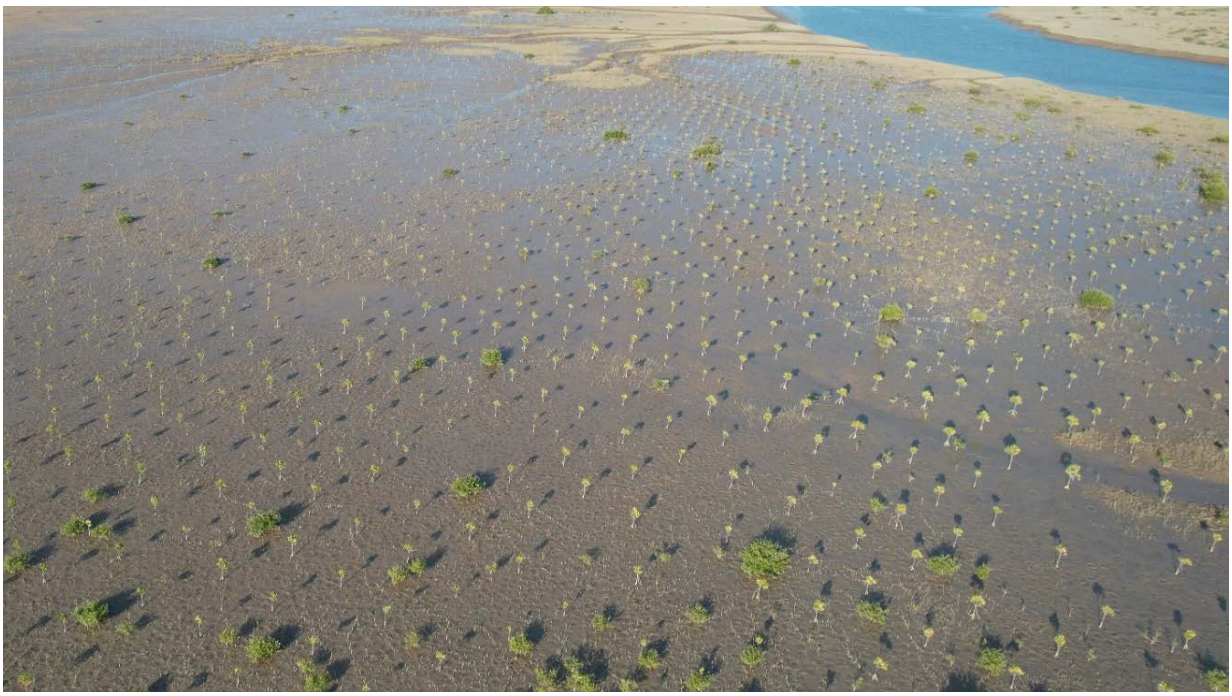
Picture 4: Showing uniformity of vegetation density and growth in the planted area (2015) throughout the Polygon and no edge effect observed.



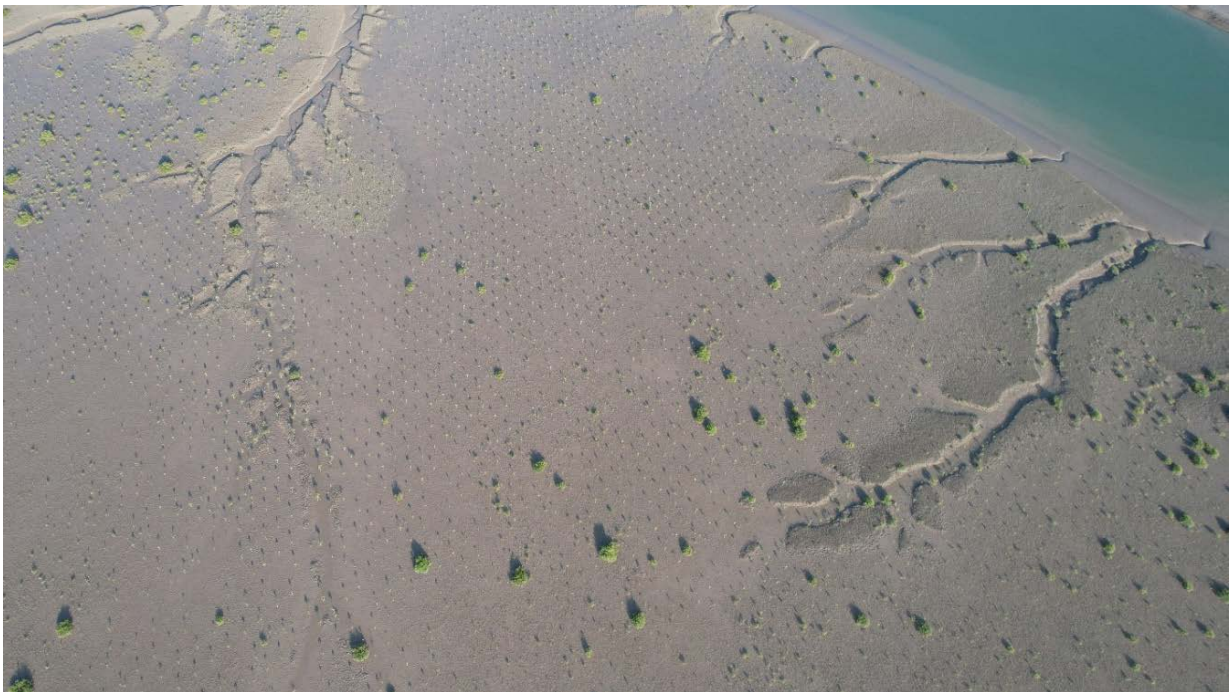
Picture 5: Showing uniformity of vegetation density and growth in the planted area (2016) throughout the Polygon and no edge effect observed.



Picture 6: Showing uniformity of vegetation density and growth in the planted area (2016) throughout the Polygon and no edge effect observed.



Picture 7: Showing uniformity of vegetation density and growth in the planted area (2017) throughout the Polygon and no edge effect observed.



Picture 8: Showing uniformity of vegetation density and growth in the planted area (2017) throughout the Polygon and no edge effect observed

Appendix 8. Details of Total Planted Areas, Eroded Areas and Persistent Planted Areas

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
1	2015	A-01, Khobar Creek	Avi, Rh	Latitude: 24.0221996 Longitude: 67.4373016	578.92	0.236714	578.68
	2015	A-02, Qalandari Creek	Avi	Latitude: 23.9958 Longitude: 67.625	19.81	0.163348	19.64
	2015	A-03, Qalandari Creek	Avi	Latitude: 24.0051994 Longitude: 67.6260986	136.17	0.716229	135.46
	2015	A-04, Bach Jo Shah	Rh	Latitude: 24.1140995 Longitude: 67.5138016	80.17	2.37655	77.80
	2015	A-05, Rorro Plot	Rh	Latitude: 24.0247993 Longitude: 67.6990967	453.79	2.1336501	451.65
	2015	A-06, Majeed Miran	Rh	Latitude: 23.9953995 Longitude: 67.7060013	988.26	0.83367	987.42
	2015	A-07, Hajamro Creek	Avi, Rh	Latitude: 24.1233006 Longitude: 67.418602	39.53	0.0501032	39.48
	2015	A-08, Leahyari Plot	Avi, Rh	Latitude: 24.0393009 Longitude: 67.748497	531.61	5.6539602	525.96
	2015	A-09, Kalka Chani	Avi	Latitude: 24.2017002 Longitude: 68.2390976	85.55	0.0008377	85.55
	2015	A-10, Kalka Chani	Avi	Latitude: 24.2110996 Longitude: 68.2312012	2.18	0.451665	1.73

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
	2015	A-11, Kalka Chani	Avi	Latitude: 24.2147007 Longitude: 68.2285995	94.86	0.926415	93.93
	2015	A-12, Kalka Chani	Avi	Latitude: 24.2152996 Longitude: 68.2210999	24.47	0.145212	24.32
	2015	A-13, Kalka Chani	Avi	Latitude: 24.2085991 Longitude: 68.2218018	3.25	0.0317896	3.22
	2015	A-14, Kalka Chani	Avi	Latitude: 24.2173004 Longitude: 68.2174988	0.83	0	0.83
	2015	A-15, Kalka Chani	Avi	Latitude: 24.2168007 Longitude: 68.2188034	2.24	0.0096387	2.23
	2015	A-16, Kalka Chani	Avi	Latitude: 24.2134991 Longitude: 68.2182007	11.26	0.0685273	11.19
	2015	A-17, Kalka Chani	Avi	Latitude: 24.2091007 Longitude: 68.2193985	1.55	0.0024532	1.55
	2015	A-18, Kalka Chani	Avi	Latitude: 24.2077007 Longitude: 68.2201996	1.38	0.0001383	1.38
	2015	A-19, Kalka Chani	Avi	Latitude: 24.2056999 Longitude: 68.2217026	7.69	0.0102903	7.68
	2015	A-20, Kalka Chani	Avi	Latitude: 24.2003002 Longitude: 68.2218018	17.37	0.0700982	17.30

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
	2015	A-21, Kalka Chani	Avi	Latitude: 24.1926003 Longitude: 68.219101	4.89	0.0814788	4.81
	2015	A-22, Kalka Chani	Avi	Latitude: 24.1914997 Longitude: 68.2052002	2.16	0.0068263	2.16
	2015	A-23, Kalka Chani	Avi	Latitude: 24.1937008 Longitude: 68.2041016	2.58	0.0398539	2.54
	2015	A-24, Kalka Chani	Rh	Latitude: 24.1900997 Longitude: 68.2072983	13.90	0.342064	13.56
	2015	A-25, Kalka Chani	Avi	Latitude: 24.1902008 Longitude: 68.2031021	8.79	0.100893	8.69
	2015	A-26, Kalka Chani	Avi	Latitude: 24.1856995 Longitude: 68.2025986	5.19	0.0395385	5.15
	2015	A-27, Kalka Chani	Avi	Latitude: 24.1842003 Longitude: 68.2068024	4.89	0.063426	4.82
	2015	A-28, Kalka Chani	Avi	Latitude: 24.1809998 Longitude: 68.2090988	7.11	0.0638096	7.04
	2015	A-29, Miyon Laal Dargah	Avi, Rh	Latitude: 24.0967007 Longitude: 67.8206024	955.80	0.530486	955.27
	2015	A-30, Sum Nala	Rh	Latitude: 24.0137997 Longitude: 67.7593994	85.41	0.477705	84.93

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
	2015	A-31, Haji Sattar at Shah Qadri	Avi	Latitude: 24.1467991 Longitude: 68.1789017	94.71	1.7403899	92.97
	2015	A-32, Bach Jo Shah Wari Khanani	Avi, Rh	Latitude: 24.1205997 Longitude: 67.5195999	13.38	0.033484	13.35
	2015	A-33, Khuni Plot	Avi, Rh	Latitude: 24.1564999 Longitude: 67.4447021	31.00	0.0460724	30.96
	2015	A-34, Khuni Plot	Avi, Rh	Latitude: 24.1580009 Longitude: 67.4411011	10.20	0.0010069	10.20
	2015	A-35, Qalandari Creek	Avi	Latitude: 24.0067005 Longitude: 67.6175003	127.03	0.25282	126.78
	2015	A-36, Kalka Chani Plot Jati	Avi	Latitude: 24.1732998 Longitude: 68.2136002	10.91	0.569255	10.34
	2015	A-37, Kalka Chani/Allah Bachayo	Avi	Latitude: 24.1879997 Longitude: 68.2195969	115.52	2.39855	113.12
	2015	A-38, Kalka Chani/Allah Bachayo	Avi	Latitude: 24.2031002 Longitude: 68.2270966	39.90	0.986962	38.92
	2015	A-39, Shah Qadri	Avi	Latitude: 24.1616993 Longitude: 68.1952972	7.12	0.0700355	7.05
	2015	A-40, Shah Qadri/Majeed	Avi	Latitude: 24.1588993 Longitude: 68.1877975	3.94	0.036481	3.90

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
	2015	A-41, Kalka Chani	Avi	Latitude: 24.2126007 Longitude: 68.2380981	42.76	0.154153	42.61
	2015	A-42, Johar Creek	Avi	Latitude: 24.2182999 Longitude: 67.9150009	58.64	0.0086644	58.64
	2015	A-43, Johar Creek	Avi	Latitude: 24.2362003 Longitude: 67.9234009	74.73	0	74.73
	2015	A-44, Haji Sattar Plot	Avi	Latitude: 24.2262993 Longitude: 67.925499	163.49	0.611977	162.87
	2015	A-45, Haji Sattar Plot	Avi	Latitude: 24.2134991 Longitude: 67.9244003	167.66	1.77197	165.89
	2015	A-46, Haji Sattar Plot	Avi	Latitude: 24.2042999 Longitude: 67.9284973	79.13	0.0922025	79.04
	2015	A-47, Johar Creek/ Majeed Bhatti area	Avi	Latitude: 24.2269993 Longitude: 67.9346008	16.89	0.0026959	16.89
	2015	A-48, Johar Creek/ Majeed Bhatti area	Avi	Latitude: 24.2227993 Longitude: 67.935997	38.09	0.01479	38.07
	2015	A-49, Johar Creek/ Majeed Bhatti area	Avi	Latitude: 24.2180004 Longitude: 67.9357986	33.86	0.266015	33.59
	2015	A-50, Johar Creek/ Majeed Bhatti area	Avi	Latitude: 24.2141991 Longitude: 67.9347	9.53	0.0055625	9.53

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
	2015	A-51, Allah Bachayo Plot	Avi	Latitude: 24.2208996 Longitude: 67.9527969	533.22	1.69336	531.53
	2015	A-52, Kodario Dargah	Avi, Rh	Latitude: 24.1578999 Longitude: 67.811203	100.40	0	100.40
	2015	A-53, Khobar Creek	Rh	Latitude: 24.0160007 Longitude: 67.4232025	105.24	0.237211	105.00
	2015	A-54, Khobar Creek	Rh	Latitude: 24.0270004 Longitude: 67.418602	12.05	0.068444	11.98
	2015	A-55, Turshian Creek	Avi	Latitude: 24.0632992 Longitude: 67.4608994	64.88	0.0011062	64.88
	2015	A-56, Bach Jo Shah Wari Khanani	Avi, Rh	Latitude: 24.1151009 Longitude: 67.5214996	82.77	0.0828701	82.69
	2015	A-57, Khareon Nala	Rh	Latitude: 24.1627998 Longitude: 67.4406967	15.31	0	15.31
	2015	A-58, Khareon Nala	Rh	Latitude: 24.1618004 Longitude: 67.4449005	11.09	0.0047077	11.08
	2015	A-59, Fattu Creek	C, Rh	Latitude: 24.1751995 Longitude: 67.4420013	56.91	0.0261563	56.88
	2015	A-60, Fattu Creek	C, Rh	Latitude: 24.1742001 Longitude: 67.4337006	35.69	0.0003282	35.69

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
	2015	A-61, Khaidy Wari	Rh	Latitude: 24.1068001 Longitude: 67.4468994	236.07	0.395627	235.67
	2015	A-62, Suleman Plot	Rh	Latitude: 23.9705009 Longitude: 67.6769028	980.84	3.9923899	976.85
	2015	A-63, Golian Wari	Rh	Latitude: 24.0559998 Longitude: 68.0759964	202.28	0.561817	201.72
	2015	A-64, Baroch Wari	Rh	Latitude: 24.0443993 Longitude: 68.093399	91.28	0.261858	91.01
	2015	A-65, Golian Wari	Rh	Latitude: 24.0209007 Longitude: 68.0656967	131.00	0.0204111	130.98
	2015	A-66, Gogaran Wari	Rh	Latitude: 24.0149002 Longitude: 67.7230988	55.32	3.7471399	51.57
	2015	A-67, Gogaran Wari	Rh	Latitude: 23.9981003 Longitude: 67.7257004	9.21	0.199529	9.01
	2015	A-68, Gogaran Wari	Rh	Latitude: 23.9939003 Longitude: 67.7303009	21.37	0	21.37
	2015	A-69, Baroch Wari	Avi	Latitude: 24.0639 Longitude: 68.0860977	27.24	0.0093467	27.23
	2015	A-70, Baroch Wari	Avi, Rh	Latitude: 24.0681992 Longitude: 68.081398	33.28	1.04678	32.23
	2015	A-71, Mal Creek	Rh	Latitude: 24.0002995	189.97	0.0000807	189.97

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
				Longitude: 67.764801			
	2015	A-72, Fattu Creek	Avi, Rh	Latitude: 24.1779995 Longitude: 67.4487991	29.70	0	29.70
	2015	A-73, Khuni Plot	Avi, Rh	Latitude: 24.1762009 Longitude: 67.4534988	38.98	0	38.98
	2015	A-74, Navy Plot	Avi, Rh	Latitude: 24.1665993 Longitude: 67.4701996	250.90	0.0359343	250.87
	2015	A-75, Kharo Chan	Avi, Rh	Latitude: 24.0044003 Longitude: 67.5128021	26.23	0	26.23
	2015	A-76, Kodario Dargah	Avi, Rh	Latitude: 24.1457996 Longitude: 67.8104019	353.14	0.0730268	353.07
	2015	A-77, Kodario Dargah	Avi, Rh	Latitude: 24.1658001 Longitude: 67.8035965	307.88	0.476821	307.41
	2015	A-78, Kodario Dargah	Avi	Latitude: 24.1718998 Longitude: 67.8237	55.42	0	55.42
	2015	A-79, Kodario Dargah	Avi	Latitude: 24.1735001 Longitude: 67.821701	10.86	0	10.86
	2015	A-80, Kodario Dargah	Avi	Latitude: 24.1741009 Longitude: 67.816597	27.69	0	27.69
	2015	A-81, Kodario Dargah	Avi	Latitude: 24.1826992 Longitude: 67.8195038	9.10	0.031892	9.07

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
	2015	A-82, Kodario Dargah	Avi, Rh	Latitude: 24.1851006 Longitude: 67.8164978	10.22	0.0001597	10.22
	2015	A-83, Kodario Dargah	Avi, Rh	Latitude: 24.1832008 Longitude: 67.814003	9.22	0	9.22
	2015	A-84, Kodario Dargah	Avi, Rh	Latitude: 24.1854 Longitude: 67.8087006	47.69	0.004356	47.68
	2015	A-85, Kodario Dargah	Avi	Latitude: 24.1893997 Longitude: 67.8069	7.50	0.0058732	7.49
	2015	A-86, Kodario Dargah	Avi, Rh	Latitude: 24.1793003 Longitude: 67.8059006	42.93	0	42.93
	2015	A-87, Kodario Dargah	Avi	Latitude: 24.1739998 Longitude: 67.802803	6.87	0.0031867	6.86
	2015	A-88, Kodario Dargah	Avi	Latitude: 24.1739998 Longitude: 67.8041	1.83	0	1.83
	2015	A-89, Kodario Dargah	Avi	Latitude: 24.1786995 Longitude: 67.7991028	12.81	0.0132739	12.80
	2015	A-90, Kodario Dargah	Avi, Rh	Latitude: 24.1770992 Longitude: 67.7966003	17.13	0	17.13
	2015	A-91, Kodario Dargah	Avi, Rh	Latitude: 24.1779003 Longitude: 67.7925034	40.44	0	40.44
	2015	A-92, Shah Bandar	Avi, Rh	Latitude: 24.1664009	94.19	0.0196569	94.17

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
				Longitude: 67.8728027			
	2015	A-93, Shah Bandar	Avi, Rh	Latitude: 24.1725998 Longitude: 67.8802032	4.96	0.0130605	4.95
	2015	A-94, Shah Bandar	Avi	Latitude: 24.1770992 Longitude: 67.8814011	13.05	0.0247379	13.03
	2015	A-95, Shah Bandar	Avi	Latitude: 24.1833992 Longitude: 67.8835983	24.05	0	24.05
	2015	A-96, Kalka Chani	Avi	Latitude: 24.2161007 Longitude: 68.2397995	8.92	0.116079	8.80
	2015	A-97, Kalka Chani	Avi	Latitude: 24.1919994 Longitude: 68.2133026	9.25	0.0004113	9.25
	2015	A-98, Haji Sattar/Shah Qadri	Avi	Latitude: 24.1224995 Longitude: 68.1873016	11.76	0.112422	11.65
	2015	A-99, Haji Sattar/Shah Qadri	Avi	Latitude: 24.1278 Longitude: 68.1835022	6.64	0.229241	6.41
	2015	A-100, Haji Sattar/Shah Qadri	Avi	Latitude: 24.1291008 Longitude: 68.1816025	2.56	0.011984	2.55
	2015	A-101, Haji Sattar/Shah Qadri	Avi	Latitude: 24.1306992 Longitude: 68.1826019	1.52	0.0080581	1.52
	2015	A-102, Haji Sattar/Shah Qadri	Avi	Latitude: 24.1322002 Longitude: 68.1811981	4.96	0.06427	4.89

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
	2015	A-103, Haji Sattar/Shah Qadri	Avi	Latitude: 24.1343002 Longitude: 68.1826019	4.55	0.0990245	4.46
	2015	A-104, Haji Sattar/Shah Qadri	Avi	Latitude: 24.0284004 Longitude: 67.4072037	45.00	0	45.00
	2015	A-105, Haji Sattar/Shah Qadri	Avi, Rh	Latitude: 23.9881992 Longitude: 67.490303	143.53	0	143.53
	2015	A-106, Haji Sattar/Shah Qadri	Avi, Rh	Latitude: 24.1308002 Longitude: 67.8161011	291.36	0.0130338	291.35
	2015	A-107 Khaidy Wari Plot	Avi, Rh	Latitude: 24.0902 Longitude: 67.4487	9.41	0	9.41
2	2016	B-01, Barochi Wari	Rh	Latitude: 24.0506992 Longitude: 68.0861969	197.48	0.569306	196.91
	2016	B-02, Majeed Plot	Avi, Rh	Latitude: 24.1261005 Longitude: 67.5087967	174.10	0.078246	174.02
	2016	B-03, Majeed Plot	Avi, Rh	Latitude: 24.0086994 Longitude: 67.6785965	659.10	2.55901	656.54
	2016	B-04, Phatord (Basriyo Plot)	Avi, Rh	Latitude: 24.1012993 Longitude: 67.5159988	12.64	0.604757	12.04
	2016	B-05, Mazar Wari Creek Plot	Avi, Rh	Latitude: 24.0944996 Longitude: 67.5143967	176.74	2.8529	173.89
	2016	B-06, Mazar	Avi, Rh	Latitude: 24.0872002	410.11	0.533532	409.58

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
		Wari Creek Rafiq Plot		Longitude: 67.4975967			
	2016	B-07, Rorro Plot	Avi, Rh	Latitude: 24.0100002 Longitude: 67.6569977	396.90	1.74861	395.16
	2016	B-08, Hajamro Creek	Avi, Rh	Latitude: 24.1105995 Longitude: 67.3890991	667.35	1.35317	666.00
	2016	B-09, Kharo chhan	Avi, Rh	Latitude: 23.9878998 Longitude: 67.6047974	126.80	0.0098225	126.79
	2016	B-10, Raisan wari dhandh	Avi	Latitude: 24.2185993 Longitude: 67.975502	245.14	0.420803	244.72
	2016	B-11, Miyon Laal Dargah	Avi, Rh	Latitude: 24.0956001 Longitude: 67.8667984	462.82	0	462.82
	2016	B-12, Miyon Laal Dargah	Avi	Latitude: 24.0774994 Longitude: 67.819603	19.80	0	19.80
	2016	B-13, Sum Nala/Sain bux Plot	Avi, Rh	Latitude: 24.1254997 Longitude: 67.4952011	304.72	0.270582	304.45
	2016	B-14, Qalandari Creek	Rh	Latitude: 23.9836998 Longitude: 67.6165009	239.43	0.0054287	239.42
	2016	B-15, Hajamro Creek	Avi, Rh	Latitude: 24.1151009 Longitude: 67.4238968	6.81	0.0000089	6.81
	2016	B-16, Hajamro Creek	Avi, Rh	Latitude: 24.1105003 Longitude: 67.4241028	27.43	0	27.43

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
	2016	B-17, Hajamro Creek	Avi, Rh	Latitude: 24.1179008 Longitude: 67.414299	105.82	0.040944	105.78
	2016	B-18, Tipan Creek	Avi	Latitude: 24.1208992 Longitude: 67.3908997	53.00	0.211527	52.79
	2016	B-19, Sum Nala /Sain bux Plot	Avi, Rh	Latitude: 24.1494007 Longitude: 67.4966965	264.73	0.0434482	264.68
	2016	B-20, Sum Nala Keti Bander	Avi, Rh	Latitude: 24.1413994 Longitude: 67.4894028	2.68	0.0404896	2.64
	2016	B-21, Sum Nala Keti Bander	Avi, Rh	Latitude: 24.1399002 Longitude: 67.4887009	1.30	0.0115731	1.29
	2016	B-22, Siddique Dablo	Avi, Rh	Latitude: 24.1261997 Longitude: 67.4372025	205.28	1.07442	204.20
	2016	B-23, Khaidy Wari	Avi, Rh	Latitude: 24.1082001 Longitude: 67.4845963	558.93	3.2251501	555.71
	2016	B-24, Joho Plot	Avi	Latitude: 24.2068005 Longitude: 67.5149994	3.27	0	3.27
	2016	B-25, Khuni Plot	Rh	Latitude: 24.1686001 Longitude: 67.4509964	18.55	0	18.55
	2016	B-26, Khuni Plot	Rh	Latitude: 24.1707001 Longitude: 67.4536972	9.39	0.0018908	9.39
	2016	B-27, Malh Creek/Shah Bandar	Avi, Rh	Latitude: 23.9162006	107.14	0.0432696	107.10

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
		Nawaz Machi Plot		Longitude: 67.7412033			
	2016	B-28, Mal Creek/Shah Bandar	Rh	Latitude: 23.9358006 Longitude: 67.7491989	484.57	2.9725001	481.60
	2016	B-29, Haji Faizo	Avi	Latitude: 24.1156998 Longitude: 68.0734024	162.06	0.0036076	162.06
	2016	B-30, Mal Creek	Rh	Latitude: 23.9615993 Longitude: 67.7562027	237.77	0.0064824	237.76
	2016	B-31, Mal Creek	Rh	Latitude: 23.9764996 Longitude: 67.7771988	1354.61	0.866627	1353.74
	2016	B-32, Ghulam Shah/ Shah Bandar	Avi, Rh	Latitude: 23.9298 Longitude: 67.7684021	372.52	0.525143	371.99
	2016	B-33, Raisen Wari Creek/Sub Mirgh Plot	Avi, Rh	Latitude: 24.1310997 Longitude: 68.0094986	232.93	0	232.93
	2016	B-34, Dadan Wari	Avi, Rh	Latitude: 23.9251003 Longitude: 67.7507019	92.07	0.659592	91.41
	2016	B-35, Mazar wari Creek Rafiq Plot	Avi, Rh	Latitude: 24.0860004 Longitude: 67.5149002	57.53	0.0048069	57.52
	2016	B-36, Mazar wari Creek Rafiq Plot	Avi, Rh	Latitude: 24.0965004 Longitude: 67.4835968	198.51	0.568503	197.94
	2016	B-37, Hajamro Creek	Avi	Latitude: 24.1142998	10.57	0	10.57

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
				Longitude: 67.4111023			
	2016	B-38, Sum Nala/Sain Bux Plot	Avi, Rh	Latitude: 24.1380997 Longitude: 67.4965973	43.68	0.0079524	43.67
	2016	B-39, Sum Nala/Sain Bux Plot	Avi, Rh	Latitude: 24.1415997 Longitude: 67.5033035	17.88	0	17.88
	2016	B-40, Sum Nala/Sain Bux Plot	Avi, Rh	Latitude: 24.1427002 Longitude: 67.4972992	16.37	0.0140455	16.35
	2016	B-41, Qalandari Creek	Rh	Latitude: 23.9932995 Longitude: 67.6187973	144.28	0.174357	144.11
	2016	B-42, Basriyo Plot	Avi	Latitude: 24.0946007 Longitude: 67.468399	504.55	2.8954	501.65
	2016	B-43, Ghulam Shah Dargah/ Shah Bandar Nawaz Machi	Rh	Latitude: 23.9167995 Longitude: 67.7231979	539.65	0.963551	538.68
	2016	B-44, Dargah Jiwan Shah	Avi, Rh	Latitude: 24.1583004 Longitude: 67.4974976	202.08	0.217074	201.86
	2016	B-45, Danboro Creek Basriyo Plot	Avi, C	Latitude: 24.0816002 Longitude: 67.4723969	116.13	0.745724	115.39
	2016	B-46, Khobar Creek	Rh	Latitude: 23.9920006 Longitude: 67.4695969	28.87	0	28.87

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
	2016	B-47, Gogaran Wari	Rh	Latitude: 24.0324001 Longitude: 67.7294998	175.79	0.069832	175.72
	2016	B-48, Mal Creek	Avi, Rh	Latitude: 23.9442005 Longitude: 67.725502	821.19	10.0768003	811.11
	2016	B-49, Kalka Channi	Avi, Rh	Latitude: 24.0039005 Longitude: 68.1791992	179.11	1.04817	178.07
	2016	B-50, Ghulam Shah Dargah	Avi, Rh	Latitude: 23.8715 Longitude: 67.756897	1018.68	10.0468998	1008.63
	2016	B-51, Rumwah Creek	Avi, Rh	Latitude: 24.2896996 Longitude: 67.4456024	313.98	3.5346301	310.45
	2016	B-52, Rumwah Creek	Avi, Rh	Latitude: 24.2907009 Longitude: 67.4583969	202.30	1.34138	200.96
	2016	B-53, Paroro Creek	Avi, Rh	Latitude: 24.4452 Longitude: 67.3940964	335.68	4.11655	331.56
	2016	B-54, Suleman Plot	Avi, Rh	Latitude: 23.9577007 Longitude: 67.6500015	644.13	10.9474001	633.18
	2016	B-55, Turshian Creek	Avi, Rh	Latitude: 24.0443993 Longitude: 67.4271011	266.90	0.0073429	266.89
	2016	B-56, Turshian Creek	Avi	Latitude: 24.0573997 Longitude: 67.4441986	59.05	0	59.05

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
	2016	B-57, Khobar Creek	Avi, Rh	Latitude: 24.0396996 Longitude: 67.4505997	104.65	0	104.65
	2016	B-58, Hajamro Creek	Avi, Rh	Latitude: 24.1040993 Longitude: 67.414299	407.00	0.0396225	406.96
	2016	B-59, Fattu Creek	Avi, Rh	Latitude: 24.1588001 Longitude: 67.4308014	140.30	0.0824232	140.22
	2016	B-60, Fattu Creek	Avi, Rh	Latitude: 24.1662998 Longitude: 67.4315033	104.01	0.0135239	104.00
	2016	B-61, Khobar Creek	Avi, Rh	Latitude: 23.9899998 Longitude: 67.4630966	2.89	0	2.89
	2016	B-62, Turshian Creek	Avi, Rh	Latitude: 23.9855003 Longitude: 67.4794998	38.10	0	38.10
	2016	B-63, Mandri Plot	Avi, Rh	Latitude: 24.0333004 Longitude: 68.0930023	162.05	0.284908	161.77
	2016	B-64, Mandri Plot	Avi, Rh	Latitude: 24.0172997 Longitude: 68.0879974	288.13	0.472425	287.65
	2016	B-65, Turshian Creek	Avi	Latitude: 24.0820999 Longitude: 67.3929977	254.07	0.0225442	254.05
	2016	B-66, Turshian Creek	Avi, Rh	Latitude: 24.0995007 Longitude: 67.3936005	84.64	0.0139763	84.63

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
	2016	B-67, Khobar Creek	Avi, Rh	Latitude: 24.0307999 Longitude: 67.4112015	68.94	0	68.94
	2016	B-68, Khaidy Wari	Avi, Rh	Latitude: 24.1040001 Longitude: 67.4353027	30.76	0	30.76
	2016	B-69, Suleman Plot	Avi, Rh	Latitude: 23.9617004 Longitude: 67.699501	385.97	33.395401	352.57
	2016	B-70, Suleman Plot	Avi, Rh	Latitude: 23.9729996 Longitude: 67.6919022	159.30	0.560599	158.74
	2016	B-71, Mal Creek	Avi, Rh	Latitude: 23.9526997 Longitude: 67.7693024	204.07	0.3262	203.74
	2016	B-72, Sum Nala	Avi, Rh	Latitude: 24.1464005 Longitude: 67.4937973	13.18	0.0634708	13.12
	2016	B-73, Mazar Wari Creek Rafiq Plot	Avi, Rh	Latitude: 24.1000996 Longitude: 67.5009995	45.50	0.0607092	45.44
	2016	B-74, Kahro Chann	Avi, Rh	Latitude: 23.9638996 Longitude: 67.6035004	63.76	0.0000012	63.76
	2016	B-75, Bajh Garho Plot	Avi	Latitude: 24.3404999 Longitude: 67.4897003	70.16	0.0027363	70.16
	2016	B-76, Gogaran Wali	Avi, Rh	Latitude: 23.9055004 Longitude: 67.8071976	1453.79	2.6807301	1451.11

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
	2016	B-77, Miyon Laal Dargah	Avi, Rh	Latitude: 24.0793991 Longitude: 67.8119965	171.83	0.001977	171.83
3	2017	C-01, Haji Faizo/Haji Sattar at Shah Qadri	Avi	Latitude: 24.1128998 Longitude: 68.0867004	266.79	1.26631	265.52
	2017	C-02, Haji Fazio/Majeed Plot	Avi	Latitude: 24.1002998 Longitude: 68.0752029	254.26	0.0065485	254.26
	2017	C-03, Waguwari Creek	Rh	Latitude: 24.3794994 Longitude: 67.4489975	113.73	0.0193609	113.71
	2017	C-04, Bajh Garho Plot	Avi	Latitude: 24.3320007 Longitude: 67.4756012	234.90	0.130624	234.77
	2017	C-05, Haji Fazio/Majeed Plot	Rh	Latitude: 24.0942001 Longitude: 68.2058029	164.27	2.70064	161.57
	2017	C-06, Nawaz Machi Plot	Avi, Rh	Latitude: 24.0037994 Longitude: 67.6417007	687.06	2.0431499	685.01
	2017	C-07, Rafeer Shareeq Wala Plot	Avi, Rh	Latitude: 24.0263996 Longitude: 67.4565964	209.28	0.155338	209.12
	2017	C-08, Nawaz Machi Plot	Avi, Rh	Latitude: 24.0282001 Longitude: 67.6449966	187.94	0.0239917	187.91
	2017	C-09, Wahid Bhatti Plot	Avi, Rh	Latitude: 24.2040997 Longitude: 67.8722992	419.45	3.30846	416.14

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
	2017	C-10, Kharo Chan Creek	Avi, Rh	Latitude: 24 Longitude: 67.6007996	117.92	0.0300564	117.89
	2017	C-11, Kharo Chan Creek	Avi, Rh	Latitude: 23.9717007 Longitude: 67.5942993	141.02	0.407978	140.62
	2017	C-12, Waguwari Creek	Avi, Rh	Latitude: 24.3707008 Longitude: 67.441803	70.44	0.0981641	70.34
	2017	C-13, Qadrio Creek/Paroro	Avi	Latitude: 24.4582005 Longitude: 67.3995972	48.54	0.0794089	48.46
	2017	C-14, Lazar Wari Plot	Rh	Latitude: 24.125 Longitude: 67.5691986	43.97	0.136646	43.83
	2017	C-15, Lazar Wari Plot	Rh	Latitude: 24.1308994 Longitude: 67.5679016	8.59	0.0977455	8.49
	2017	C-16, Suleiman Plot	Rh	Latitude: 24.0317993 Longitude: 67.6564026	109.40	0.0016762	109.40
	2017	C-17, Turshian Plot	Avi, Rh	Latitude: 24.0834007 Longitude: 67.4236984	125.62	0.174163	125.45
	2017	C-18, Ghulam Shah Dargah Plot	Avi, Rh	Latitude: 23.9020004 Longitude: 67.6850967	150.58	0.0184734	150.56
	2017	C-19, Khobar Plot	Avi, Rh	Latitude: 24.0317001 Longitude: 67.4682007	132.92	0.0648937	132.85

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
	2017	C-20, Khobar Plot	Avi, Rh	Latitude: 24.0464001 Longitude: 67.4615021	432.42	1.25449	431.17
	2017	C-21, Shah Bander Plot	Avi, Rh	Latitude: 24.1289005 Longitude: 67.8919983	777.10	0.0413423	777.06
	2017	C-22, Lazar Wari Plot	Avi, Rh	Latitude: 24.1114006 Longitude: 67.5623016	142.36	4.5406399	137.82
	2017	C-23, Lazar Wari Plot	Avi, Rh	Latitude: 24.1261005 Longitude: 67.5605011	179.21	0.243314	178.96
	2017	C-24, Lazar Wari Plot	Avi, Rh	Latitude: 24.1100006 Longitude: 67.5509033	92.47	0.249522	92.22
	2017	C-25, Gharho Plot	Avi, Rh	Latitude: 24.3283005 Longitude: 67.5438995	573.21	4.7659702	568.44
	2017	C-26, Gharho Plot	Avi, Rh	Latitude: 24.3379002 Longitude: 67.5594025	97.36	2.3742299	94.98
	2017	C-27, Dabbo Plot	Avi, Rh	Latitude: 24.3316002 Longitude: 67.5082016	133.28	0.949937	132.33
	2017	C-28, Gharho Plot	Avi, Rh	Latitude: 24.3227997 Longitude: 67.5221024	97.22	0.73113	96.48
	2017	C-29, Dabbo Plot	Avi, Rh	Latitude: 24.3129005 Longitude: 67.4972992	330.50	0.288907	330.21
	2017	C-30, Dabbo Plot	Avi, Rh	Latitude: 24.3553009	187.40	0.79345	186.61

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
				Longitude: 67.4960022			
	2017	C-31, Gharho Plot	Avi, Rh	Latitude: 24.2933998 Longitude: 67.5121002	611.41	11.8104	599.60
	2017	C-32, Gharho Plot	Avi, Rh	Latitude: 24.3638 Longitude: 67.5416031	30.02	0.456297	29.56
	2017	C-33, Gharho Plot	Avi, Rh	Latitude: 24.3579006 Longitude: 67.5314026	407.17	2.23789	404.94
	2017	C-34, Gharho Plot	Avi, Rh	Latitude: 24.3554001 Longitude: 67.5147018	63.78	0.213494	63.57
	2017	C-35, Gharho Plot	Avi, Rh	Latitude: 24.3785992 Longitude: 67.520401	212.43	0.401438	212.02
	2017	C-36, Gharho Plot	Avi, Rh	Latitude: 24.3708 Longitude: 67.5054016	42.70	0.0009521	42.70
	2017	C-37, Gharho Plot	Avi, Rh	Latitude: 24.4139996 Longitude: 67.4916	632.48	6.3839002	626.09
	2017	C-38, Qadrio Creek/Paroro	Avi	Latitude: 24.4533005 Longitude: 67.4116974	109.64	0.428833	109.21
	2017	C-39, Bhambhore Plot	Avi, Rh	Latitude: 24.7115993 Longitude: 67.495903	174.51	0.464413	174.05
	2017	C-40, Haji Fazio/Majeed Plot	Avi, Rh	Latitude: 24.0869007 Longitude: 68.1765976	1075.76	4.4982901	1071.26

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
	2017	C-41, Kalka Channi Plot	Avi, Rh	Latitude: 24.0531006 Longitude: 68.1953964	574.49	0.224774	574.26
	2017	C-42, Kalka Channi Plot	Avi, Rh	Latitude: 24.0216007 Longitude: 68.1752014	123.20	0.127787	123.07
	2017	C-43, Gharho Plot	Avi, Rh	Latitude: 24.3495998 Longitude: 67.5682983	104.75	0.0625709	104.69
	2017	C-44, Gharho Plot	Avi, Rh	Latitude: 24.3654003 Longitude: 67.5531998	199.67	1.5959001	198.07
	2017	C-45, Haji Fazio/Majeed Plot	Avi, Rh	Latitude: 24.0998993 Longitude: 68.1311035	1859.69	3.0657301	1856.62
	2017	C-46, Haji Fazio/Majeed Plot	Avi, Rh	Latitude: 24.1100998 Longitude: 68.1044998	278.16	0.222102	277.93
	2017	C-47, Haji Fazio/Majeed Plot	Avi, Rh	Latitude: 24.1438999 Longitude: 68.1668015	284.76	0.475081	284.28
	2017	C-48, Haji Fazio/Majeed Plot	Avi, Rh	Latitude: 24.1599007 Longitude: 68.1717987	450.03	0.263911	449.76
	2017	C-49, Kodario Dargah	Avi, Rh	Latitude: 24.1688995 Longitude: 67.7770996	224.85	0.0174719	224.83
	2017	C-50, Haji Fazio/Majeed Plot	Avi, Rh	Latitude: 24.1587009 Longitude: 68.2089996	704.80	6.6240702	698.18

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
	2017	C-51, Keti Bander Plot	Avi, Rh	Latitude: 24.1427994 Longitude: 67.4128036	456.43	8.0883799	448.34
	2017	C-52, Lazar Wari Plot	Avi, Rh	Latitude: 24.1100998 Longitude: 67.5328979	91.75	0.0316077	91.71
	2017	C-53, Chhan Plot	Avi, Rh	Latitude: 24.2068996 Longitude: 67.4222031	56.27	0.148561	56.12
	2017	C-54, Qadrio Creek/Paroro	Avi, Rh	Latitude: 24.4517994 Longitude: 67.427002	109.16	0.0910447	109.07
4	2018	D-01, Janwari Dhand	Avi, Rh	Latitude: 24.7070999 Longitude: 67.4849014	113.67	0.698324	112.97
	2018	D-02, Katori Waro Dabo Plot	Ag, Avi, C	Latitude: 24.4032001 Longitude: 67.4297028	310.01	0.168931	309.84
	2018	D-03, Ghulam Shah Dargah	Rh	Latitude: 23.8964996 Longitude: 67.7376022	858.70	9.4699602	849.23
	2018	D-04, Nawaz Machi Plot	Avi, Rh	Latitude: 24.2166004 Longitude: 68.1985016	506.75	0.0274738	506.72
	2018	D-05, Kather Karim	Avi, C, Rh	Latitude: 24.0244999 Longitude: 67.6595993	106.53	0.370491	106.15
	2018	D-06, Kather Karim	Avi, Rh	Latitude: 24.0238991 Longitude: 67.6722031	56.51	0.0054659	56.50
	2018	D-07, Ghulam	Rh	Latitude: 23.9171009	262.60	0.08869	262.51

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
		Shah Dargah		Longitude: 67.7623978			
	2018	D-08, Gogaran Plot	Rh	Latitude: 23.9006004 Longitude: 67.7802963	469.32	1.6702	467.65
	2018	D-09, Malook Shah Dargah Kodari Sub Creek	Avi	Latitude: 24.1634998 Longitude: 67.7879028	144.88	0.0000777	144.88
	2018	D-10, Khanario Plot	Avi, C	Latitude: 24.4053001 Longitude: 67.4113998	197.70	0.903882	196.80
	2018	D-11, Katori Waro Dabo Plot	Ag, Avi, C	Latitude: 24.4018002 Longitude: 67.4179993	50.96	0.0391667	50.92
	2018	D-12, Gogran Wari Plot	Avi, Rh	Latitude: 24 Longitude: 67.7413025	1212.79	2.1234	1210.67
	2018	D-13, Gharho Jetty Plot	Avi, Rh	Latitude: 24.2992992 Longitude: 67.5372009	384.11	0.872924	383.24
	2018	D-14, Qadrio Plot	Avi, Rh	Latitude: 24.4389 Longitude: 67.441803	502.27	7.4717302	494.79
	2018	D-15, Gharho Plot	Avi, Rh	Latitude: 24.3880997 Longitude: 67.5323029	578.82	1.0090899	577.81
	2018	D-16, Hajamro Plot	Avi, Rh	Latitude: 24.1623001 Longitude: 67.3892975	307.14	0.659869	306.48
	2018	D-17, Hajamro Plot	Avi, Rh	Latitude: 24.1473999 Longitude: 67.3872986	446.18	1.84567	444.33

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
	2018	D-18, Bhal Goth Plot	Avi, Rh	Latitude: 24.2089996 Longitude: 67.4983978	750.31	0.961552	749.35
	2018	D-19, Bhal Goth Plot	Avi, Rh	Latitude: 24.191 Longitude: 67.5076981	140.84	0.505514	140.33
	2018	D-20, Bhal Goth Plot	Avi, Rh	Latitude: 24.1972008 Longitude: 67.492897	132.73	0.941224	131.79
	2018	D-21, Bhal Goth Plot	Avi, Rh	Latitude: 24.2035999 Longitude: 67.5028992	121.61	0.642362	120.97
	2018	D-22, Bhal Goth Plot	Avi, Rh	Latitude: 24.2122993 Longitude: 67.501503	263.21	2.0416901	261.17
	2018	D-23, Sim Nala Plot	Avi, Rh	Latitude: 24.1163998 Longitude: 67.5479965	97.75	0.0926291	97.65
	2018	D-24, Bhal Goth Plot	Avi	Latitude: 24.1678009 Longitude: 67.5059967	134.70	0.0000202	134.70
	2018	D-25, Majeed Bhatti Plot	Avi, Rh	Latitude: 23.9855995 Longitude: 67.6344986	173.37	1.7705801	171.60
	2018	D-26, Bachayo Plot	Avi, Rh	Latitude: 23.9251003 Longitude: 67.6087036	126.87	0.0373524	126.83
	2018	D-27, Ghulam Shah Dargah	Avi, Rh	Latitude: 23.8754997 Longitude: 67.7854996	532.85	1.11338	531.74
	2018	D-28, Paroro Plot	Avi, Rh	Latitude: 24.3532009	199.23	0.260282	198.97

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
				Longitude: 67.4857025			
	2018	D-29, Dabbo Plot	Avi, Rh	Latitude: 24.5097008 Longitude: 67.3797989	213.74	0.693083	213.05
	2018	D-30, Paroro Plot	Avi, C, Rh	Latitude: 24.4204998 Longitude: 67.4220963	726.15	1.5663199	724.58
	2018	D-31, Gogaran Plot	Rh	Latitude: 23.9055996 Longitude: 67.7869034	44.69	0.134706	44.56
	2018	D-32, Gogaran Plot	Rh	Latitude: 23.9060993 Longitude: 67.7699966	72.24	0.0053693	72.23
	2018	D-33, Majeed Bhatii Plot	Avi, Rh	Latitude: 23.9839993 Longitude: 67.6268997	63.13	0.909592	62.22
	2018	D-34, Gogaran Plot	Avi, Rh	Latitude: 23.9360008 Longitude: 67.7863007	171.41	0.195744	171.21
5	2019	E-01, Malh Sub Creek	Rh	Latitude: 23.8661995 Longitude: 67.7863007	157.04	0.149496	156.90
	2019	E-02, Katori Wari Dabo/Pharwaro darya/plot	Avi, Rh	Latitude: 24.3864002 Longitude: 67.3839035	241.54	0.151529	241.39
	2019	E-03, Kote Wari Creek/kotiwaro darya plot	Avi, Rh	Latitude: 24.3945999 Longitude: 67.3675003	320.96	1.03292	319.93
	2019	E-04, Katorioro	Avi, Rh	Latitude: 24.405899	393.64	0.916285	392.72

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
		Creek/parharo plot		Longitude: 67.3908997			
	2019	E-05, Nawaz Machi Plot	Avi, Rh	Latitude: 24.0879002 Longitude: 67.9505005	3055.73	2.29232	3053.44
	2019	E-06, Nawaz Machi Plot	Avi, Rh	Latitude: 24.0786991 Longitude: 67.9831009	550.53	0.104091	550.42
	2019	E-07, Majeed bhatti Plot	Avi, Rh	Latitude: 24.0319004 Longitude: 67.6827011	206.40	0.501389	205.90
	2019	E-08, Wagu Wari Creek/Waggo crocodile plot	Avi, Rh	Latitude: 24.3721008 Longitude: 67.4704971	29.37	0.482754	28.89
	2019	E-09, Near Windmill/Jakhi Bandar	Rh	Latitude: 24.6898994 Longitude: 67.4941025	94.10	0.485156	93.62
	2019	E-10, Near Windmill	Rh	Latitude: 24.6839008 Longitude: 67.4979019	5.87	0.120858	5.75
	2019	E-11, Near Windmill	Rh	Latitude: 24.6865005 Longitude: 67.4989014	2.85	0.0359323	2.81
	2019	E-12, Zaffry company	Avi	Latitude: 24.6942997 Longitude: 67.5021973	44.43	0.125102	44.31
	2019	E-13, Near Windmill	Rh	Latitude: 24.6835995 Longitude: 67.4947968	1.92	0.0545803	1.87
	2019	E-14, Zafar wind mill company/A	Avi, Rh	Latitude: 24.7217007	209.00	0.141406	208.86

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
		hmed khaskheli		Longitude: 67.4590988			
	2019	E-15, Zafar wind mill company/Ahmed khaskheli	Avi, Rh	Latitude: 24.0345001 Longitude: 67.6645966	190.14	0.272146	189.87
	2019	E-16, Suleiman Plot	Avi, Rh	Latitude: 24.0408001 Longitude: 67.6641998	78.19	0.0129618	78.18
	2019	E-17, Majeed Bhatti Plot	Avi, Rh	Latitude: 24.6142998 Longitude: 67.4828033	445.96	1.6426899	444.31
	2019	E-18, Juman Goth Plot	Avi, Rh	Latitude: 24.4890003 Longitude: 67.4414978	2114.13	5.6866298	2108.44
	2019	E-19, Paroro Plot	Avi, Rh	Latitude: 24.3829994 Longitude: 67.4618988	194.52	0.208802	194.31
	2019	E-20, Paroro Plot	Avi, Rh	Latitude: 24.3789005 Longitude: 67.4832993	350.03	0.0538336	349.98
	2019	E-21, Basriyo Plot	Rh	Latitude: 24.3150997 Longitude: 67.5121002	124.68	0.127885	124.55
	2019	E-22, Sajan Wari Plot	Avi, Rh	Latitude: 24.0972996 Longitude: 67.5538025	118.97	3.00793	115.96
	2019	E-23, Sajan Wari Plot	Avi, Rh	Latitude: 24.0953999 Longitude: 67.5379028	133.00	11.4066	121.59
	2019	E-24, Khobar Plot	Rh	Latitude: 23.9869003 Longitude: 67.4604034	28.92	0	28.92

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
	2019	E-25, Khobar Plot	Rh	Latitude: 23.9834995 Longitude: 67.4604034	7.36	0	7.36
	2019	E-26, Khobar Plot	Rh	Latitude: 23.9794006 Longitude: 67.4586029	65.00	0.0002165	65.00
	2019	E-27, Majeed Plot	Avi, Rh	Latitude: 24.0214996 Longitude: 67.6194	204.16	0.0189842	204.14
6	2020	F-01, Janwari Dhand/Bhamboor Chatka Plot	Rh	Latitude: 24.7171993 Longitude: 67.4804001	51.91	0	51.91
	2020	F-02, Miyon Laal Dargh Waro Plot	Avi, Rh	Latitude: 24.0760994 Longitude: 67.7884979	637.77	0.121578	637.65
	2020	F-03, Basrio/Plot	Avi, Rh	Latitude: 24.3101006 Longitude: 67.5625	316.96	0.135683	316.83
	2020	F-04, Danboro Creek /Plot	Avi, Rh	Latitude: 24.0706997 Longitude: 67.4810028	414.91	0.0152346	414.90
	2020	F-05, Sub Creek Mirgh Plot	Avi, Rh	Latitude: 24.1420002 Longitude: 67.9600983	1087.92	0.294017	1087.63
	2020	F-06, Jamali Plot	Rh	Latitude: 24.0566998 Longitude: 67.4906998	601.27	4.0304999	597.24
	2020	F-07, Bhori Khobar/Plot	Avi, Rh	Latitude: 24.0862999 Longitude: 67.5240021	19.69	0.0347128	19.65

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
	2020	F-08, Wango Creek	Avi, Rh	Latitude: 24.6760998 Longitude: 67.4447021	903.63	0.254318	903.37
	2020	F-09, Near Windmill	Rh	Latitude: 24.6889992 Longitude: 67.4834976	134.91	0.53058	134.38
	2020	F-10, Janwari Dhand	Rh	Latitude: 24.7161007 Longitude: 67.5046997	215.51	0	215.51
	2020	F-11, Zafar wind mill company/Ahmed khaskheli	Rh	Latitude: 24.7119007 Longitude: 67.4695969	203.43	0.027568	203.41
	2020	F-12, Basriyo Plot	Rh	Latitude: 24.2903004 Longitude: 67.5254974	74.65	0.0771145	74.57
	2020	F-13, Chhan Creek Plot	Avi, Rh	Latitude: 24.2175999 Longitude: 67.4374008	145.29	0.270725	145.02
	2020	F-14, Joho Plot	Avi, Rh	Latitude: 24.2504005 Longitude: 67.5028992	248.50	1.51468	246.98
	2020	F-15, Gharho Plot	Avi, Rh	Latitude: 24.2688007 Longitude: 67.5205994	572.31	1.58463	570.73
	2020	F-16, Gharho Plot	Avi, Rh	Latitude: 24.2721004 Longitude: 67.5008011	660.24	34.2821007	625.96
	2020	F-17, Bhori Khobar Plot	Avi, Rh	Latitude: 24.0790005 Longitude: 67.5183029	224.04	1.51091	222.53

Stratum	Planting Year	Plantation Polygon No. and Reference	Species Planted	Plantation Polygon Coordinates	Planted Area	Eroded Area	Persistent Planted Area
	2020	F-18, Miyon Laal Plot	Avi, Rh	Latitude: 24.0944004 Longitude: 67.9033966	2057.70	6.8547001	2050.85
	2020	F-19, Salt Farm Plot	Avi, Rh	Latitude: 24.7374992 Longitude: 67.4991989	258.04	0.366223	257.68
	2020	F-20, Bhori Khobar Plot	Avi, Rh	Latitude: 24.0706005 Longitude: 67.5080032	118.82	0.0680919	118.75
	2020	F-21, Mirgh Shah Plot	Rh	Latitude: 24.1250992 Longitude: 67.9366989	437.36	1.77388	435.58

Appendix 9. Comparative Table of Trend of Birds

Birds Data of Indus Delta Second Monitoring								
S No	Common Name	Scientific Name	Baseline Data	MR-1	MR-2	%	Status	Residential / Migratory
Passeriformes (Shrikes)								
1	Bay-backed Shrike	*Lanius vittatus*	4	0	6	0.08	Least Concern	Wintering
Passeriformes (Drongos)								
2	Black Drongo	*Dicrurus macrocercus*	30	0	45	0.57	Least Concern	Year Around
Passeriformes (Cisticolas, Prinias)								
3	Rufous-fronted Prinia	*Prinia buchanani*	5	0	3	0.04	Least Concern	Year Around
Passeriformes (Babblers)								
4	Jungle Babbler	*Turdoides striata*	0	0	20	0.25	Least Concern	Year Around
Passeriformes (Munia, Silverbill, Sunbird)								
5	Purple Sunbird	*Cinnyris asiaticus*	23	0	40	0.51	Least Concern	Year Around
Passeriformes (Fairy Flycatchers)								
6	Indian Paradise Flycatcher	*Terpsiphone paradisi*	0	0	3	0.04	Least Concern	Wintering
Passeriformes (Larks)								
7	Sand Lark	*Alaudala raytal*	5	0	10	0.13	Least Concern	Year Around
Passeriformes (Swallows and Martins)								
8	Barn Swallow	*Hirundo rustica*	75	0	300	3.81	Least Concern	Wintering
9	Wire-tailed Swallow	*Hirundo smithii*	0	20	75	0.95	Least Concern	Year Around
Passeriformes (Bulbuls)								
10	White-eared Bulbul	*Pycnonotus leucotis*	35	0	75	0.95	Least Concern	Year Around
11	Red-vented Bulbul	*Pycnonotus cafer*	44	0	50	0.63	Least Concern	Year Around
Passeriformes (White-eyes)								
12	Indian White-eye	*Zosterops palpebrosus*	23	0	20	0.25	Least Concern	Year Around
Passeriformes (Flycatchers)								
13	Indian Robin	*Copsychus fulicatus*	8	0	6	0.08	Least Concern	Year Around
Passeriformes (Chats)								
14	Pied Bushchat	*Saxicola caprata*	14	0	24	0.30	Least Concern	Year Around
Passeriformes (Starlings)								
15	Rosy Starling	*Pastor roseus*	0	0	200	2.54	Least Concern	

16	Common Myna	*Acridotheres tristis*	0	0	150	1.90	Least Concern	Year Around
Passeriformes (Wagtails and Pipits)								
17	Gray Wagtail	*Motacilla cinerea*	1	0	0	-	Least Concern	Wintering
18	Citrine Wagtail	*Motacilla citreola*	13	0	23	0.29	Least Concern	Wintering
19	Western yellow Wagtail	*Motacilla flava*	6	3	10	0.13	Least Concern	Passage Migrant
20	White Wagtail	*Motacilla alba*	12	0	15	0.19	Least Concern	Wintering
Passeriformes (Sparrows)								
21	House Sparrow	*Passer domesticus*	170	0	150	1.90	Least Concern	Year Around
Pelecaniformes (Pelicans)								
22	Dalmatian Pelican	*Pelecanus crispus*	4	0	7	0.09	Near Threatened	Wintering
23	Great White Pelican	*Pelecanus onocrotalus*	5	3	4	0.05	Least Concern	Wintering
Phoenicopteriformes (Flamingos)								
24	Greater Flamingo	*Phoenicopterus roseus*	45	33	80	1.01	Least Concern	Passage Migrant
25	Lesser Flamingo	*Phoeniconaias minor*	1	0	1	0.01	Near Threatened	Year Around
Anseriformes (Ducks and Geese)								
26	Common Shelduck	*Tadorna tadorna*	6	0	0	-	Least Concern	Wintering
27	Eurasian Wigeon	*Mareca penelope*	4	0	0	-	Least Concern	Wintering
28	Green-winged Teal	*Anas carolinensis*	35	0	60	0.76	Least Concern	Wintering
29	Mallard	*Anas platyrhynchos*	23	0	20	0.25	Least Concern	Wintering
30	Northern Shovler	*Spatula clypeata*	18	0	30	0.38	Least Concern	Wintering
Suliformes (Cormorants)								
31	Little Cormorant	*Microcarbo niger*	311	240	400	5.07	Least Concern	Year Around
32	Great Cormorant	*Phalacrocorax carbo*	0	22	25	0.32	Least Concern	Wintering
Pelecaniformes (Herons, Egrets, and Bitterns)								
33	Cattle Egret	*Bubulcus ibis*	87	0	75	0.95	Least Concern	Year Around
34	Little Egret	*Egretta garzetta*	66	120	100	1.27	Least Concern	Year Around
35	Intermediate Egret	*Ardea intermedia*	3	1	5	0.06	Least Concern	Year Around
36	Great Egret	*Ardea alba*	42	0	80	1.01	Least Concern	Year Around

37	Indian Pond Heron	*Ardeola grayii*	13	65	60	0.76	Least Concern	Year Around
38	Western Reef Heron	*Egretta gularis*	23	54	75	0.95	Least Concern	Year Around
39	Black-crowned Night-Heron	*Nycticorax nycticorax*	14	0	20	0.25	Least Concern	Year Around
40	Gray Heron	*Ardea cinerea*	7	13	10	0.13	Least Concern	Year Around
41	Purple Heron	*Ardea purpurea*	2	0	5	0.06	Least Concern	Year Around
Pelecaniformes (Ibises and Spoonbills)								
42	Glossy Ibis	*Plegadis falcinellus*	0	2	6	0.08	Least Concern	Passage Migrant
43	Eurasian Spoonbill	*Platalea leucorodia*	3	8	7	0.09	Least Concern	Wintering
Ciconiiformes (Storks)								
44	Painted Stork	*Mycteria leucocephala*	4	3	5	0.06	Near Threatened	Wintering
Cuculiformes (Coucal, Koel)								
45	Greater Coucal	*Centropus sinensis*	0	12	10	0.13	Least Concern	Year Around
46	Asian Koel	*Eudynamys scolopaceus*	0	0	14	0.18	Least Concern	Year Around
Accipitriformes (Osprey)								
47	Osprey	*Pandion haliaetus*	4	0	10	0.13	Least Concern	Wintering
Accipitriformes (Hawks, Eagles and Vultures)								
48	Brahminy Kite	*Haliastur indus*	25	37	35	0.44	Least Concern	Year Around
49	Steppe Eagle	*Aquila nipalensis*	0	6	10	0.13	Endangered	Wintering
50	Egyptian Vulture	*Neophron percnopterus*	1	0	0	-	Endangered	Year Around
51	Cinereous Vulture	*Aegypius monachus*	1	0	3	0.04	Near Threatened	Wintering
52	Common Buzzard	*Buteo buteo*	1	0	4	0.05	Least Concern	Wintering
53	White-eyed Buzzard	*Butastur teesa*	0	3	2	0.03	Least Concern	Year Around
54	Black-winged Kite	*Elanus caeruleus*	0	2	7	0.09	Least Concern	Year Around
55	Eurasian Marsh Harrier	*Circus aeruginosus*	12	7	9	0.11	Least Concern	Wintering
56	Shikra	*Accipiter badius*	2	0	4	0.05	Least Concern	Year Around
Charadriiformes (Stilts and Allies)								
57	Black-winged Stilt	*Himantopus himantopus*	165	143	200	2.54	Least Concern	Year Around

58	Eurasian Oystercatcher	*Haematopus ostralegus*	0	0	20	0.25	Near Threatened	Wintering
Charadriiformes (Plovers and Lapwings)								
59	Greater Sand-plover	*Charadrius leschenaultii*	340	0	500	6.34	Least Concern	Wintering
60	Lesser Sand-plover	*Charadrius mongolus*	430	0	600	7.61	Least Concern	Wintering
61	Little Ringed Plover	*Charadrius dubius*	17	12	14	0.18	Least Concern	Wintering
62	Kentish Plover	*Charadrius alexandrinus*	170	0	250	3.17	Least Concern	Wintering
63	Red-wattled Lapwing	*Vanellus indicus*	32	0	75	0.95	Least Concern	Year Around
Charadriiformes (Godwits, Sandpipers and Snipes, etc)								
64	Bar-tailed Godwit	*Limosa lapponica*	4	0	10	0.13	Near Threatened	Wintering
65	Black-tailed Godwit	*Limosa limosa*	34	0	100	1.27	Near Threatened	Wintering
66	Common Sandpiper	*Actitis hypoleucos*	57	0	50	0.63	Least Concern	Wintering
67	Marsh Sandpiper	*Tringa stagnatilis*	155	0	150	1.90	Least Concern	Passage Migrant
68	Ruddy-turnstone	*Arenaria interpres*	0	0	20	0.25	Least Concern	Wintering
69	Whimbrel	*Numenius phaeopus*	120	0	170	2.16	Least Concern	Wintering
70	Eurasian Curlew	*Numenius arquata*	130	76	250	3.17	Near Threatened	Wintering
71	Common Greenshank	*Tringa nebularia*	24	0	40	0.51	Least Concern	Wintering
72	Spotted Redshank	*Tringa erythropus*	6	0	0	-	Least Concern	Wintering
73	Common Redshank	*Tringa totanus*	70	55	150	1.90	Least Concern	Wintering
74	Common Snipe	*Gallinago gallinago*	25	20	35	0.44	Least Concern	Wintering
75	Little Stint	*Calidris minuta*	800	0	750	9.51	Least Concern	Wintering
76	Dunlin	*Calidris alpina*	240	0	350	4.44	Least Concern	Wintering
Charadriiformes (Gulls and Terns)								
77	Lesser Black-backed Gull	*Larus fuscus*	0	0	400	5.07	Least Concern	Wintering
78	Black-headed Gull	*Larus marinus*	70	90	150	1.90	Least Concern	Wintering

79	Brown-headed Gull	*Chroicocephalus brunnicephalus*	18	0	25	0.32	Least Concern	Wintering
80	Slender-billed Gull	*Chroicocephalus genei*	470	0	700	8.88	Least Concern	Year Around
81	Sandwich Tern	*Thalasseus sandvicensis*	7	0	5	0.06	Least Concern	Passage Migrant
82	Little Tern	*Sternula albifrons*	0	14	25	0.32	Least Concern	Wintering
83	Lesser Crested Tern	*Thalasseus bengalensis*	18	0	15	0.19	Least Concern	Passage Migrant
84	Whiskered Tern	*Chlidonias hybrida*	0	0	250	3.17	Least Concern	Passage Migrant
85	Caspian Tern	*Hydroprogne caspia*	22	37	35	0.44	Least Concern	Passage Migrant
86	Common Tern	*Sterna hirundo*	6	3	5	0.06	Least Concern	Summer Breed
Caprimulgiformes (Nightjars)								
87	Eurasian Nightjar	*Caprimulgus europaeus*	1	0	3	0.04	Least Concern	Passage Migrant
Bucerotiformes (Hoopoes)								
88	Eurasian Hoopoe	*Upupa epops*	5	0	3	0.04	Least Concern	Wintering
Coraciiformes (Kingfishers)								
89	Common Kingfisher	*Alcedo atthis*	0	0	5	0.06	Least Concern	Year Around
90	Pied Kingfisher	*Ceryle rudis*	0	0	20	0.25	Least Concern	Year Around
91	White-throated Kingfisher	*Halcyon smyrnensis*	0	0	15	0.19	Least Concern	Year Around
Coraciiformes (Bee-eaters and Rollers)								
92	Blue-cheeked Bee-eater	*Merops persicus*	8	0	14	0.18	Least Concern	Passage Migrant
93	Asian Green-bee Eater	*Merops orientalis*	77	0	75	0.95	Least Concern	Year Around
Falconiformes (Falcons)								
94	Peregrine Falcon	*Falco peregrinus*	0	0	1	0.01	Least Concern	Wintering
	Total		**4,751**	**1,104**	**7,884**			

Appendix 10. Comparative Table of Trend of Mammals

Mammals Data of DBC-1 Second Monitoring						
S No	Common Name	Scientific Name	Status	Baseline	MR-1	MR-2
1	Fruit Bat	*Pteropus giganteus*	Least Concern		450≈	800≈
2	Golden Jackal	*Canis aureus*	Least Concern	13≈	10≈	25≈
3	Indian Crested Porcupine	*Hystrix indica*	Least Concern			16≈
4	Long-eared Hedgehog	*Hemiechinus auritus*	Least Concern		4≈	12≈
5	Fishing Cat	*Prionailurus viverrinus*	Vulnereble	1		2≈
6	Indian Grey Mongoose	*Herpestes edwardsii*	Least Concern	35≈	45≈	40≈
7	Indian ocean Humpback Dolphin	*Sousa plumbea*	Endangered		14≈	22≈
8	Indian Palm Squirrel	*Funambulus palmarum*	Least Concern			50≈
9	Bottle Nose Dolphin	*Tursiops*	Least Concern	4≈	3≈	6≈
10	Desert Hare	*Lepus tibetanus*	Least Concern		2≈	7≈
11	Wild Boar	*Sus scrofa*	Least Concern	1		9≈

Appendix 11. Comparative Table of Trend of Amphibians

Amphibians Data of DBC-1 Second Monitoring						
S No	Common Name	Scientific Name	Status	Baseline	MR-1	MR-2
1	Indus Valley Toad	*Duttaphrynus stomaticus*	Not evaluated		7	12
2	Common Skittering Frog	*Euphlyctis cyanophlyctis*	Not evaluated		20	17

Appendix 12. Comparative Table of Trend of Reptiles

Reptiles Data of DBC-1 Second Monitoring						
S No	Common Name	Scientific Name	Status	Baseline	MR-1	MR-2
1	Oriental Rat Snake	*Ptyas mucosa*	Least Concern			2
2	Indian Cobra	*Naja naja*	Least Concern		1	3
3	Indian Monitor Lizard	*Varanus bengalensis*	Near Threatened		2	7
4	Indian Flapshell Turtle	*Lissemys punctata*	Vulnerable		4	10
5	Oriental Garden Lizard	*Calotes versicolor*	Least Concern			15

Appendix 13. Comparative Table of Trend of Fishes

S.No	Scientific Name	1st Monitoring	Second Monitoring
1	*Parastromateus Niger*	Black Pomfret	-
2	*Leiognathus equulus*	Common Ponyfish	-
3	*Solea elongata*	Common Sole	-
4	*Chelon parsia*	Goldspot mullet	-
5	*Valamugil seheli*	Bluespot mullet	-
6	*Alectis indica*	Diamond trevally	-
7	*Drepane punctata*	Spotted sickle-fish	-
8	*Thryssa dayi*	Day's thryssa	-
9	*Terapon Theraps*	Banded grunter	-
10	*Acanthopagrus omanensis*	Black Margined Seabream	-
11	*Pomadasys kaakan*	Javelin grunter	-
12	*Ilisha sirishae*	Clupeid fish	-
13	*Chanos chanos*	Milkfish	-
14	*Acanthopagrus arabicus*	Arabian yellowfin seabream	-
15	*Anodonstomata chachunda*	Chacunda gizzard shad	Chacunda gizzard shad
16	*Arius arius*	Threadfin sea catfish	Threadfin sea catfish
17	*Escualosa thoracata*	White sardine	White sardine
18	*Johnius elongatus*	Spindal Croaker	Spindal Croaker
19	*Lepturacanthus savala*	Ribbon fish	Ribbon fish
20	*Pampus argenteus*	White paplet	White paplet
21	*Scatophgaus argus*	Spotted scat	Spotted scat
22	*Thyrssa vitriorostris*	Orange mouth glassnose	Orange mouth glassnose
23	*Acanthopagrus berda*	-	Gold silk seabream
24	*Alepis djadaba*	-	Shrimp scad
25	*Argyrops spinifer*	-	Kings solder bream
26	*Atropus atropos*	-	Claftbelly trevally
27	*Aulopareia ocellata*	-	Fat tail-eyed goby
28	*Brachirus orientialis*	-	Oriental sole
29	*Charybdis feriata*	-	Crucifix crab
30	*Filimanus similis*	-	Indian seven thread fin
31	*Gerrus limbatus*	-	Seddleblack seabody
32	*Gobidea spp*	-	Mudskeeper
33	*Gudusia chapra*	-	Indian river shad
34	*Gymnura poecilura*	-	Long-tail butterfly ray
35	*Hyporhamphus sindensis*	-	Halfbeak fish
36	*Hyporhamphus unifasciatus*	-	Silver strip halfbeak.
37	*Lagocephalus guentheri*	-	Diamondback puffer
38	*Uroteuthis duvaucelii*	-	common Indian squid
39	*Lutjanus johnii*	-	John snapper
40	*Matuta planipes*	-	Flower moon crab
41	*Megalaspis cordyla*	-	Torpedo scad
42	*Metapeneaus affinis*	-	Jhinga shrimp
43	*Mugil cephalus*	-	Flathead grey mullet
44	*Muraenesox bagio*	-	Common pike conger
45	*Nematalosa nasus*	-	Bloch gizzard shad

46	*Nibea maculata*	-	Kathala croaker
47	*Ophisternon candidum*	-	Blind eel
48	*Oratosquilla oratoria*	-	Japanese mantis shrimp
49	*Oreochromis mossambicus*	-	Moasambique tilapia
50	*Otolituhs cuvieri*	-	Lesser tiger tooth crocker
51	*Penaeus indicus*	-	Indian Prawn
52	*Penaeus monodon*	-	Giant tiger shrimp
53	*Penaeus pulchricaudatus*	-	Western kuruma prawn
54	*Pilcofollis dussumieri*	-	Blacktip catfish
55	*Plotusus lineatus*	-	Stripped eel catfish
56	*Pomadasys maculatus*	-	Saddle grunt
57	*Portunus sanguinolentus*	-	Three spotted crab
58	*Portunus segins*	-	Arabian Flower crab
59	*Psedorhombus javanica*	-	Javan flounder
60	*Pseudosynanceia nelanistigma*	-	Black fin stone fish
61	*Scylla tranquebrica*	-	Purple mud crab
62	*Secutor interruptus*	-	Pugnosed pony fish
63	*Sillago sihama*	-	Ladyfish
64	*Sillago indicus*	-	Indian sillago
65	*Strongylura strongylura*	-	Spottail needle fish
66	*Stylopherus indicus*	-	Indian anchovy
67	*Tenualosa toli*	-	Toli shad
68	*Terpon jaruba*	-	Tarpon
69	*Thenus indicus*	-	Indian flathead lobster
70	*Thryssa hammilonii*	-	Hamilton thryssa
71	*Torpedo fuscomaculata*	-	Black spotted torpedo
72	*Trypeauchen agina*	-	Pink worm eel
73	*Gastropods*	-	Snails

Appendix 14. Comparative Table of Trend of Triggered Species

Triggered Species						
S No	Common Name	Scientific Name	Global Status	Baseline	MR-1	MR-2
1	Indian Ocean Humpback Dolphin	*Sousa plumbea*	Endangered	0	14	22
2	Bottle Nose Dolphin	*Tursiops*	Least Concern	4	3	6
3	Fishing Cat	*Prionailurus viverrinus*	Vulnerable	1	0	2
4	Egyptian Vulture	*Neophron percnopterus*	Endangered	1	0	0
5	Indian Pangolin	*Pholidota*	Endangered	1	0	1
6	Steppe Eagle	*Aquila nipalensis*	Endangered	0	6	10

Appendix 15. Monitoring Protocol/Monitoring Plan for Biodiversity Section Monitoring

(See Section 5.3.1)

Protocol for DBC-1 project biodiversity impact assessment			
Version	1.0	Date of Issue	10-08-2021
Purpose	This Protocol describes the biodiversity parameters that will be monitored at each monitoring event and the procedures for making the measurements.		
Responsibilities	It is the responsibility of the senior staff members of Sindh Forest Department and IDC who are professional foresters and biodiversity specialists to ensure that this protocol is followed at the time of making biodiversity impact assessments of DBC-1 Project and taking measurements when collecting, analyzing, compiling, storing, archiving and handling the collected data including QA/QC procedures.		
Prerequisites	Relevant provision of the validated PD Document and the provisions of relevant elements of the CCB Monitoring Plan of the PD Document of DBC-1 Project.		
Related documents	Key findings of the baseline situation, Problem Flow and Causal Chain Diagram of DBC-1 Project Biodiversity Component, CCB Biodiversity Monitoring Plan of DBC-1 Project and Biodiversity Impact Assessment Methods and Protocols		
Scope	This protocol applies to field works that involve data collection in the biodiversity assessment stations and other sample plots/stations that are to be laid out for biodiversity impact assessment of DBC-1 Project.		

BIODIVERSITY IMPACT ASSESSMENT OF DBC-1 PROJECT

Background

DBC-1 (Delta Blue Carbon-1) Project has been conceived, designed, developed and being implemented as a Triple Gold Project with significant climate change mitigation and adaptation, community development and biodiversity conservation benefits. This a sixty years project starting from 2015. At the start of the project, a biodiversity baseline of the Project Area/Project Zone has been established. Key findings of the baseline situation are given in Annex-1.

To achieve biodiversity related goal and objectives of the project, a suite of interventions has been developed and targeted for implementation using proper problem flow diagrams, causal chains and Theory of Change in SBIA workshops conducted with different stakeholder groups. The Problem Flow Diagram and Causal Chain of the project are given in Annex-2.

The project has also developed a CCB Monitoring Plan for achieving its biodiversity related positive impacts. This Monitoring Plan is attached as Annex-3.

Now the project intends to assess and quantify the biodiversity related impacts of its interventions strictly in accordance with the requirements set by and guidance given by the CCB Standard Third Edition Version 3.1 for assessing the net positive benefits of biodiversity.

This assessment process has to be completed in a systematic, independent and transparent way wherein each step of the process is fully documented through a variety of ways (videos, photos, field notes, etc.) following standard and internationally accepted Protocols and Standard Operating Procedures (SOPs) for the conduct of various Biodiversity Surveys. Selected examples of these Protocols/SOPs are given in Annex-4.

Scope of Work

Following is the scope of work for this biodiversity impact assessment protocol:

Biodiversity Changes: Describe all the changes in biodiversity resulting from project activities in the project zone during this monitoring period. Impacts must include all those identified in the project description and any other unplanned impacts

Mitigation Actions: Describe activities and/or processes implemented to mitigate negative impacts on biodiversity and any measures taken for maintenance or enhancement of the HCV attributes. Explain how such actions are consistent with the precautionary principle.

Net Positive Biodiversity Impacts: Assess that the project's net impacts on biodiversity in the project zone are positive compared with conditions under the without-project land use scenario.

Also, assess how the project activities assist the biodiversity to adapt to the probable impacts of climate change.

High Conservation Values Protection: Assess that no HCVs related to biodiversity in the project zone have been negatively affected by the project.

Invasive Species: Assess that no known invasive species have been introduced into any area affected by the project and that the population of any invasive species has not increased as a result of the project.

Impacts on Non-native species: Assess and describe that there has been no use of any non-native species in the project zone by the project proponents.

GMO Exclusion: Assess that no GMOs have been used to generate GHG emissions reductions or removals.

Inputs Justification: Assess and describe that the project has not used any fertilizers, chemical pesticides, biological control agents and other inputs for the project.

Offsite Biodiversity Impacts: Assess and describe any negative impacts on biodiversity outside the project zone resulting from the project activities.

Net Offsite Biodiversity Benefits: Describe the evaluation of unmitigated negative impacts on biodiversity outside the project zone and compare them with the project's biodiversity benefits within the project zone. Assess that the net effect of the project on biodiversity benefits is positive.

Exceptional Biodiversity Benefits:

Describe the population trends of each trigger species (Indian Ocean Humpback Dolphin, Indian Pangolin, Fishing Cat, Egyptian Vulture) and actions taken to maintain or enhance the population status of each species in the project zone.

Adaptation Benefits for Biodiversity: Assess the different adaptation benefits for biodiversity. Examples of these include: (1) number of community members in the project zone reporting presence or increased number of endemic, rare, vulnerable, threatened or endangered species; (2) number of community members in the project zone reporting presence or increased extent of landscape level ecosystems and mosaics that are characteristic of wetlands landscapes; (3) number of community members in the project zone reporting presence or increased extent of rare, threatened or endangered ecosystems, habitats or refugia; (4) number of community members in the project zone reporting presence or increased extent of at least one dimension of Key Biodiversity Areas such as increased ecological integrity, biological processes, or irreversibility dimension, etc.); (5) number of community members in the project zone reporting presence or increased extent of trigger species, threatened or geographically restricted biodiversity or reduced threats status.

Deliverables

The assessment study will deliver the following specific outputs as part of this biodiversity impact assessment:

- A comprehensive biodiversity impact assessment report of DBC-1 Project for the intended monitoring periods. For MR-1, the period is from 15 February, 2015 to 15 November, 2021, which is in English language and language edited. The report has to cover all the topics as given in the scope of work given above and on all the CCB Monitoring Plan indicators provided vide Appendix-3.
- Thematic maps for the three biodiversity related HCVs Areas in the Project Zone (HCV 1, 2 and 3).
- Documents and Documentary of how the whole exercise has been conducted.
- Presentation of findings of the Assessment Report to IDC Team.

ANNEX-1

Key findings of the baseline situation

Biodiversity Baseline Study of DBC-1 Project (Pages 209 to 218 of PD Document).

ANNEX-2

Problem Flow and Causal Chain Diagram of Biodiversity Component of DBC-1 Project

Biodiversity Problem Flow and Causal Chain Diagram of DBC-1 Project (Pages 219 to 224 of PD Document).

APPENDIX-3

CCB Biodiversity Monitoring Plan of DBC-1 Project

CCB Biodiversity Monitoring Plan of DBC-1 Project (Pages 319 to 339 of PD Document). The CCB Biodiversity Monitoring Plan Indicators are to be used for reporting progress on Biodiversity Impact Assessment.

ANNEX-4

BIODIVERSITY MONITORING METHODS AND PROTOCOLS

1. Vegetation/Vascular Plants Monitoring

Mangrove species and other vegetation at the sample plot will be monitored and will include description of their conservation status, global, regional and local. The IUCN latest RED List has to be used for determining the conservation status of different floral and faunal species. The indicators to be used for assessment are given in Appendix-3 above. Suggested method to use for monitoring is either the Circular Plot Method or the Modified Gentry Plot Method. In the Circular Plot Method, Circular Plots of 8.92 m which have been laid out in the field for the collection of biomass and soil carbon data will be used in each of the six strata (2015, 2016, 2017, 2018, 2019, 2020 planting cohorts). Details about using the Modified Gentry Plot Method are given in Table-1 below:

Table-1: Modified Gentry Pot Method as a Survey Method

Survey Method	Modified Gentry Plots
Description	The lay-out of each plot can be modified according to the site. Figure-1 below shows an example of a possible lay-out; each grid or sub-plot size can be adjusted accordingly. Each Modified Gentry Plot (MGT) will cover an area of 0.1 ha within a 100 m x 200 m sampling grid. Ten 2 m x 50 m subplots should be established with six 1 m x 1 m square plots to be set up adjacent to each of the 10 sub-plots as shown in Figure-1.

	Each woody plant which is rooted within the sub-plot should identified or classified to the species level, if possible. Any peculiarities about the plant should be recorded. Within each 1 m x 1 m subplot, each herbaceous plant should be identified or classified to the species level, if possible.
Spread	The number of GMPs should be randomly spread out such that 10-15 % of each vegetation type is sampled.
Duration	N/A
Timing	N/A
Frequency	Once per site.
Notes	The Flora of Pakistan should be consulted for identification of any unknown plants based on samples (leaf cuttings, flowers) and photographs.

The following outcomes should be included in the report:

- Species list of vascular plants found on site, including their global and local conservation status, whether each species is native, exotic, or invasive, and whether the species is likely the result of planting or assisted natural regeneration.
- Plant height and diameter measurements.
- Information on whether the plants are flowering or fruiting.
- Number of each tree/woody species identified on site.
- Herbaceous plants can be estimated by number or percentage of groundcover.
- Maps indicating plots location and location of species of conservation interest.
- Photographs of rare species or species of conservation interest should be taken and incorporated in the report.

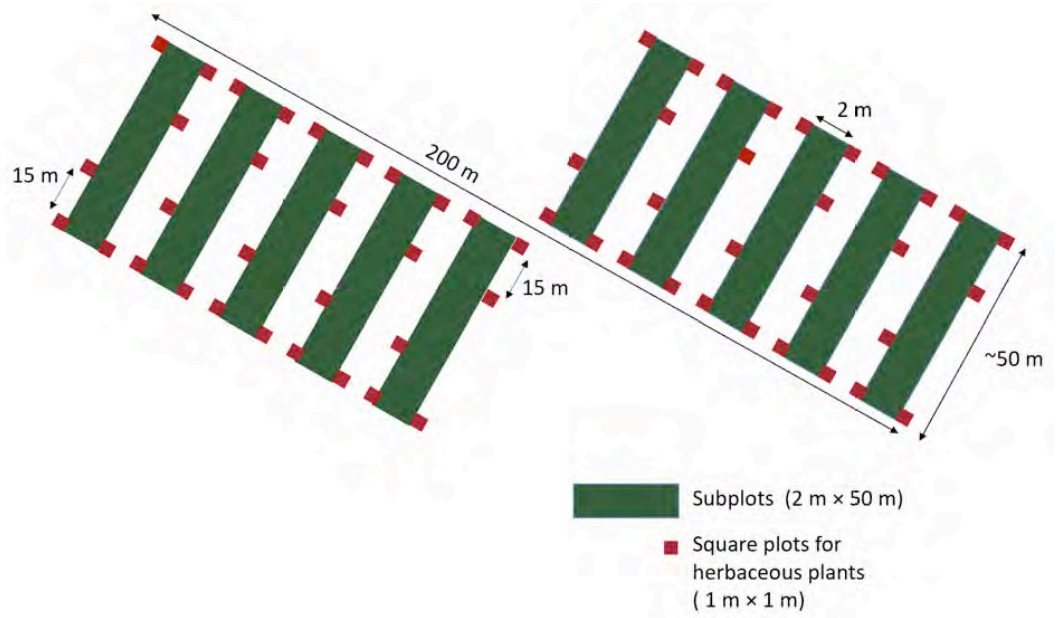


Figure-1: Lay out of Modified Gentry Plots

2. Birds Surveys

This survey should establish the diversity of birds at the site, and include their global and local conservation status. The suggested methods are using count methods and/or line transects.

2.1 Point Counts as a Birds Survey Method

Table-2: Point Counts Survey Methods

Survey Method	Point Counts
Description	Surveyor to stand at various points across the site and record all birds heard and seen within 50 m of each point. Sex (male or female) and age class (adult or juvenile) should also be noted if possible.
Spread	Spaced approximately 100 m apart.
Duration	Ten minutes at each point.
Timing	7 am to 9 am
Frequency	Each point should minimally be sampled once during local breeding season (December to June), and once during migratory season (September to March).
Notes	Selected points should be at least 100 m from line transects.

3. Line Transects as a Birds Survey Method

Table-3: Line Transects Survey Methods

Survey Method	Line Transects
Description	Surveyor should walk along the transect at a steady pace and should record all the birds heard and seen within 50 m on either side of the transect and 50 m line to stand at various points across the site and record all birds heard and seen within 50 ahead. Sex (male or female) and age class (adult or juvenile) should also be noted if possible, along with any behaviour (e.g., foraging, nesting).
Spread	200 m for each transect, spaced approximately 100 m apart.
Duration	30 minutes per transect.
Timing	Dawn (approximately 7 am to 10 am) and Dusk (7 pm to 9 pm).
Frequency	Each transect should minimally be sampled once during local breeding season (December to June), and once during migratory season (September to March).
Notes	Transects should be at least 100 m from point count locations.

The following outcomes should be included in the report:

- Species list of birds found on site, including their global and local conservation status, whether each species is native, exotic, or invasive, and whether the species is resident or migratory.
- Number of each species observed at each point location.
- Noteworthy behaviour should be recorded and highlighted, especially for species of conservation interest (e.g., nesting behaviour such as adult birds with nesting material or feeding young birds should be noted).
- Map indicating point count and/or line transect locations of species of conservation interest.
- Where possible photographs of rare species or species of conservation interest should be taken and incorporated in the report.

4. Reptiles and Amphibians

The methods given here establish the diversity of herpetofauna at the site, and include their global or local conservation status. The suggested methods are line transects and/or pitfall traps.

Table-4: Line Transect as a Survey Method

Survey Method	Line Transects
Description	Surveyor should walk along the transect at a steady pace and should record each individual amphibian or reptile observed within 10 m on either side of the transect ahead. Surveyors should also turn logs or rocks, searching for potential refuges as they move along the transect, before returning the logs or rocks to their original position. Surveyors should also record the presence of calling frogs. The time of the day each animal is seen or heard should also be recorded. Sex (male or female) and age class (adult or juvenile) should also be noted if possible, along with any behaviour (e.g., foraging, nesting).
Spread	200 m for each transect, spaced approximately 50 m apart.
Timing	8 am to 10 am for morning surveys 30 to 60 minutes after dark for night surveys.
Duration	30 minutes per transect
Frequency	Each transect should minimally be sampled once during the day and once at night.
Notes	N/A

Table-5: Pitfall Traps as a Survey Method

Survey Method	Pitfall Traps
Description	Pitfall Traps should be arranged in arrays. A suggested array design consists of three 15 m-long arms of drift fence with seven pitfall traps. See Figure-2 and 3 below.

	To prevent drowning of any trapped animals during heavy rains, holes should be punched in the bucket or a branch should be lodged mid-way in the bucket for animals to rest on. All organisms obtained should be counted and identified to the best of the surveyor's abilities and released on the spot.
Spread	Minimum of one array per habitat type.
Timing	Each pitfall should be checked by 9 am the next day and immediately after rain for trapped animals. 30 to 60 minutes after dark for night surveys.
Duration	N/A
Frequency	Each trap should minimally be sampled once during the day and once at night.
Notes	Cover the traps when they are not activated.

The following outcomes should be included in the report:

- Species list of amphibians and reptiles found on site, including their global and local conservation status, whether each species is native, exotic, or invasive.
- Number of each species observed at each transect or pitfall trap.
- Time of day that each species was observed/discovered (for line transects).
- Noteworthy behaviour should be recorded and highlighted, especially for species of conservation interest.
- Map indicating line transect locations and of species of conservation interest.
- Where possible photographs of rare species or species of conservation interest should be taken and incorporated in the report.

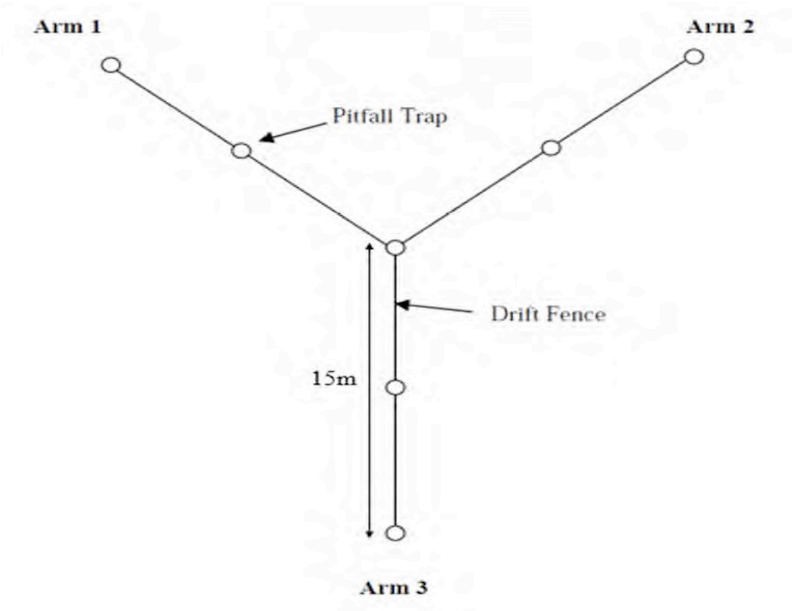


Figure 2: Example of a Pitfall Trap Array

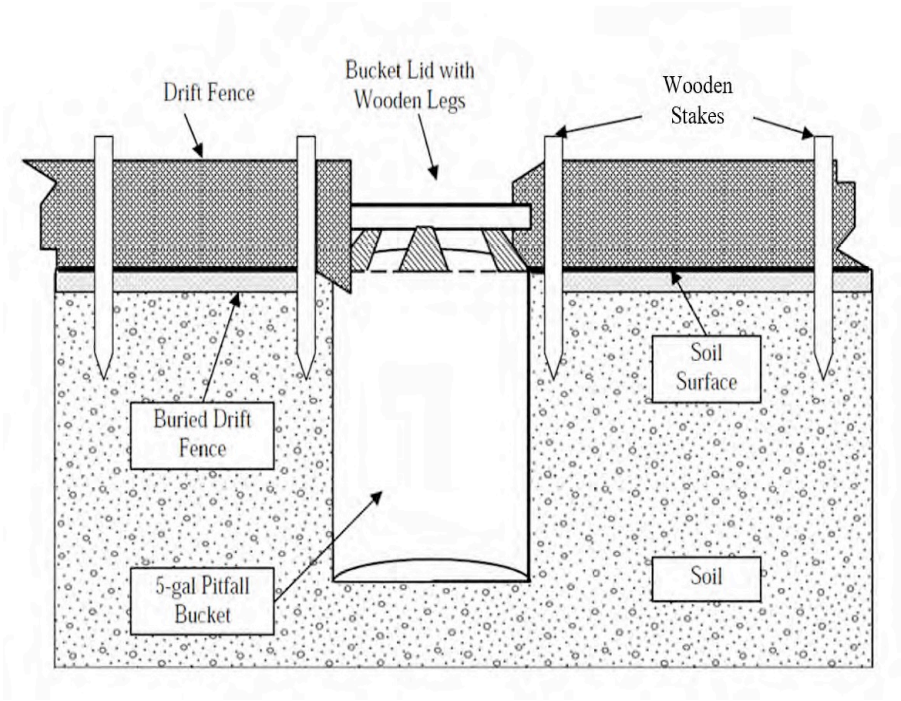


Figure-3: Example of Pitfall Trap Design

5. Mammals (Except Bats)

Here we do the diversity of mammals (except bats) at the site, and include their global and local conservation status. The suggested methods are camera traps and/or line transects.

Table-6: Camera Traps as a Survey Method

Survey Method	Camera Traps
Description	Camera traps should be mounted at a height of 30 to 50 cm off the ground. The angle of the camera should be such that there is clear and direct field of view of possible wildlife trail or of a relatively open area. Camera traps settings should be adjusted such that the trigger speed of cameras are 1/10th of a section or faster, and that colour photographs are taken during the day and infrared photographs are taken during the night. When the camera trap data is retrieved and reviewed, information such as the time and behaviour of the animal (e.g., foraging) should also be recorded.
Spread	Spaced approximately 100 m apart.
Timing	N/A
Duration	N/A
Frequency	N/A
Notes	Ensure that understory plans do not obscure the camera view.

Table-7: Line Transects as a Survey Method

Survey Method	Line Transects
Description	Surveyor should walk along the transect at a steady pace and should record each individual within 50 m on either side of the transect and 50 m ahead. At the same time the surveyors should also look for indirect evidence of mammals, such as scats and tracks. Sex (male or female) and age class (adult or juvenile) should also be noted if possible, along with any behaviour (e.g., foraging, nesting).
Spread	200 m for each transect, spaced approximately 50 m apart and randomized within the site.
Timing	6 am to 10 am for morning surveys* 7:30 pm to 10 pm for night surveys (*Note: 6 am to 7 am for nocturnal animals returning to their dens, and 7 am to 10 am to record diurnal animals)
Duration	N/A
Frequency	Each transect should minimally be sampled once during the day and once at night.
Notes	N/A

The following outcomes should be included in the report:

- Species list of mammals found on site, including their global and local conservation status, whether each species is native, exotic, or invasive.
- Number of each species observed at each transect or camera trap.
- Time of day that each species was observed/discovered (for line transects).
- Noteworthy behaviour such as foraging should be recorded and highlighted, especially for species of conservation interest.
- Map indicating line transect and camera traps locations and of species of conservation interest.
- Where possible photographs of rare species or species of conservation interest should be taken and incorporated in the report.

6. Bats

This section is meant to describe the diversity of bats at the site and their global and local conservation status. The suggested methods are acoustic recordings and harp traps.

Table-8: Acoustic Recordings as a Survey Method

Survey Method	Acoustic Recording
Description	Recording devices should be placed in an open area and elevated 3 meters above ground on a secured pole. The devices should have flat (even) responses from the lowest (18 kHz) to the highest (150 kHz) expected frequencies and should have a continuous minimum sampling rate of 384 kHz. The microphones

	on the devices should be oriented slightly less than horizontal so that moisture does not pool on the microphone membrane.
Spread	Spaced approximately 200 m apart.
Timing	7 pm to 7 am
Duration	N/A
Frequency	Each location should minimally be sampled once.
Notes	When recording data is reviewed, the calls recorded should be measured and matched with known reference calls (Refer to Pottie et al., 2005).

Table-9: Harp Traps as a Survey Method

Survey Method	Harp Traps (only to be used within forest habitats)
Description	Harp Traps should be set up at locations with overhanging and closed side vegetation. The sides of each trap should be filled with material to prevent bats from going around or under the trap. Traps should be checked hourly. All organisms obtained should be counted and identified to the best of the surveyor's abilities and released on the spot.
Spread	Spaced approximately 100 m apart along a fixed transect within the forested area of the site.
Timing	6 pm to 7 am.
Duration	N/A
Frequency	Each location should minimally be sampled once.
Notes	Traps placed near roosts should be checked every hour. If ants are seen anywhere near a harp trap, the trap must be taken down, animals released and data discarded.

The following outcomes should be included in the report:

- Species list of bats found on site, including their global and local conservation status, whether each species is native, exotic, or invasive.
- Number of each species observed for each recording device or harp trap.
- Map indicating line transect locations and and/or of harp traps and of species of conservation interest.
- Where possible photographs of rare species or species of conservation interest should be taken for verification and incorporated in the report.

7. Butterflies

This section is for establishing the diversity of butterflies at the site, and include their global and local conservation status. The suggested method is line transects.

Table-10: Line Transects as a Survey Method

Survey Method	Line Transects
Description	Surveyor should walk along the transect at a steady pace and should record each individual butterfly within 5 m on either side of the transect and 5 m ahead. Sweep netting can be used to collect species that are difficult to identify in flight, and all butterflies caught should be released. If a butterfly caterpillar is found to be feeding on a plant, the plant should be identified and recorded as well.
Spread	200 m for each transect, spaced approximately 50 m apart.
Timing	10 am to 12 pm on sunny days.
Duration	N/A
Frequency	Each location should minimally be sampled once.
Notes	N/A

The following outcomes should be included in the report:

- Species list of butterflies found on site, including their global and local conservation status.
- Numbers of each species observed for each transect.
- List of plants on which the butterflies caterpillars are feeding on.
- Map indicating line transect locations and of species of conservation interest.
- Where possible photographs of rare species or species of conservation interest should be taken for verification and incorporated in the report.

8. Odonates

This section is for establishing the diversity of odonates at the site, and include their global and local conservation status. The suggested method is line transects.

Table-10: Line Transects as a Survey Method

Survey Method	Line Transects
Description	Surveyor should walk along the transect at a steady pace and should record each individual butterfly within 5 m on either side of the transect and 5 m ahead. Sweep netting can be used to collect species that are difficult to identify in flight, and all odonates caught should be released.
Spread	Full perimeter of pond and/or water body or full length of stream.
Timing	10 am to 12 pm on sunny days. 5 pm to 7 pm on sunny days.
Duration	N/A
Frequency	Each location should minimally be sampled once during late morning and once during dusk.
Notes	N/A. For dragonfly larvae sampling refer to next section.

The following outcomes should be included in the report:

- Species list of odonates found on site, including their global and local conservation status.
- Numbers of each species observed for each transect.
- Map indicating line transect locations and of species of conservation interest.
- Where possible photographs of rare species or species of conservation interest should be taken for verification and incorporated in the report.

9. Marine Organisms

This section is meant to establish diversity of marine organisms such as fish, crustaceans, molluscs and other invertebrates at the site, and include their global and local conservation status. The suggested methods are net transects and baited traps.

Table-11: Net Transects as a Survey Method

Survey Method	Net Transects
Description	During a fixed amount of time the surveyor will net as many marine organisms as possible. For streams of creeks, push netting and scoop netting are sufficient. For deeper water bodies such as ponds, cast netting may be deployed as well. All organisms obtained will be counted and identified to the best of surveyors' abilities should be released on the spot.
Spread	10 me for each transect, spaced approximately 50 m apart along a stream or the perimeter of a water body.
Timing	Daytime.
Duration	30 minutes per transect.
Frequency	Each location should minimally be sampled once.
Notes	Visual observations of organisms which may be too fast to catch can also be added to the survey results provided the surveyor is confident of identification of the species.

Table-12: Baited Traps as a Survey Method

Survey Method	Baited Traps
Description	Commercial Fish Traps are baited with meat (e.g., kuning) and checked the next day. All organisms obtained should be counted and identified to the best of the surveyor's abilities and released on the spot.
Spread	Every 50 m apart along a creek stream or perimeter of a water body.
Timing	Each trap should be checked by noon the following day.
Duration	Over night.
Frequency	Each stream or water body should minimally be sampled once.
Notes	Ensure that traps are not fully sub-merged as there are some local species of fish which breath air and can drown if sub-merged for too long.

The following outcomes should be included in the report:

- Species list of marine organisms found on site, arranged by taxa, including their global and local conservation status, whether each species is native, exotic, or invasive, and whether the species is a generalist or a specialist.
- Local abundance of each species discovered, expressed in terms of catch per unit effort.
- Number of each species observed for each trap or netting catch.
- Map indicating transects locations and/or of baited traps and of species of conservation interest.
- Where possible photographs of rare species or species of conservation interest should be taken for verification and incorporated in the report.

10. Identifying High Conservation Priority Areas

Upon completion of the biodiversity assessment survey, the surveyor/consultant should overlay all the vegetation maps and maps indicating locations of species of conservation interest, keystone species, and bioindicator species. Areas with High Conservation Values (HCVs 1-6) and critical and natural habitats should be highlighted as high conservation priority areas. Table-13 provides a guide to help determine which areas could be considered critical, natural or modified habitats. Whether a habitat is considered critical, natural or modified depends on both vegetation type and fauna type and importance to species of conservation concern. However, much of this classification is dependent on-site context, and what constitutes a high conservation priority area is typically based on CCB Criteria.

Table-13: Habitat Conservation Values

Habitat Classification	Description
Critical Habitat	Critical habitats are areas with high conservation value, including: ▪ Habitat of significant importance to locally and globally Critically Endangered and/or Endangered species. ▪ Habitat of significant importance to rare, endemic and restricted range species. ▪ Habitat supporting globally significant concentrations of migratory species and/or congregatory species. ▪ Highly threatened and/or unique ecosystems in the national and global context. And/or ▪ Areas associated with key evolutionary processes (e.g., genetically distinct populations)
Natural Habitat	Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological function and species composition.
Modified Habitat	Modified habitats are areas that may contain a large proportion of plant and/or animal species of largely non-native, and/or where human activity has substantially modified an area's primary ecological function and species composition. Modified habitats may include areas managed for agriculture, forest plantations, reclaimed coastal zones and reclaimed wetlands.

A map will be created that will show the location of different habitats in the site. This map will be in GIS format so that other layers can be added to it and used for decision-making.

Version Log

Version	Author/s	Material changes from previous version	Release Date
1.0	Alamgir Khan Gandapur	Not applicable	10-08-2021

Appendix 16. Marine Biodiversity and Environmental Assessment Report Of DBC-1 Project

INDUS DELTA CAPITAL

MARINE BIODIVERSITY AND ENVIRONMENTAL ASSESSMENT REPORT OF DBC-1 PROJECT



Team

Dr. Muhsan Ali

Prof. Dr. Muhammad Shafi

Mr. Wajahat Abbas (Research Associate)

Summary

Current study on Biodiversity and water quality parameters were conducted from Indus Delta region from Korangi creeks to Shahbandar area. Total of 60 stations were conducted from 15 creeks 4 from each creek during January to March 2023. During the survey the finfish and shellfish samples were collected from fishing boats operating that area and conducted gujjo trawl for collection of diversity samples from each creek. It is also noted that the fishing boats operating in the creeks area mostly using *Bullo Gujjo* net particularly for shrimp fisheries. However, this net completely banned in this area but gives us completely diversity of samples to monitor the marine biodiversity from the creeks area during the survey.

Total of 59 different finfish and shellfish species were observed during present survey from all creeks. During the present study Rato Kof-cham, Korangi and Hajamro creek found diverse in marine biodiversity with Shannon Index at 3.5, 2.565 and 3.148 respectively, which indicate the rich in biodiversity index. However, Khadro, Navy and Kajhar creeks were low in diversity index at 0.47, 1.413 and 1.989 respectively, compared to other creeks. While the water quality parameters were observed also measured from each creek. The lowest temperature was measured at 17.4 and 17.5 ^{o}C from Khadro and Korangi creek respectively, while highest were measured at 35.33 ^{o}C from Hajamro creek the average temperature from all creeks were measured at 24.51^{o}C (±4.25 ^{o}C). However, the averaged salinity was measured at 33.3-38.38ppt average at 35.13ppt (±1.09ppt). The highest dissolved oxygen at 1.5mg/l were observed from Dodee wari creek and lowest at 0.62 mg/l from Cabin wari creek, overall average at 0.9mg/l (±0.22mg/l). The average pH from all creeks were at 8.2 (±0.11) during the survey.

In conclusion, the assessment of marine biodiversity and water quality parameters survey from creeks area is essential for the sustainability of these unique and important ecosystems. Creeks are particularly vulnerable to human activities, and regular monitoring is essential to ensure. By conducting regular surveys, we can track changes in marine biodiversity over time and develop strategies to protect and restore threatened species and ecosystems. Additionally, marine biodiversity assessment surveys can provide valuable data for scientific research, education, and policymaking.

1.INTRODUCTION

Pakistan coast is about 1001 kilometers (km) from Iranian to Indian border with an Exclusive Economic Zone (EEZ) of 350 nm, about 299, 000 km^2 (UN, March 2015) (Pakistan Navy, 2016). The continental shelf was 200 nm while it was extended up to 350 n.m during 2015 (UN, March 2015) from which Pakistan can explore and exploit its marine resources. Pakistan coast comprises on Balochistan and Sindh provinces and are rich in fishery resources which is one of the backbone of national economy. Sindh coastline starts from Indian border to Hub River in Balochistan about 366.5 km (Pakistan Navy, 2016). Sindh coast has freshwater inflow from Indus River which creates network of small and large channels and creeks that makes rich mangrove ecosystem (FAO, 2009). Freshwater inflow is the amount of freshwater that flows from rivers, streams, and other sources into the ocean. This inflow is critical to the health of marine ecosystems, as it helps to maintain the delicate balance between saltwater and freshwater, which is necessary for the survival of many species of plants and animals. Freshwater inflow also plays a vital role in regulating water quality and nutrient levels in the ocean. It carries essential nutrients, such as nitrogen and phosphorus, from land to the sea, which are necessary for the growth of plankton and other marine organisms at the base of the food chain. Firstly, they provide habitat and breeding grounds for a diverse range of marine species, including finfish and shellfish. This makes them critical for supporting the fisheries industry, which is an important source of income and food security for many coastal communities. Secondly, mangrove forests play a crucial role in mitigating the impacts of climate change by storing carbon dioxide in their biomass and sediment. They also protect the coastline from erosion and storm surges, thereby reducing the risk of damage from extreme weather events. Thirdly, creeks and mangroves are important sources of biodiversity, providing habitat for a range of wildlife, including birds, reptiles, and mammals. They are also important for ecotourism, attracting visitors who are interested in experiencing the natural beauty and diversity of the coast.

Indus Delta Region

The Indus Delta is an expansive delta system located in southern Pakistan, which is one of the largest and most important deltas in the world. The Indus Delta creeks area of Sindh is a complex network of intertidal channels and mudflats formed by the Indus River as it flows into the Arabian Sea.

The Indus Delta is home to one of the largest mangrove forests in the world, with 97% of mangrove cover in Pakistan found in the deltaic region. The mangrove forest in the Indus Delta region covers a vast area along the Sindh Coast and comprises 17 major creeks, numerous minor creeks, extensive mudflats, and mangrove forests. The Baluchistan Coast, on the other hand, has three major pockets of mangrove forests located in Miani Hor, Kalmat Khor, and Gawatar Bay, which make up only 3% of the total mangrove cover in Pakistan. The distribution of mangroves is under the influence of freshwater supply, which explains why the largest mangrove forests are found along coastlines that receive freshwater supply from major rivers like the Indus and Amazon deltas and heavy rainfall like the Pacific Coast of Columbia.

In the Indus Delta region, the mangrove ecosystem is under continuous threat from both natural and anthropogenic activities, including deforestation, over-grazing by camels, and significant reductions in water and sediment fluxes through the Indus River due to the construction of dams and dikes upstream. Deforestation and grazing effects are quite visible, and the cut forest may be seen through miles and miles. The grazing by camels alone in the Keti Bunder area poses a major threat to the proliferation of mangrove forests. However, in the past few years, the Sindh Forest Department has initiated reforestation activity in this region and discouraged many camel herd owners from bringing camels for grazing in areas around Keti Bunder. As a result, new natural forests are emerging, along with the planted species of mangroves.

Reduced freshwater flux has also been identified as a factor impacting mangroves in the Indus Delta. Runoff from the Indus River has been decreasing over the past few decades, and only during flood season (summer), some water in the Indus finds its way down the Kotri barrage into the creeks near Keti Bunder. Indus River should be allowed to flow into the coastal areas not only for freshwater but most importantly for sediment flux. The reduced sediment in the past has resulted in the net erosion in some areas in the Indus Delta, such as the case of the Bundal Island. Mangroves may survive reduced water flux, but the sediment load is necessary for land-building activity and the sustenance of the mangrove forest ecosystem.

The Indus delta mangrove ecosystem is an important coastal region in Pakistan that supports diverse flora and fauna. In this study, we conducted a field survey to assess the current status of biodiversity in the Indus delta mangrove ecosystem. The survey covered various aspects including fisheries, avifauna,

mangrove forests, benthic fauna, and water quality parameters across major creeks of the Indus delta. Our findings provide important insights into the current status of biodiversity and highlight the need for conservation efforts in the region.

The deltaic ecosystem is a unique and important ecological region that supports a diverse array of flora and fauna, including migratory and resident bird species, fish, and marine mammals. The delta comprises a network of creeks, mudflats, and mangrove forests that provide critical habitats for a diverse range of flora and fauna. The biodiversity of the Indus Delta is exceptional, with more than 100 species of fish, 30 species of reptiles and amphibians, 15 species of mammals, and over 300 species of birds being documented in the area. These species include several globally threatened and endangered species, such as the Indus dolphin (*Platanista minor)*, green turtle *(Chelonia mydas)*, and olive ridley turtle *(Lepidochelys olivacea)*. The Indus Delta's biodiversity is not only ecologically important but also vital for the livelihoods of millions of people in the region. The delta's resources are essential for sustaining the local fishing industry, which provides employment and food security for many coastal communities. However, the delta is facing numerous threats, including habitat loss and degradation, overfishing, pollution, and climate change, which are impacting the delta's biodiversity and the communities that depend on it.

Marine Biodiversity

Marine biodiversity refers to the variety of aquatic organisms and fish species that inhabit freshwater, brackish, and marine environments. Fisheries biodiversity is vital for the functioning and resilience of aquatic ecosystems and plays a crucial role in supporting human livelihoods and well-being. However, the increasing human activities such as overfishing, habitat destruction, pollution, and climate change are threatening the fisheries biodiversity and the ecosystem services it provides. The conservation and sustainable management of fisheries biodiversity are essential to ensure the long-term health, productivity, and resilience of aquatic ecosystems and the sustainability of fisheries. Several studies have highlighted the importance of fisheries biodiversity and its contribution to the ecological, social, and economic well-being of human societies. For instance, studies have shown that fisheries biodiversity supports food security and livelihoods, contributing to the well-being of millions of people worldwide (Pikitch *et al*., 2014; FAO, 2020). In addition, fisheries biodiversity plays a crucial role in maintaining the ecological integrity of aquatic ecosystems, regulating nutrient cycling, maintaining water quality, and supporting the health of other species (Biodiversity International, 2021). However, the global decline in fisheries biodiversity due to overfishing, habitat destruction, and pollution is undermining the provision of ecosystem services and the well-being of human societies (Worm *et al*., 2006; Cinner *et al.,* 2020). The loss of fisheries biodiversity has significant ecological, social, and economic consequences, affecting the stability and resilience of aquatic ecosystems, and reducing the availability of food and livelihoods for millions of people worldwide (Pikitch *et al*., 2014; FAO, 2020). Environmental assessment of creeks area has revealed the presence of various pollutants, including heavy metals, organic pollutants, and nutrients (Okeke *et al*., 2021). These pollutants can have adverse effects on marine species and human health. The creeks area is also vulnerable to climate change impacts, including sea level rise and ocean acidification, which can affect the distribution and abundance of marine species.

Importance of Mangroves Ecosystem

Avifauna, or bird species, are an important component of the mangrove ecosystem for several reasons. First, mangroves provide essential habitat for many bird species, including nesting and roosting sites (Barrett *et al.,* 2013). Some bird species also feed on the abundant invertebrates found in the intertidal zone of mangrove forests. Birds are important indicators of ecosystem health and provide insight into the status of the overall ecosystem (Ellison *et al.,* 1999). Changes in bird populations can indicate changes in the abundance and diversity of prey species, as well as the quality of the habitat. Some bird species, such as migratory birds, travel long distances and connect mangrove ecosystems with other regions, making them important for the broader ecological network. Therefore, avifauna is an important part of the mangrove ecosystem, and its conservation is necessary to ensure the long-term health and sustainability of this ecosystem (Kathiresan *et al.,* 2003).

Therefore, the conservation and sustainable management of fisheries biodiversity are critical to ensure the provision of ecosystem services, support human well-being and livelihoods, and maintain the ecological integrity of aquatic ecosystems. Ecosystem-based management (EBM) approaches have been proposed to achieve these goals, integrating ecological, social, and economic objectives to ensure the long-term sustainability of fisheries and the conservation of biodiversity (FAO, 2014).

Objectives

- To assess the physicochemical parameters of marine waters in the creeks area
- To identify and enumerate the fish species in the creeks area
- To determine the diversity and abundance of fish species in the creeks area
- To assess the impact of human activities on marine fisheries diversity and physicochemical parameters of marine waters in the creeks area

MATERIALS AND METHODS

Sampling locations

Biodiversity and marine environment assessment surveys are critical to understanding the health and productivity of marine ecosystems. These surveys help researchers and managers identify areas of high biodiversity, areas of concern, and potential impacts from human activities such as fishing, pollution, and climate change. One critical aspect of these surveys is the selection of appropriate sampling stations. In the case of the survey being described, four pre-selected sampling stations were chosen from each creeks from the study area (Figure 1, Table 1). These creeks were likely chosen based on their ecological importance, historical data, and the availability of funding and resources. The number and distribution of the sampling stations were likely based on the size of the study area and the desired level of spatial resolution. The selection of sampling stations is a critical step in the design of biodiversity and marine environment assessment surveys. The sampling stations must be representative of the larger ecosystem and should be chosen based on ecological, physical, and logistical considerations. For example, areas with high biodiversity or unique habitats should be included in the sampling scheme to ensure that the full range of species and habitats are represented in the survey. Similarly, areas that are known to be impacted by human activities should be sampled to assess the extent and severity of the impacts. Once the sampling stations have been selected, a sampling plan must be developed to guide the collection of data. This plan should specify the types of samples to be collected, the frequency and timing of sampling, and the methods for collecting and processing the samples. The sampling plan should also include measures to ensure that the data collected is of high quality, such as standard operating procedures for sample collection, quality control measures, and data management protocols.

Fish and Oceanographic Parameters

Fish samples were collected from *bhula nets* being operated from all those creeks area, randomly gill net were also operated to collect the fish samples where applicable in different creeks during January to March 2023. Water quality parameters and sediment samples were collected from each station (Figure 2 & 3). Finfish and shellfish samples were collected using *bulla juga* and fishing boats operating in those creeks during the survey. The fishes were sorted and their length into centimeters (cm) and weight in grams (g) were measured using measuring board and weight machine (Figure 4) at each sampling station. (Figures 5 & 6). Seawater quality parameters, such as salinity, temperature, dissolved oxygen, pH, and nutrient concentrations, are important for the health and functioning of mangrove ecosystems. Salinity affects the water balance and nutrient uptake of mangroves and can limit the growth and survival of seedlings and young trees. High salinity levels can also increase the toxicity of certain pollutants, such as heavy metals and pesticides.

Mangroves are sensitive to changes in temperature, which can affect their growth, reproduction, and survival. High temperatures can lead to increased evapotranspiration rates, reduced soil moisture, and decreased nutrient availability, while low temperatures can limit photosynthesis and increase the risk of frost damage. Mangrove roots require oxygen to survive, and dissolved oxygen levels in the water are therefore critical for their health and functioning. Low levels of dissolved oxygen can lead to root death and increased susceptibility to diseases and pests.

The pH of seawater can affect the availability and uptake of nutrients by mangroves. Changes in pH can also affect the solubility and toxicity of certain pollutants, such as heavy metals and pesticides. Mangroves require nutrients such as nitrogen, phosphorus, and potassium for growth and functioning. Nutrient concentrations can be affected by a range of factors, including human activities such as fertilizer use and sewage discharge. High nutrient levels can lead to eutrophication, which can result in algal blooms and reduced oxygen levels in the water. (Smith *et al.,* 1996, Ellison *et al.,* 1996, Profitt *et al*,. 2003, Kathiresan *et al.,* 2001, 2003, Bhutta, M. N, 2003, Barrett *et al.,* 2013, Siddiqui *et al*., 2008, Osland *et al*., 2013,). The water quality parameters like Temperature (°C), Dissolved Oxygen (DO) (mg/l), Salinity (ppt), pH, TDS and Conductivity from surface and bottom were measured from each station using HANNA multiparamter

instrument. Other observations like Birds, Turtles, and Dolphins were also recorded from sampling site, were measured in-situ at all sampling stations. Measurements were taken from the surface (at a depth of 1 meter) to a maximum depth of 30 meters, using a multipara meter probe from HANNA (Model HI98494) (Figure 2).

Statistical analysis

Fish sampling from at least four fishing boats using Bula net and gill net and water quality stations from same stations were conducted from each creek. Fish biodiversity from all those four stations were compiled into creek diversity and water quality parameter also complied at average range of creek area. The statistical alpha biodiversity analysis was used to estimate diversity index as follows:

- Simpson Index Approximation: $\frac{\sum_i n_i^2}{N^2}$
- Dominance Index: D $1 - \left(\frac{\sum_i n_i(n_i-1)}{N(N-1)}\right)$
- Dominance Index Approximation $1 - \left(\frac{\sum_i n_i^2}{N^2}\right)$
- Shannon Index: H' $-\sum_i \left(\frac{n_i}{N} \cdot \ln\left(\frac{n_i}{N}\right)\right)$
- Equitability Index $-\frac{\sum_i \left(\frac{n_i}{N} \cdot \ln\left(\frac{n_i}{N}\right)\right)}{\ln N}$
- Berger-Parker Dominance Index: $\frac{n_{max}}{N}$
- Margalef Richness Index: $\frac{S-1}{\ln N}$

The Shannon diversity index, also known as the Shannon-Wiener index, is a measure of the biodiversity of a community. It takes into account both the number of species present and the relative abundance of each species. The index is calculated using the following formula; Where: H = the Shannon diversity index pi = the proportion of individuals belonging to the species ln = natural logarithm. The index ranges from 0 to ln(S), where S is the total number of species present in the community. Higher values of H indicate greater biodiversity.

RANDOM BIODIVERSITY POINTS			
Creek Name	Longitude	Latitude	AOI
Khobar 1	67.579471	24.070235	Keti Bandar
Khobar 2	67.569706	24.074559	Keti Bandar
Khobar 3	67.516353	24.070334	Keti Bandar
Khobar 4	67.517582	24.058036	Keti Bandar
Turshian 1	67.489037	24.116812	Keti Bandar
Turshian 2	67.443582	24.117932	Keti Bandar
Turshian 3	67.406481	24.084264	Keti Bandar
Turshian 4	67.404529	24.077401	Keti Bandar

Hajamro 1	67.46739	24.15382	Keti Bandar
Hajamro 2	67.433444	24.137244	Keti Bandar
Hajamro 3	67.409896	24.126172	Keti Bandar
Hajamro 4	67.38278	24.134249	Keti Bandar
Chhan 1	67.423062	24.237519	Keti Bandar
Chhan 2	67.422811	24.233439	Keti Bandar
Chhan 3	67.396242	24.230789	Keti Bandar
Chhan 4	67.360719	24.248063	Keti Bandar
Dabbo 1	67.420468	24.320781	Keti Bandar
Dabbo 2	67.401005	24.326179	Keti Bandar
Dabbo 3	67.381407	24.339781	Keti Bandar
Dabbo 4	67.330125	24.358038	Keti Bandar
Paitiani 1	67.336827	24.475571	Keti Bandar
Paitiani 2	67.327645	24.462558	Keti Bandar
Paitiani 3	67.307401	24.462668	Keti Bandar
Paitiani 4	67.300286	24.454772	Keti Bandar
Khai 1	67.363473	24.562114	Keti Bandar
Khai 2	67.314189	24.550692	Keti Bandar
Khai 3	67.291508	24.533333	Keti Bandar
Khai 4	67.272747	24.521387	Keti Bandar
Khuddi 1	67.370014	24.634884	Keti Bandar
Khuddi 2	67.329965	24.638384	Keti Bandar
Khuddi 3	67.283208	24.609641	Keti Bandar
Khuddi 4	67.270449	24.574053	Keti Bandar
Wari Creek 1	67.951229	23.99613	Shah Bandar
Wari Creek 2	67.890204	23.940534	Shah Bandar
Kajhar Creek 1	68.039063	23.892528	Shah Bandar
Kajhar Creek 2	68.023083	24.003087	Shah Bandar
Jhari Creek 1	67.33936	24.74600	Keti Bandar
Jhari Creek 2	67.27619	24.73438	Keti Bandar
Jhari Creek 3	67.23796	24.73206	Keti Bandar

Table 1. Selected station from all 15 creeks along Indus Delta Region during the survey

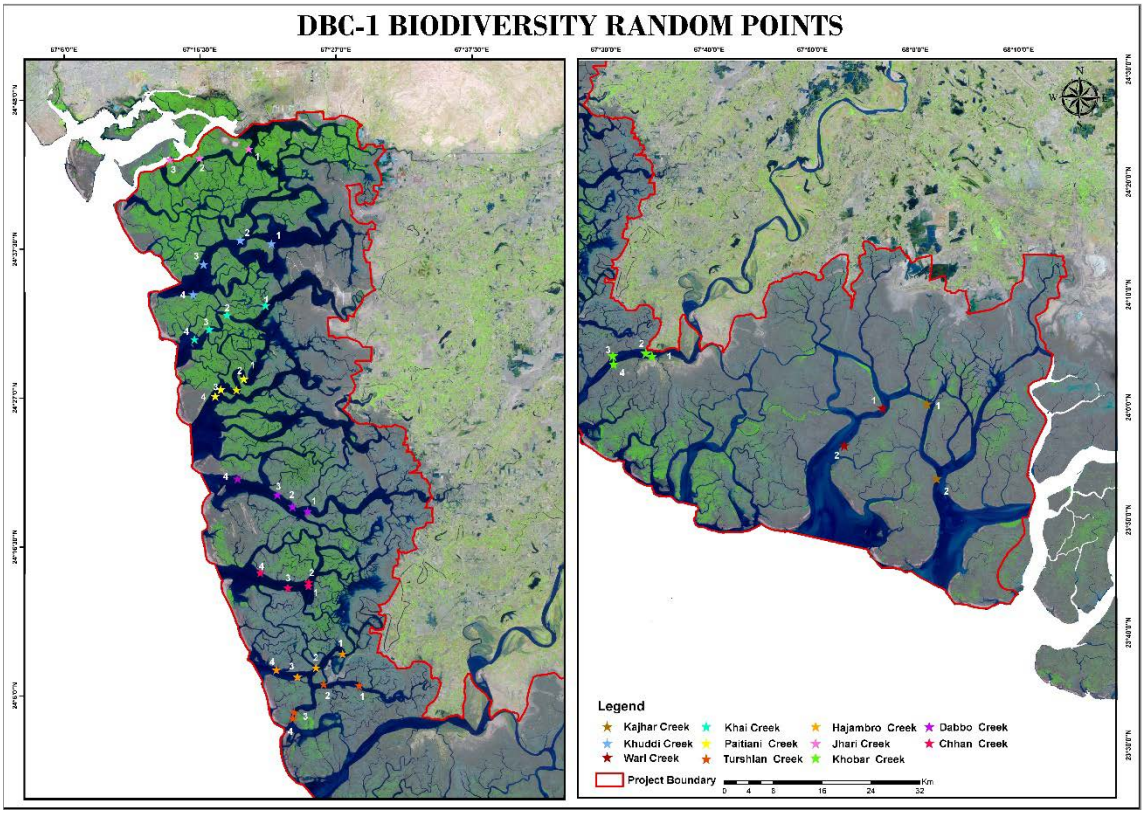


Figure 3. Pre-selected random sampling stations from each creek from Indus Delta Region



Figure 4. Measurement of water quality parameters using HANNA multiparameter instrument and water samples (Heavy metals, Microplastic and Plankton) from each station



Figure 5. Sediment samples from each station from Indus Delta region



Figure 6. Collection of fish samples and measurement from each station during survey



Figure 7. Different survey activities and sample collection during the research survey along Indus Delta region



Figure 8. Field survey activities and monitoring of fishing activities and fishing trawl used by fishermen community along Indus Delta Region

RESULTS AND OBSERVATION

Finfish and Shellfish Diversity

Total of 60 stations for fish diversity and water quality parameters were conducted from 15 creeks at least four stations from each creek (Table 1 & Figure 1). Total of 59 species were observed during present survey from all creeks (Table 2). Diversity from Khadro creek was only 4 species in which *Johnius elongates* was at highest percentage 36.59 and Gobidea at 29.27% (Table 3). Overall, eight species were observed from Rato Kof-cham creek in which *Penaeus monodon* were observed at 29.58 and *Thryssa hammilonii* at 19.72% (Table 4). Four stations were conducted from Korangi creek and overall, 23 number of species were observed from which *Penaeus indicus* and *Metapeneaus affinis* were at highest percentage at 17.17, however *Mugil cephalus* at 15.11 and later on croaker fishes were dominant species in this creek (Table 5). Total of 20 number of species were found from Phiti creek from all those stations, in which *Metapeneaus affinis* shrimp and *Johnius elongates* croaker species were found at highest percentage at 26.69 and 18.15%, respectively. However other species also found at reasonable percentage (Table 6). Four stations were conducted from Khudi creek and 16 species were determined in which shrimp species *Penaeus indicus* and *Metapeneaus affinis* found at high percentage 35.19 and 21.26%. *Mugil cephalus* found at third high species in Khudi creek (Table 7). However in Khai creek 15 diverse species were observed in high diversity percentage of *Penaeus indicus* and *Metapeneaus affinis* shrimp found at 28.20 and 22.56% respectively, while *Mugil cephalus* found 15.98% (Table 8). Total of 13 diverse species were observed from Patiani creek from which two shrimp species i.e *Penaeus indicus* and *Metapeneaus affinis* found at high percentage at 19.53 and 17.58% respectively. Later on, *Terapon jarbua* found at 13.67% other species share also shown (Table 9). 11 diverse species from Daboo creek were observation in which *Mugil cephalus* found at high percentage at 35% and *Penaeus indicus* at 14.38 and *Johnius elongatus* croaker found at 10.63% (Table 10). Fish and shellfish diversity were found at 15 species of different taxa from Chanr creek, in which *Penaeus indicus* at 32.65% and *Mugil cephalus* at 13.41% contributes the highest percentage from creek (Table 11). Hajamro creek is most diverse creek area along Indus Delta from which overall 39 different species were observed during present survey. The highest percentage from this creek was shrimp *Metapeneaus affinis* species later on *Thryssa hammilonii* was at 9.29% (Table 12). Total of 23 number of different fish and shellfish species were observed from Tushan creek in which *Thryssa vitriorostris* found at 23.56% and *Scatophgaus argus* at 14.72% (Table 13). Diversity from Navy creeks was found at 6 species in which *Mugil cephalus* observed in highest percentage at 40.82%, while Penaeus monodon at 20.41% other species percentage shown in Table 14. The Cabin wari creek is also one of the rich in biodiversity from which total of 25 different species were observed. From which shrimp species like *Metapeneaus affinis*, *Penaeus indicus* and *P. monodon* was found highest in percentage at 26.04, 16.93 and 15.63% respectively (Table 15). Fish and shellfish diversity from Kajhar creek was at 23 species in which same pattern as Cabin creek with rich in shrimp species diversity at 27.32% of *Metapeneaus affinis*, 17.76% of *Penaeus indicus* and 16.39% of *P. monodon* was found as major species (Table 16).

However, diversity indexes were applied for better understand the diversity richness of species within different creeks of Indus Delta region, in which different statistical analysis were used. During present

survey it was observed that the highest Shannon index and Margalef richness index was observed from Hajamro creek in which high fish and shellfish biodiversity index was observed. While, the lowest values were observed from Khadro, Navy and Kajhar creek area. While other creeks area index was within normal range during the present study (Table 17 & Figure 7).

Table 2. Overall, 59 fish and shellfish biodiversity observations from all 15 creeks along Indus Delta region

S. No	Scientific Name	English Name
1	*Acanthopagrus berda*	Gold silk seabream
2	*Alepis djadaba*	Shrimp scad
3	*Anodonstomata chachunda*	Chacunda gizzard shad
4	*Argyrops spinifer*	Kings solder bream
5	*Arius arius*	Threadfin sea catfish
6	*Atropus atropos*	Claftbelly trevally
7	*Aulopareia ocellata*	Fat tail-eyed goby
8	*Brachirus orientialis*	Oriental sole
9	*Charybdis feriata*	Crucifix crab
10	*Escualosa thoracata*	White sardine
11	*Filimanus similis*	Indian seven thread fin
12	*Gerrus limbatus*	Seddleblack seabody
13	*Gobidea* spp	Mudskeeper
14	*Gudusia chapra*	Indian river shad
15	*Gymnura poecilura*	Long-tail butterfly ray
16	*Hyporhamphus sindensis*	Halfbeak fish
17	*Hyporhamphus unifasciatus*	Silver strip halfbeak.
18	*Johnius elongatus*	Spindal Croaker
19	*Lagocephalus guentheri*	Diamondback puffer
20	*Lepturacanthus savala*	Ribbon fish
21	*Uroteuthis duvaucelii*	common Indian squid
22	*Lutjanus johnii*	John snapper
23	*Matuta planipes*	Flower moon crab
24	*Megalaspis cordyla*	Torpedo scad
25	*Metapeneaus affinis*	Jhinga shrimp
26	*Mugil cephalus*	Flathead grey mullet
27	*Muraenesox bagio*	Common pike conger
28	*Nematalosa nasus*	Bloch gizzard shad

29	*Nibea maculata*	Kathala croaker
30	*Ophisternon candidum*	Blind eel
31	*Oratosquilla oratoria*	Japanese mantis shrimp
32	*Oreochromis mossambicus*	Moasambique tilapia
33	*Otolituhs cuvieri*	Lesser tiger tooth crocker
34	*Pampus argenteus*	White paplet
35	*Penaeus indicus*	Indian Prawn
36	*Penaeus monodon*	Giant tiger shrimp
37	*Penaeus pulchricaudatus*	Western kuruma prawn
38	*Pilcofollis dussumieri*	Blacktip catfish
39	*Plotusus lineatus*	Stripped eel catfish
40	*Pomadasys maculatus*	Saddle grunt
41	*Portunus sanguinolentus*	Three spotted crab
42	*Portunus segins*	Arabian Flower crab
43	*Psedorhombus javanica*	Javan flounder
44	*Pseudosynanceia nelanistigma*	Black fin stone fish
45	*Scatophgaus argus*	Spotted scat
46	*Scylla tranquebrica*	Purple mud crab
47	*Secutor interruptus*	Pignosed pony fish
48	*Sillago sihama*	Ladyfish
49	*Sillago indicus*	Indian sillago
50	*Strongylura strongylura*	Spottail needle fish
51	*Stylopherus indicus*	Indian anchovy
52	*Tenualosa toli*	Toli shad
53	*Terpon jaruba*	Tarpon
54	*Thenus indicus*	Indian flathead lobster
55	*Thryssa hammilonii*	Hamilton thryssa
56	*Thyrssa vitriorostris*	Orange mouth glassnose
57	*Torpedo fuscomaculata*	Black spotted torpedo
58	*Trypeauchen agina*	Pink worm eel
59	Gastropods	Snails

Table 3. Fish and shellfish biodiversity from Khadro creek from selected stations

Khadro creek		
S. No	**Scientific Name**	**%age**
1	*Johnius elongatus*	36.59
2	*Gobidea* spp	29.27
3	*Penaeus indicus*	21.95
4	*Sillago sihama*	12.20

Table 4. Fish and shellfish biodiversity from Rato Kof-cham creek from selected stations

Rato Kof-cham creek		
S. No	**Scientific Name**	**%age**
1	*Penaeus monodon*	29.58
2	*Thryssa hammilonii*	19.72
3	*Sillago sihama*	12.68
4	*Lutjons johni*	11.27
5	*Johnius* spp	11.27
6	*Alepis dejidaba*	7.04
7	*Gerrius lambitus*	5.63
8	*Gobidea* spp	2.82

Table 5. Fish and shellfish biodiversity from Korangi creeks from selected stations

Korangi creek		
S. No	**Scientific Name**	**%age**
1	*Penaeus indicus*	17.17
2	*Metapeneaus affinis*	17.17
3	*Mugil cephalus*	15.11
4	*Johnius elongatus*	8.15
5	*Otolituhs cuvieri*	6.87
6	*Terpon jaruba*	6.01
7	*Thryssa hammilonii*	5.58
8	*Secutor interruptus*	3.43
9	*Pseudosynanceia nelanistigma*	3.43
10	*Sillago sihama*	3.00

11	*Brachirus orientialis*	2.15
12	*Penaeus monodon*	1.89
13	*Thyrssa vitriorostris*	1.55
14	*Gobidea* spp	1.29
15	*Lepturacanthus savala*	1.29
16	*Portunus segins*	1.29
17	*Uroteuthis duvaucelii*	1.03
18	*Portunus sanguinolentus*	0.86
19	*Arius arius*	0.77
20	*Scatophgaus argus*	0.69
21	*Pampus argenteus*	0.60
22	*Stylopherus indicus*	0.34
23	*Plotusus lineatus*	0.34

Table 6. Fish and shellfish biodiversity from Phiti creeks from selected stations

Phiti creek		
S. No	**Scientific Name**	**%age**
1	*Metapeneaus affinis*	26.69
2	*Johnius elongatus*	18.15
3	*Mugil cephalus*	9.25
4	*Matuta planipes*	8.01
5	*Thryssa hammilonii*	6.23
6	*Secutor interruptus*	6.23
7	*penaeus indicus*	4.45
8	*Portunus sanguinolentus*	3.38
9	*Otolituhs cuvieri*	2.67
10	*Thyrssa vitriorostris*	2.67
11	*Stylopherus indicus*	2.67
12	*Portunus segins*	2.49
13	*Brachirus orientialis*	2.14
14	*Pampus argenteus*	0.89
15	*Arius arius*	0.89
16	*Psedorhombus javanica*	0.89
17	*Gobidea* spp	0.71

18	*Uroteuthis duvaucelii*	0.71
19	*Penaeus monodon*	0.53
20	*Scatophgaus argus*	0.36

Table 7. Fish and shellfish biodiversity from Khudi creeks from selected stations

Khudi creek		
S. No	**Scientific Name**	**%age**
1	*Penaeus indicus*	35.19
2	*Metapeneaus affinis*	21.26
3	*Mugil cephalus*	13.49
4	*Secutor interruptus*	6.60
5	*Johnius elongatus*	5.13
6	*Arius arius*	3.37
7	*Thyrssa vitriorostris*	3.23
8	*Thryssa hammilonii*	2.35
9	*Terpon jaruba*	2.20
10	*Penaeus monodon*	1.47
11	*Portunus sanguinolentus*	1.47
12	*Brachirus orientialis*	1.17
13	*Portunus segins*	1.17
14	*Otolituhs cuvieri*	0.73
15	*Sillago sihama*	0.59
16	*Stylopherus indicus*	0.59

Table 8. Fish and shellfish biodiversity from Khai creeks from selected stations

Khai creek		
S. No	**Scientific Name**	**%age**
1	*Penaeus indicus*	28.20
2	*Metapeneaus affinis*	22.56
3	*Mugil cephalus*	15.98
4	*Arius arius*	6.02
5	*Stylopherus indicus*	4.32
6	*Terpon jaruba*	3.76
7	*Brachirus orientialis*	2.82

8	*Secutor interruptus*	2.82
9	*Portunus sanguinolentus*	2.63
10	*Thryssa hammilonii*	2.44
11	*Johnius elongatus*	2.26
12	*Thyrssa vitriorostris*	2.26
13	*Penaeus monodon*	1.69
14	*Otolituhs cuvieri*	1.32
15	*Portunus segins*	0.94

Table 9. Fish and shellfish biodiversity from Patiani creeks from selected stations

Patiani creek		
S. No	**Scientific Name**	**%age**
1	*Penaeus indicus*	19.53
2	*Metapeneaus affinis*	17.58
3	*Terpon jaruba*	13.67
4	*Mugil cephalus*	11.72
5	*Sillago sihama*	7.81
6	*Johnius elongatus*	5.86
7	*Thryssa hammilonii*	5.86
8	*Arius arius*	4.69
9	*Stylopherus indicus*	3.91
10	*Brachirus orientialis*	3.52
11	*Portunus sanguinolentus*	3.13
12	*Portunus segins*	1.56
13	*Penaeus monodon*	1.17

Table 10. Fish and shellfish biodiversity from Daboo creeks from selected stations

Daboo creek		
S. No	**Scientific Name**	**%age**
1	*Mugil cephalus*	35
2	*Penaeus indicus*	14.38
3	*Johnius elongatus*	10.63
4	*Arius arius*	10
5	*Thyrssa vitriorostris*	7.5

6	*Metapeneaus affinis*	7.5
7	*Terpon jaruba*	6.25
8	*Brachirus orientialis*	2.5
9	*Thryssa hammilonii*	2.5
10	*Portunus segins*	2.5
11	*Portunus sanguinolentus*	1.25

Table 11. Fish and shellfish biodiversity from Chanr creeks from selected stations

Chanr creek		
S. No	**Scientific Name**	**%age**
1	*Penaeus indicus*	32.65
2	*Mugil cephalus*	13.41
3	*Secutor interruptus*	8.75
4	*Thryssa hammilonii*	5.83
5	*Escualosa thoracata*	5.83
6	*Sillago sihama*	4.66
7	*Stylopherus indicus*	4.37
8	*Metapeneaus affinis*	4.37
9	*Thyrssa vitriorostris*	4.08
10	*Brachirus orientialis*	3.50
11	*Arius arius*	3.50
12	*Portunus sanguinolentus*	3.50
13	*Portunus segins*	2.62
14	*Terpon jaruba*	2.33
15	*Penaeus monodon*	0.58

Table 12. Fish and shellfish biodiversity from Hajamro creeks from selected stations

Hajamro creek		
S. No	**Scientific Name**	**%age**
1	*Metapeneaus affinis*	16.09
2	*Thryssa hammilonii*	9.29
3	*Mugil cephalus*	8.29
4	*Brachirus orientialis*	7.46
5	*Escualosa thoracata*	7.46

6	*Alepis djadaba*	3.48
7	*Hyporhamphus unifasciatus*	3.32
8	*Stylopherus indicus*	3.15
9	*Portunus sanguinolentus*	2.49
10	*Acanthopagrus berda*	2.49
11	*Arius arius*	2.32
12	*Sillago sihama*	1.99
13	*Terpon jaruba*	1.99
14	*Thyrssa vitriorostris*	1.99
15	*Secutor interruptus*	1.99
16	*Sillago indicus*	1.99
17	*Matuta planipes*	1.99
18	*Ophisternon candidum*	1.99
19	*Aulopareia ocellata*	1.99
20	*Psedorhombus javanica*	1.99
21	*Trypeauchen agina*	1.99
22	*Gobidea* spp	1.66
23	*Pseudosynanceia nelanistigma*	1.66
24	*Filimanus similis*	1.66
25	*Penaeus indicus*	1.49
26	*Scylla tranquebrica*	1.33
27	*Oreochromis mossambicus*	1.00
28	*Lepturacanthus savala*	0.83
29	*Nematalosa nasus*	0.83
30	*Hyporhamphus sindensis*	0.66
31	*Strongylura strongylura*	0.66
32	*Portunus segins*	0.50
33	*Anodonstomata chachunda*	0.50
34	*Penaeus monodon*	0.33
35	*Thenus indicus*	0.33
36	*Pomadasys maculatus*	0.33
37	*Penaeus pulchricaudatus*	0.17
38	*Oratosquilla oratoria*	0.17
39	*Pilcofollis dussumieri*	0.166

Table 13. Fish and shellfish biodiversity from Turshan creeks from selected stations

Turshan creek		
S. No	**Scientific Name**	**%age**
1	*Thyrssa vitriorostris*	23.56
2	*Scatophgaus argus*	14.72
3	*Penaeus indicus*	14.49
4	*Lepturacanthus savala*	10.25
5	*Penaeus monodon*	5.89
6	*Sillago indicus*	5.30
7	*Metapeneaus affinis*	4.59
8	*Escualosa thoracata*	4.12
9	*Thryssa hammilonii*	3.53
10	*Mugil cephalus*	2.94
11	*Arius arius*	2.47
12	*Pseudosynanceia nelanistigma*	2.12
13	*Aulopareia ocellata*	1.18
14	*Lagocephalus guentheri*	1.06
15	*Matuta planipes*	0.94
16	*Stylopherus indicus*	0.82
17	*Anodonstomata chachunda*	0.59
18	*Nibea maculata*	0.35
19	*Psedorhombus javanica*	0.24
20	*Trypeauchen agina*	0.24
21	*Argyrops spinifer*	0.24
22	*Charybdis feriata*	0.24
23	*Atropus atropos*	0.12

Table 14. Fish and shellfish biodiversity from Navy creeks from selected stations

Navy creek		
S. No	**Scientific Name**	**%age**
1	*Mugil cephalus*	40.82
2	*Penaeus monodon*	20.41
3	*Sillago sihama*	15.31
4	*Matuta planipes*	15.31

5	*Hyporhamphus unifasciatus*	4.08
6	*Aulopareia ocellata*	4.08

Table 15. Fish and shellfish biodiversity from Cabin wari creeks from selected stations

Cabin wari		
S. No	**Scientific Name**	**%age**
1	*Metapeneaus affinis*	26.04
2	*Penaeus indicus*	16.93
3	*Penaeus monodon*	15.63
4	*Thryssa hammilonii*	6.51
5	*Mugil cephalus*	6.51
6	*Stylopherus indicus*	3.91
7	*Sillago indicus*	2.99
8	*Johnius elongatus*	2.60
9	*Scylla tranquebrica*	2.60
10	*Pilcofollis dussumieri*	2.08
11	*Thyrssa vitriorostris*	1.95
12	*Arius arius*	1.95
13	*Portunus segins*	1.95
14	*Matuta planipes*	1.56
15	*Hyporhamphus unifasciatus*	1.30
16	*Gerrus limbatus*	1.30
17	*Muraenesox bagio*	1.30
18	*Portunus sanguinolentus*	0.65
19	*Lepturacanthus savala*	0.52
20	*Lagocephalus guentheri*	0.52
21	*Escualosa thoracata*	0.39
22	*Pampus argenteus*	0.26
23	*Scatophgaus argus*	0.26
24	*Ophisternon candidum*	0.13
25	*Charybdis feriata*	0.13

Table 16. Fish and shellfish biodiversity from Kajhar creeks from selected stations

Kajhar creek		
S. No	**Scientific Name**	**%age**
1	*Metapeneaus affinis*	27.32
2	*Penaeus indicus*	17.76
3	*Penaeus monodon*	16.39
4	*Thryssa hammilonii*	6.83
5	*Mugil cephalus*	6.83
6	*Stylopherus indicus*	4.10
7	*Sillago indicus*	3.14
8	*Scylla tranquebrica*	2.73
9	*Thyrssa vitriorostris*	2.05
10	*Arius arius*	2.05
11	*Portunus segins*	2.05
12	*Matuta planipes*	1.64
13	*Hyporhamphus unifasciatus*	1.37
14	*Gerrus limbatus*	1.37
15	*Muraenesox bagio*	1.37
16	*Portunus sanguinolentus*	0.68
17	*Lepturacanthus savala*	0.55
18	*Lagocephalus guentheri*	0.55
19	*Escualosa thoracata*	0.41
20	*Pampus argenteus*	0.27
21	*Scatophgaus argus*	0.27
22	*Ophisternon candidum*	0.14
23	*Charybdis feriata*	0.14

Table 17. Alpha Biodiversity index from all 15 creeks along Indus Delta region

Creeks	SIA	DI	SI	EI	DIA	BPDI	MRI
Khadro creek	0.487	0.562	0.47	0.671	0.512	0.697	0.8
Rato kof-cham	0.418	0.825	3.5	0.875	0.852	0.217	2.21
Korangi	0.105	0.895	2.565	0.818	0.895	0.171	3.116
Phiti	0.133	0.867	2.392	0.798	0.866	0.266	3.001
Khuddi	0.198	0.803	2.02	0.728	0.801	0.351	2.299
Khai	0.167	0.834	2.143	0.791	0.832	0.282	2.23
Patiani	0.12	0.882	2.293	0.893	0.879	0.195	2.164
Daboo	0.181	0.823	2.008	0.837	0.818	0.35	1.97
Chaanr	0.151	0.85	2.292	0.846	0.848	0.326	2.398
Hajamro	0.063	0.938	3.148	0.865	0.936	0.161	5.781
Turshan	0.122	0.978	2.426	0.773	0.877	0.235	3.262
Khobar	0.145	0.855	2.297	0.78	0.855	0.277	2.577
Navy	0.279	0.723	1.413	0.877	0.72	0.425	0.709
Cabin Wari	0.141	0.86	2.37	0.745	0.859	0.266	3.473
Kajhar	0.23	0.77	1.989	0.653	0.769	0.412	3.035

Simpson Index Approximation (SIA); Dominance Index (DI); Shannon Index (SI); Equitability Index (EI); Dominance Index Approximation (DIA); Berger-Parker Dominance Index (BPMI); Margalef Richness Index (MRI)

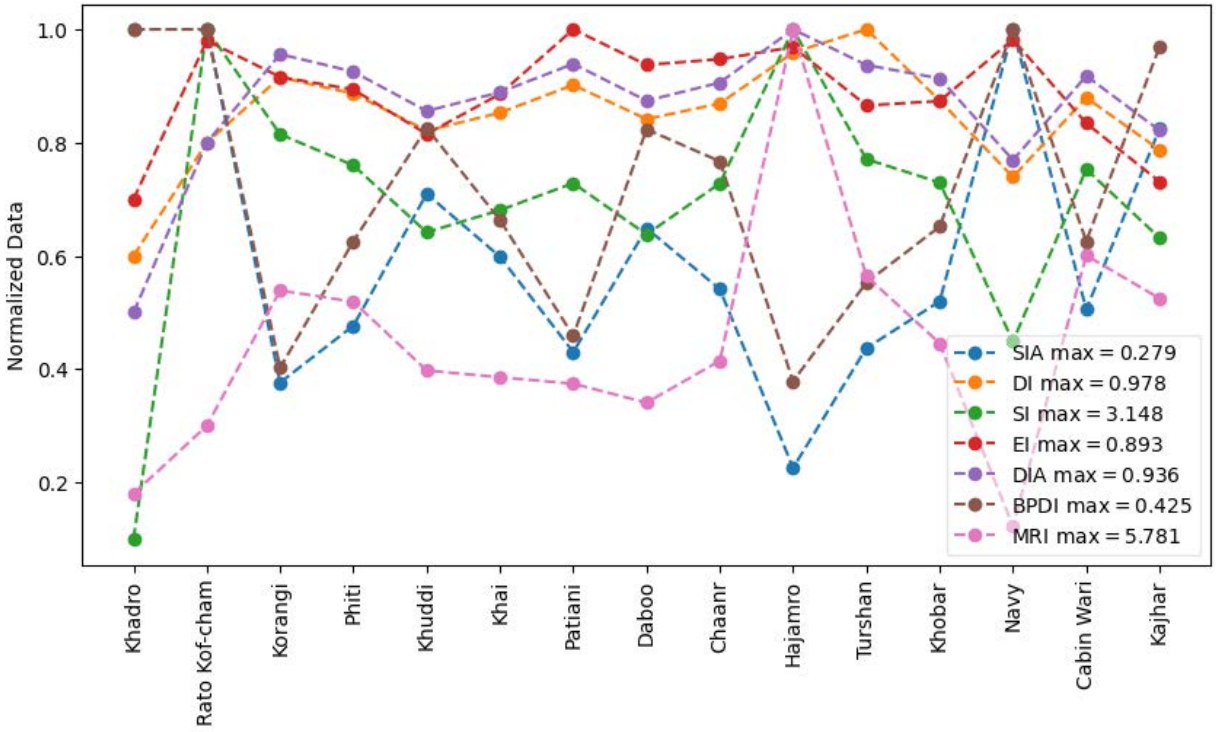


Figure 9. Different diversity index from Indus Delta region during January to March 2023

PLATE-1: Marine Biodiversity



Orinatal sole: *Brachirus orientialis*



Javan flounder: *Psedorhombus javanica*



Mantis *Shrimp: Oratosquilla oratoria*



Jinga Shrimp: *Metapenaeus affinis*



Giant Tiger Shrimp: *Penaeus monodon*



Western Kuruma prawn: *Penaeus pulchricaudatus*



Indian prawn: *Penaeus indicus*



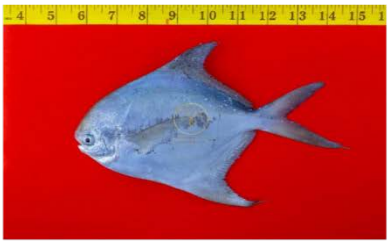
Giant tiger shrimp: *Penaeus monodon*



Giant tiger shrimp: *Penaeus monodon*



King solder bream: *Argyrops spinifer*



Pampus pomfret: *Pampurs argenteus*



Cleftbelly trevally: *Atropus atropos*



Indian Flathead lobster:Thenus *indicus*



Common pike conger: *Muraenesox bagio*



Longtail butterfly Ray: *Gymnura poecilura*



Crucifix crab: *Charybdis feriata*



Common Indian Squid: *Loligo Duvauceli*



Black spotted torpedo: *Torpedo fuscomaculata*



Flat head gray mullet: *Mugil cephalus*



Silver strip halfbeak: *Hyporhamphus sindensis*



Halfbeak fish: *Hyporhamphus sindensis*



Spottail needlefish: *Strongylura strongylura*



Savalai hairtail: *Lepturacanthus savala*



Gobiidae sp



Fat taileyed goby: *Aulopareia ocellata*



Gobiidae sp



Pink worm eel: *Trypauchen vagina*



Hamilton's thryssa: *Thryssa hamiltonii*



Indian river shad: *Gudusia chapra*



Jarbua terapon: *Terpon jarbua*



Johnius sp.



Torpedo scad: *Megalaspis cordyla*



Jhon's snapper: *Lutjanus johnii*



Shrimp scad: *Alepis djedaba*



Silver sillago: *Sillago sihama*



Blacktip sea catfish: *Plicofollis dussumieri*



Indian anchovy: *Stolephorus indicus*



Goldsilk sea bream: *Acanthopagrus berda*



Blotched croaker: *Nebea maculata*



Saddleback silverbiddy: *Gerrus limbatus*



Croaker: *Johnius* sp.



Orange mouth anchovy: *Thryssa vitriorostris*



Tiger tooth croaker: *Otolithes ruber*



Saddle grunt: *Pomadasys maculatus*



Thilapia: *Oreochromis mossambicus*



Bloc's gizzard shad: *Nematalosa nasus*



Lesser tigertooth Croaker: *Otolithes cuvieri*



Indian seven finger threadfin: *Filimianus similis*

Water quality parameters

The water quality parameters, including Temperature (°C), Dissolved Oxygen (DO) (mg/l), Salinity (ppt), pH, TDS and Conductivity from surface and bottom were measured from all 20 stations using HANNA multiparameter instrument during January to March 2023. Four stations for water quality parameters from surface to bottom were conducted from each creek during present study. The measurement from each station were compiled at average values for each creek for each parameter (Table 18). During present study the highest average temperature was observed from Hajamro creek at 35.33°C, while the lowest temperature was measured at 17.4 °C and 17.5 °C from Khadro and Korangi creek respectively. The average temperature standard deviation was calculated at ±4.25°C from all creeks. However, the highest averaged salinity at 38.4ppt was measured from Cabin wari creek and lowest values at 33.3 ppt were observed from Khobar creek. The averaged standard values of salinity from all creeks were found at ±1.09 ppt. The highest dissolved oxygen values were found at 1.5 mg/l from Dodee wari and lowest values at 0.7 mg/l was 0.6 from Cabin wari creek. Overall, 0.9 mg/l average values, while standard deviation of all creeks were observed at ±0.22 mg/l. were found from all creeks of Indus Delta region. The averaged pH values from all creeks were within the range of 8.2 with standard deviation at ±0.11, other values of conductivity (72.1 S/m) and TDS (53729 mg/l) within the normal range during present study time (Table 18; Figure 8).

Table 18. Water quality parameter analysis from different creeks along Indus Delta region during January to March 2023.

Stations	Temperature (°C)	Salinity (ppt)	DO (mg/l)	pH	TDS (mg/l)	Conductivity (S/m)
Rato Kof-Cham	17.6	34.5	71.5	0.5	8.4	36545
Khadro creek	17.4	35.5	74.3	0.7	8.6	35654
Korangi creek	17.5	37.1	63.8	0.9	8.3	36550
Phitti creek	18.5	35.2	65.3	0.7	8.3	34243
Khudi creek	26.1	34.9	74.3	1.0	8.2	36807
Khai creek	26.4	34.5	74.3	1.0	8.3	36725
Paitiani creek	25.1	34.5	71.3	1.0	8.6	36747
Dabo creek	25.1	34.4	71.4	0.83	8.3	35509
Chanr creek	25.4	34.6	73.0	0.68	8.3	36314
Hajamro creek	35.3	35.0	70.5	0.87	8.3	34234
Turshan creek	24.8	35.0	70.5	0.87	8.3	29324
Khobar creek	25.1	33.3	69.4	1.2	8.1	35654
Cabin wari	15.2	38.4	82.1	0.62	8.1	32445
Kajhar creek	27.1	35.0	74.1	0.89	8.3	32455
Satatari creek	24.4	35.0	73.0	0.88	8.3	36543
Waari creek	25.8	35.7	74.8	0.68	8.2	37482
Tango creek	24.6	35.2	73.0	1.1	8.2	36550
Mini Tango	24.1	34.5	70.2	1.3	8.2	35690

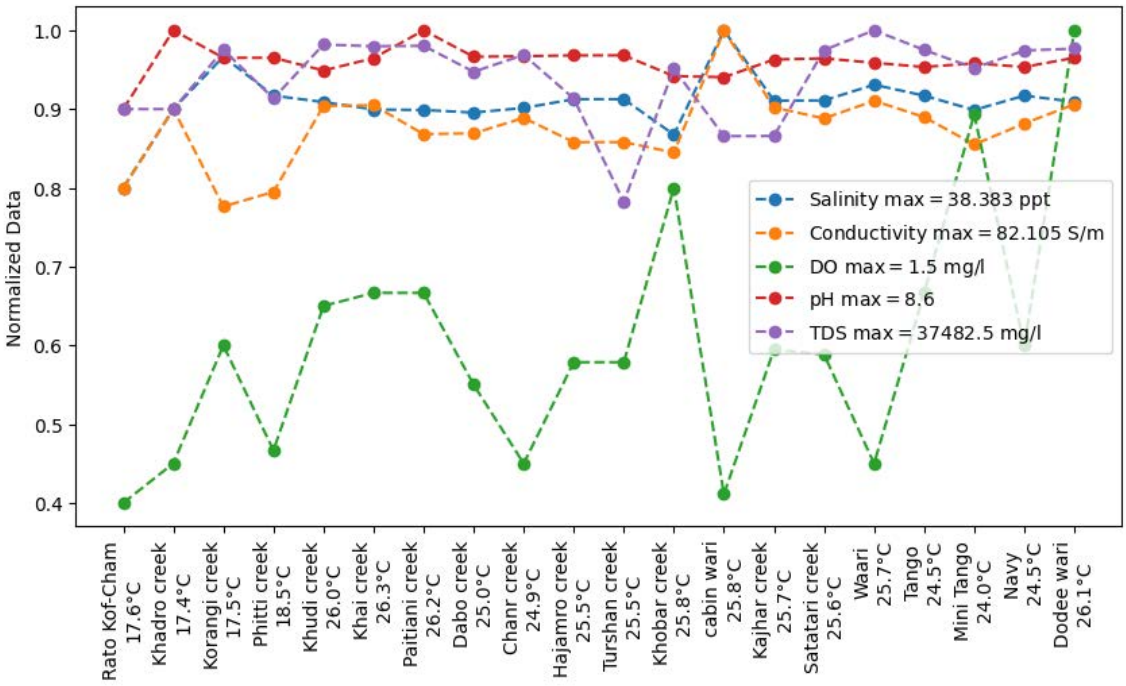


Figure 10. Water quality parameters along Indus Delta region during January to March 2023

DOLPHIN AND TURTLE OBSERVATIONS

DISTRIBUTION OF DOLPHINS ALONG INDUS DELTA REGION			
Creek Name	No. of Dolphins	Longitude	Latitude
Tango Creek	2	67.452562	24.194076
Dabo Creek	2	67.511948	24.340641
Dabo Creek	2	67.331254	24.353297
Chann Creek	6	67.415821	24.233842
Phitti Creek	2	67.184589	24.692152
Hajamro Creek	2	67.466639	24.155189
Hajamro Creek	1	67.439189	24.138968
Hajamro Creek	2	67.414556	24.129092
Turshian Creek	2	67.484419	24.118046
Khobar Creek	3	67.564084	24.071613
Khobar Creek	4	67.522090	24.069522
Cabin Wari Creek	2	67.847625	24.090844

Table 19. Distribution of dolphins along the Indus Delta region during the research survey.

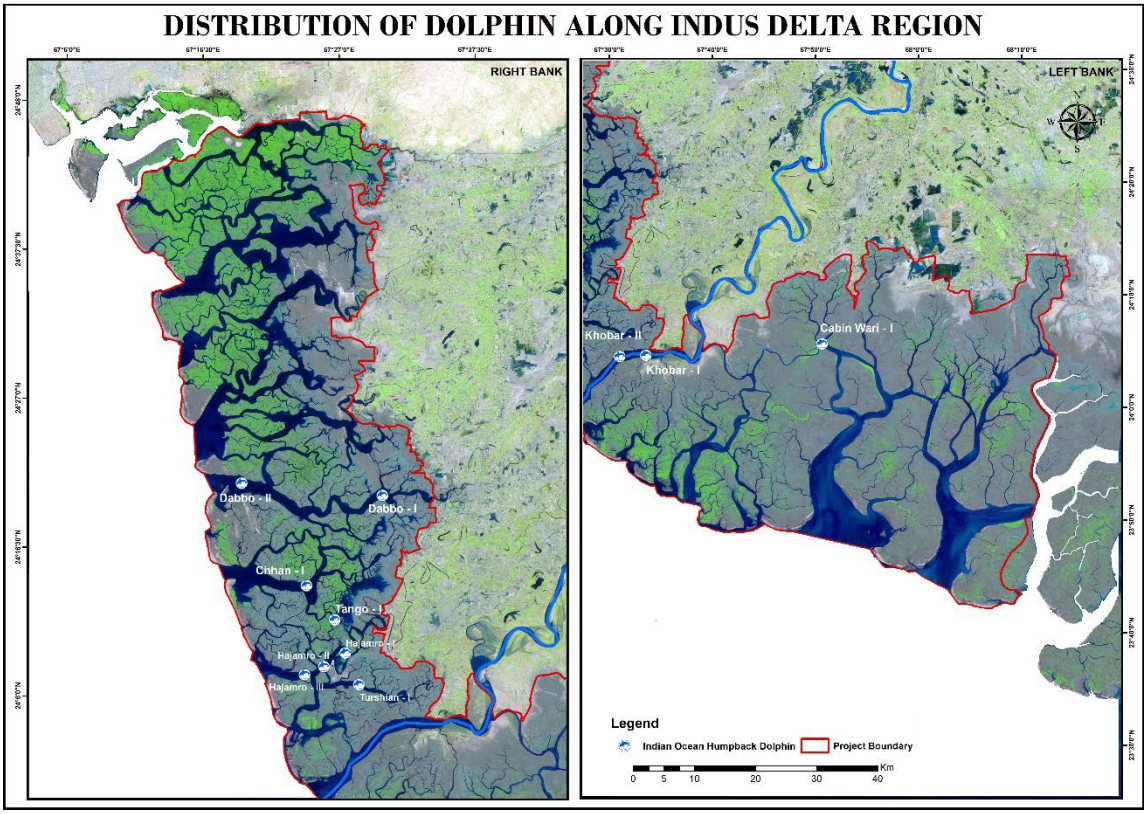


Figure 11. Dolphin Observations from Indus Delta regions during the research survey



Figure 12. Observation of Humpback Dolphin from Ketibandar area Indus Delta during the research survey

IMPACT OF TRASH FISH ON BIODIVERSITY

During the present study it was observed that most of the fishing boats using *Bulla Gujja* which not only destroying the fisheries but also destroying the bottom ecology of creeks. The impact of those nets is alarming not only for the fisheries but also destroying the environment for the marine biodiversity. Most of that bycatch which also consist of valuable fisheries used in trash and dry fish. Moreover, trash fish catch can also have negative environmental impacts, such as overfishing and disruption of the ecosystem. Some fish species considered as trash fish may actually have important ecological roles in the creeks and canals where they are caught, such as cleaning up waste and contributing to the food web. Overfishing or eliminating these species can have unintended consequences for the overall health and balance of the ecosystem. Efforts have been made to reduce trash fish catch by promoting sustainable fishing practices and finding alternative markets for these fish, such as using them for animal feed or fertilizer. However, more work is needed to address the economic and environmental impacts of trash fish catch in creeks areas (Figure 11).



Figure 13. Most of fish from Indus Delta region used as trash fish except shrimp catch

CONCLUSION AND RECOMMENDATIONS

Current study on Biodiversity and water quality parameters were conducted from Indus Delta region from Korangi creeks to Shahbandar area. Total of 60 stations were conducted from 15 creeks 4 from each creek during January to March 2023. During the survey the fish and shellfish samples were collected from fishing boats operating that area and also conducted gujjo trawl for collection of diversity samples. It is noted that the fishing boats operating in the creeks area mostly using *Bullo Gujjo* net particularly for shrimp fisheries. However, this net completely banned in this area but gives us completely diversity of samples to monitor the marine biodiversity from the creeks area during the survey.

Marine biodiversity and water quality parameters survey from creeks area are essential for the sustainability of the ecosystem. Creeks are important sources of freshwater and saltwater, and the mixing of these waters creates a dynamic environment that is home to a variety of marine species. The assessment of marine biodiversity and water quality parameters survey in creeks is crucial for identifying areas of high biodiversity, assessing the impact of human activities on these ecosystems, and developing strategies to protect and restore threatened species and habitats.

The importance of marine biodiversity assessment surveys from creeks area cannot be overstated, as they play a crucial role in ensuring the long-term sustainability of these unique and important ecosystems. Creeks are particularly vulnerable to human activities, such as urbanization, deforestation, and agriculture.

These activities can introduce pollutants and nutrients into the water, leading to changes in water quality and impacts on marine biodiversity. Therefore, conducting regular surveys to monitor the health of these ecosystems is essential to ensure that they remain healthy and productive.

One of the main reasons for conducting surveys in creeks is to assess the water quality parameters. The water quality parameters in creeks include temperature, pH, salinity, dissolved oxygen, TDS and conductivity. These parameters are essential for the survival of marine species and can be affected by human activities.

Temperature is an important water quality parameter that affects the physiology, behavior, and distribution of marine species. Changes in temperature can cause changes in the timing of breeding, migration, and feeding of marine organisms. This can, in turn, affect the entire food web, including the predators that rely on these organisms for food.

Salinity is another important water quality parameter that can be affected by human activities such as irrigation or runoff. Changes in salinity can affect the physiology of marine organisms, particularly those that are adapted to a specific salinity range. Salinity can also affect the growth and survival of marine plants, which are important for maintaining healthy ecosystems.

Dissolved oxygen is critical for the survival of marine organisms, as it is essential for respiration. Changes in dissolved oxygen can occur due to a variety of factors, including temperature, salinity, and human activities such as sewage discharge or nutrient runoff. Oxygen depletion can cause stress and mortality in marine organisms, particularly those that are less tolerant of low oxygen levels.

Total of 59 different finfish and shellfish species were observed during present survey from all creeks. During the present study Rato Kof-cham, Korangi and Hajamro creek found diverse in marine biodiversity with Shannon Index at 3.5, 2.565 and 3.148 respectively, which indicate the rich in biodiversity index. However, Khadro, Navy and Kajhar creeks were low in diversity index at 0.47, 1.413 and 1.989 respectively, compare to other creeks. While the water quality parameters were observed also measured from each creek. The lowest temperature were measured at 17.4 and 17.5 ^{o}C from Khadro and Korangi creek respectively, while highest were measured at 35.33 ^{o}C from Hajamro creek the average temperature from all creeks were measured at 24.51^{o}C (±4.25 ^{o}C). However the averaged salinity were measured at 33.3-38.38ppt average at 35.13ppt (±1.09ppt). The highest dissolved oxygen at 1.5mg/l were observed from Dodee wari creek and lowest at 0.62 mg/l from Cabin wari creek, overall average at 0.9mg/l (±0.22mg/l). The average pH from all creeks were at 8.2 (±0.11) during the survey.

In addition to assessing water quality parameters, marine biodiversity assessments in creeks are also essential for identifying areas of high biodiversity and developing conservation strategies. Creeks are particularly important habitats for juvenile fish and invertebrates, as they provide shelter and food for these organisms. Therefore, monitoring the health of these ecosystems is essential to ensure the survival of these important species.

Marine biodiversity assessments in creeks can also help to identify the impact of human activities on these ecosystems. For example, habitat loss due to urbanization or deforestation can lead to declines in species abundance and diversity. By monitoring changes in biodiversity over time, we can develop strategies to mitigate the negative impacts of human activities and promote the recovery of threatened species and habitats.

In conclusion, the assessment of marine biodiversity and water quality parameters survey from creeks area is essential for the sustainability of these unique and important ecosystems. Creeks are particularly vulnerable to human activities, and regular monitoring is essential to ensure. By conducting regular surveys, we can track changes in marine biodiversity over time and develop strategies to protect and restore threatened species and ecosystems. Additionally, marine biodiversity assessment surveys can provide valuable data for scientific research, education, and policymaking.

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