ADJUSTED WATER MANAGEMENT IN RICE CULTIVATION IN SOUTHERN LUJIANG COUNTY

Document Prepared by Shanghai Libra Investment & Management Co., Ltd

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1 PROJECT DETAILS

1.1 Summary Description of the Project

The project changing from continuously flooded to intermittent flooded condition during rice cultivation is conducted in the south of Lujiang County within Hefei City, Anhui Province of China, with a total acreage of 14,096 ha for double-cropping rice. Without the implementation of this project, which provides ditches to conduct intermittently flooded method, the continuously flooded method would be continued, so the scenario that rice was cultivated by continuously flooded method is the baseline scenario. Since the organic matter in rice soil under flooded condition can emit a large amount of methane (CH_4) because of anaerobic decomposition, the intermittent flooded method is more beneficial to water conservation, production increase and methane emission removal than the continuously flooded.

This project solved the problems of excessive water used during rice cultivation which results in not only large amount of methane (CH_4) emissions but also low rice productivity by replacing the continuously flooded method with intermittent flooded method, which shortens the period of anaerobic decomposition of soil organic matter. In this case, the CH_4 emission can be declined by an average of 48%[1]. Hence, with the proposed project activity, an estimated amount of GHG emission reduction 4.19 tCO_2e/ha for double-cropping rice is expected.

The implementation of the project is expected to reduce the GHG emissions amounting to 413,301 tCO_2e in the first 7 years, with an average annual GHG emission removal of 59,043tCO_2e.

This project aims to:

- Sequester greenhouse gas and mitigate climate changes;
- Increase the rice productivity resulting in higher living standard of local farmers;
- Provide more job opportunities, especially women workers;
- Invest a part of profit to improve the local medical care;
- Use a proportion of benefits to improve the local children's education.

1.2 Sectoral Scope and Project Type

[1] Dr. Reiner Wassmann (2016). Coordinator, Climate Change Research. International Rice Research Institute. Available from: r.wassmann@irri.org

The project is developed under VCS scope 14 “Agriculture, Forestry and Other Land Use (AFOLU)” with an activity category of Improved Cropland Management (ICM) under Agricultural Land Management (ALM). The project is not a grouped project.

1.3 Project Eligibility

This project produces methane (CH_4) emission reductions, which is eligible under the scope of VCS program. Besides, this project activity is supported by the CDM small-scale methodology: *Methane emission reduction by adjusted water management practice in rice cultivation* which is approved under a VCS approved GHG program – United Nations Clean Development Mechanism.

1.4 Project Design

This project is a single project activity instance.

Eligibility Criteria

The project is not a grouped project.

1.5 Project Proponent

Organization name	Hefei Luyu Agricultural Technology Co., Ltd
Contact person	Yiliang Chen
Title	Manager
Address	Room 2212, Building C, Xinhua International Square, No.320 Qianshan Road, Hefei City, Anhui Province, China
Telephone	+86-1331686686
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Hefei Luyu Agricultural Technology Co., Ltd. (hereinafter referred to as Hefei Luyu or Luyu) is a private entity and its core business involves agricultural technology and agricultural project development.

1.6 Other Entities Involved in the Project

Organization name	Shanghai Libra Investment & Management Co., Ltd

Role in the project	Consultant
Contact person	Shaohui Zhong
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Shanghai Libra Investment & Management Co., Ltd (hereinafter referred to as Shanghai Libra or Libra) is founded in 2008 with a registered capital of 5 million and 8 full-time employees. Libra has developed more than 200 offset projects in China, ranging from wind, solar and forestry, under various standards including CDM, VCS, Gold Standard and CCER.

1.7 Ownership

The ownership of the rice paddies of the agricultural land management project belongs to the farmers, which has been confirmed by the local government and agricultural bureau. Since these rice paddies are all legal agricultural fields, and the ownership is clear, there is no dispute over land ownership in the project site.

Furthermore, these farmers also have right to authorize Hefei Luyu as a representative of the project owner and Hefei Luyu only has the right to make decisions about the carbon reduction project including the type of the carbon credit project to be developed, the sales target, the sales price, etc.[2]

1.8 Project Start Date

According to VCS standard, the project start date is the date on which activities that lead to the generation of GHG emission reductions or removals are implemented, for this project, the project start date is 14-March-2018 when the land preparation was started.

1.9 Project Crediting Period

[2] Source: carbon reduction project cooperation agreement signed between the farmers and Hefei Luyu.

The crediting period of this project will be using a 7-year, twice renewable crediting period, for a combined total project crediting period of 21 years from 14-March-2018 to 13-March-2039, and the project lifetime is 30 years[3] from 26- February-2018 to 25-February-2048.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	√
Large project	

Year	Estimated GHG emission reductions or removals (tCO_2e)
14-March -2018 to 13-March-2019	59,043
14-March -2019 to 13-March-2020	59,043
14-March -2020 to 13-March-2021	59,043
14-March -2021 to 13-March-2022	59,043
14-March -2022 to 13-March-2023	59,043
14-March -2023 to 13-March-2024	59,043
14-March -2024 to 13-March-2025	59,043
Total estimated ERs	413,301 tCO_2e
Total number of crediting years	7 years
Average annual ERs	59,043tCO_2e

1.11 Description of the Project Activity

The project changing from continuously flooded to intermittent flooded condition during rice cultivation is conducted in the south of Lujiang County, Hefei City, Anhui Province of China. Anhui Province, located in eastern China, is one of the major rice-producing provinces in China. At the same time, Lujiang County where the annual household income of farmers is

[3] The Acceptance Report of Hefei National Comprehensive Agricultural Development High-standard Farmland Construction Project in 2017

only 15769 CNY [4], and most of they are used to maintain the survival. In this case, they lacked funds to build ditches for applying intermittently flooded method. So, continuously flooded method was used in rice paddies, which means fields have standing water throughout the rice growing season and may only dry out for harvest. However, the organic matter in rice soil under flooded condition can emit a large amount of methane (CH_4) because of anaerobic decomposition. In contrast, there are at least once aeration period of more than three days, except for end-season drainage, during the cropping season by conducting intermittently flooded method after the cement ditches is built in this project activity. Since the CH_4 in rice paddies is produced by the anaerobic decomposition of organic matter after the flooding, allowing the field to drain halts CH_4 production, which happens in anaerobic condition, reducing the total quantity of CH_4 released during the cropping season. Moreover, the intermittently flooded method is more beneficial to water conservation, production increase and methane emission removal than the continuously flooded. The project aims to replace the traditional cultivation method by intermittent flooded method for GHG removal whilst contributing to Sustainable Development Goals (SDGs) in the project zone. 14,096 ha (212,835 Mu[5]) of rice paddies are changed to apply intermittently flooded method in the south of Lujiang County where the rice used to be cultivated under continuously flooded condition.

The project is located in the south of Lujiang County, with a total population of nearly 420,380[6]. All the rice paddies belong to the farmers and Hefei Luyu Agricultural Technology Co., Ltd. (hereafter referred to as Hefei Luyu) has been fully authorized by all the farmers to act as the project proponent to implement project management and monitoring, and to sell VCUs generated from the project so that Hefei Luyu consolidates the offset resources into sizeable forestry offset projects. Hefei Luyu shall profit-share with the farmers from selling VCUs. The implementation of the project activity generates 59,043tCO_2e/year and contributes to 6 SDGs.

This project is not located within a jurisdiction covered by a jurisdictional REDD+ program.

The main objectives of the project are to improve the productivity of rice and contribute to the sustainable development and SDGs, including:

1. Goal 1-No Poverty

   The project increases yield by applying intermittently flooded method during cultivation in rice paddies, so the farmers in impoverished counties can see a higher net return and get out of poverty.

2. Goal 2-Zero Hungry

[4]Source: The ex ante investigation report in Lujiang County in 2017 from Anhui Academy of Social Sciences.

[5] A Chinese metric unit of area, 1ha = 15 Mu.

[6]http://www.ljxf.gov.cn/

The project provides canals, reservoirs and pumps for practicing intermittently flooded method, which helps in increase the rice production.

3. Goal 4-Quality Education

   A part of the profit of this project would be used to buy more books for the local children, which provides them with quality education.

4. Goal 5-Gender Equality

   The project provides training to women who wish to participate in and facilitate more ownership of resources and access to economic opportunities.

5. Goal 8-Decent Work and Economic Growth

   Field staff personnel would be hired from the local villages to conduct intermittently flooded water regime in the project area.

6. Goal 13-Climate Action

   The project generates 59,043tCO_2e of emission reductions in rice paddies by practicing intermittently flooded water regime, which makes contribution to the climate problems.

The implementation schedule of this project is listed as follows:

Date	Milestone (s) in the project's development and implementation
29-May-2017	Hefei Luyu Agricultural Technology Co., Ltd held a general meeting of their stockholders and they decided to develop this project as a carbon trading project.
6-November-2017	Construction of high standard rice fields was started in the south of Lujiang County
14-March-2018	The land preparation was started in the south of Lujiang County, which means the project activity was started.
15-April -2021	The draft PD was completed.

1.12 Project Location

The project is located in the south of Lujiang County of Hefei City in Anhui Province, China. In 2020, the project in the south of Lujiang has jurisdiction over 6 towns. The geographical coordinates of the project zone are between 117°5.83' and 117°31.73' east longitude and between 30°50.19' and 31°14.90'north latitude.

The project is located in the south of Lujiang County in Hefei City, as shown in Figure 1-2. According to VCS standard, the south of Lujiang County are defined as the project zone, and the rice paddies applied intermittent flooded water regime in the south of Lujiang County are defined as the project area. Please refer to Section 3.3 for the boundaries of the project area and project zone is shown in Figure 1-4, and the KML file has also been submitted.

Figure 1-1 The map of China

Figure 1-2 The map of Anhui Province

Figure 1-3 The map of Hefei City

Figure 1-4 The map of project zone – The south of Lujiang County

1.13 Conditions Prior to Project Initiation

Prior to the project initiation, economic conditions in the project area are not very good and the level of education is relatively low[7], so farmers lack advanced irrigation technologies, such as the intermittent flooded water regime. However, intermittent flooded water regime

[7] The ex ante investigation report of Lujiang County in 2017 from Anhui Academy of Social Sciences

requires that irrigation and drainage can be controlled according to the growth needs of rice during its cultivation. Whereas, the low economic level leads to the low income of farmers**错误!未定义书签。**, which means that farmers have no additional economic capacity to afford the construction of cement ditches which are able to practice controllable irrigation and drainage. So, the project has not been implemented to generate GHG emissions for the purpose of their subsequent reduction, removal or destruction.

Since the conditions existing prior to the project initiation is the same as baseline scenario, please refer to Section 3.4 (Baseline Scenario) to see the detail information. Besides, this project does not affect the environmental conditions, including climate, hydrology, topography, soils, relevant historical conditions, type of vegetation, ecosystems, etc., so, the present and prior environmental conditions of this project are the same, which are listed as follows.

Climate	Lujiang County belongs to the North subtropical humid monsoon climate zone. It has the characteristics of four distinct seasons, mild climate, abundant rainfall, sufficient sunlight and short frost and snow periods.
Hydrology	Lujiang County belongs to the Yangtze River system. There are 14 rivers, including Hangbu River, Xianhe River, baishitian River and so on.
Topography	Lujiang County is located in the low mountains, hills, polder areas and lakes. The terrain is high in the southwest and low in the northeast.
Soils	Lujiang County belongs to the yellow-brown soil soil zone. The hilly areas are mainly gall-type, fertile-type paddy soil and yellow-brown soil developed from the Xiashu loess parent material; the polder area along Chaohu Lake is mainly composed of river alluvium the fertile paddy soil formed by the development of the parent material of the sediments of the river and lake facies
Relevant historical conditions	In the early days of the People's Republic of China, administrative offices for northern Anhui and southern Anhui were established; in July 1952, the administrative offices were abolished and Anhui Province was established with a special area under Hefei area; in 1970, the area was changed to a region, which belongs to Hefei area.
Type of vegetation	The vegetation in Lujiang County is mainly natural vegetation and artificial vegetation. Among natural vegetation, it is more common in natural pine forests, secondary shrubs, thatch communities, and aquatic vegetation. Artificial vegetation mainly includes wood, bamboo and crop vegetation.
Animal resources	Lujiang County is rich in wild animal and plant resources, among which the rare animals listed as national protection include leopard, muntjac, fox, swan,

	crane, pheasant, black stork, grey magpie, woodpecker, azalea, oriole, swallow, Shrike, owl, wild duck, great tit, etc

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

The project conforms to all kinds of regulations, which are listed as below:

PRC Constitution, *PRC Agricultural Law*, *Law of the PRC on Land Administration*, *Implementing Regulations of the Law of the PRC on Land Administration*, *Law of the PRC on Rural Land Contracting*, *PRC Production Safety Law*, and *PRC Labour Law*.

According to the Inspection and Acceptance Report of the project, the project has complied with the above regulations and laws during the construction period and will be subject to regular inspection by local government during the implementation period to ensure continuous compliance.

1.15 Participation under Other GHG Programs

1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

The project has not been registered or is seeking registration under any other GHG programs.

1.15.2 Projects Rejected by Other GHG Programs

The project has not been rejected by any other GHG programs.

1.16 Other Forms of Credit

1.16.1 Emissions Trading Programs and Other Binding Limits

The project is not involved in an emission trading program or any other mechanism that includes GHG allowance trading.

1.16.2 Other Forms of Environmental Credit

The project has not sought or received another form of GHG-related environmental credit.

1.17 Additional Information Relevant to the Project

Leakage Management

According to the applied methodology: *Methane Emission Reduction by Adjusted Water Management Practice in Rice Cultivation*, any effects of the project activity on GHG emissions outside the project boundary are deemed to be negligible and do not have to be considered under this methodology. So, leakage does not need to be considered.

Commercially Sensitive Information

None of the project documents will be considered commercially sensitive information, and all the documentation is available to any stakeholders.

Sustainable Development

The Project provides many benefits that will help achieve China's Sustainable Development Goals, a set of 17 universal goals covering the thematic areas of environmental, economic and social development.

The project contributes to achieving sustainable development as following:

- High yield brings extra income and improves the living standard of local farmers (Goal 1 mentioned as Section 1.11);
- Increase the rice productivity alleviates hunger problem (Goal 2 mentioned as Section 1.11);
- Use a proportion of benefits to improve the local children's education (Goal 4 mentioned as Section 1.11);
- Women are given priority for employment and their social status is raised (Goal 5 mentioned as Section 1.11);
- Provide more job opportunities for local farmers (Goal 8 mentioned as Section 1.11);
- Sequester greenhouse gas and mitigate climate changes (Goal 13 mentioned as Section 1.11).

Goal 1	Higher income

Type of Impact	The impact is a positive impact as increasing yield and new job opportunities created by the change of rice cultivation method.
Affected Stakeholder Group(s)	Farmers participated in the project
Expected achievement	Agricultural farming is a major source of income for the farmers in the project zone. Therefore, the increase of yield is of great importance for them. In addition, farmers could get extra pay because of more job opportunities, which could help them get out of poverty.

Goal 2	Increase in rice yield
Type of Impact	The impact is a positive impact as the rice grown using the intermittently flooded method can increase its production.
Affected Stakeholder Group(s)	Farmers participated in the project
Expected achievement	Rice is an important staple for local farmers and even the whole country, so higher yields could solve the hunger problem to some extent.

Goal 4	Help in quality education
Type of Impact	The impact is a positive impact as the project will help to improve the local education.
Affected Stakeholder Group(s)	Farmers participated in the project
Expected achievement	A part of the profit of this project shall be used to buy some books for the local children, which provides them with quality education.

Goal 5	Help in gender equality
Type of Impact	The impact is a positive impact as the project provides training to women who wish to participate in and facilitates more ownership of resources and access to economic opportunities.
Affected Stakeholder Group(s)	Women workers within the project area
Expected achievement	Some new job occupations would be created by this project, and the women shall be given priority for employment which improves their social status.

Goal 8	More job opportunities and growth of local economy
Type of Impact	The impact is a positive impact as the project provides more job opportunities for practicing the intermittently flooded method. At the same time, higher rice production could bring growth in local economy.
Affected Stakeholder Group(s)	Farmers within the project area
Expected achievement	In order to practice the intermittently flooded method, some better irrigation and drainage facilities should be provided, such as the canals, reservoirs and pumps. In this case, a large number of job occupations could be created. Therefore, the male adults working outside the county would come back to make contribution to their hometown.

Goal 13	CH_4 emission reduction
Type of Impact	The impact is a positive impact as CH_4 emissions generated by soil organic matter under anaerobic conditions is reduced. The impact is an actual impact which is a direct consequence of the project activity.

Affected Stakeholder Group(s)	Farmers within the project area
Expected achievement	It is expected to reduce 59,043tCO_2e every year by conducting this project, because the duration of anaerobic decomposition of soil organic matters in rice paddies is shorten by replacing continuously flooded with intermittently flooded.

Further Information

There is no any further information that may have a bearing on the eligibility of the project, the net GHG emission reductions or removals, or the quantification of the project's net GHG emission reductions or removals.

2 SAFEGUARDS

2.1 No Net Harm

The potential negative environmental and socio-economic impacts and steps to mitigate them have been summarized in the following table:

Environmental		Socio-Economic	
Potential Negative Impacts	Actions	Potential Negative Impacts	Actions
Improper pesticide application would be harmful to natural environment, including polluting soil, water and air conditions, as well as the habitat of the wildlife.	In this project activity, adhere to the principle of "prevention first", and give priority to the use of biological and mineral pesticides in the selection of pesticides, thus reducing the harm	Before the project, the income from rice cultivation was not high, so the local labor force was lost.	After the project activity was implemented, the productivity of rice was improved and more job opportunities were created, which means higher income, thus, many migrant workers are more likely to return home.
Excessive application of nitrogen fertilizer can	With this project implementation, the	If the intermittently flooded method	The relevant training should be

also pollute the soil and even the air.	amount of nitrogen fertilizer used in rice paddies cannot exceed the optimal amount recommended.	cannot be conducted strictly during rice cultivation within the project area, then the yield would not be great and the income will not be increased.	conducted every year and the technician should also give timely guidance during every monthly inspection.

2.2 Local Stakeholder Consultation

Stakeholder consultations include an ex ante surveys and stakeholder meetings, requiring stakeholders to present their opinions on project design and their willingness to participate.

Before the project started, Anhui Academy of Social Sciences conducted stakeholder meetings to ask their willingness of participation. Anhui Academy of Social Sciences organized a team of people to interview the village representatives, relevant governmental officials and distribute the questionnaires to gather local farmers' opinions. A total of 100 questionnaires were distributed, and 100 were collected. The surveys took 1 week and completed on 21 June 2017. The feedback collected is summarized below:

- Most farmers are well aware of the benefits of adjusted water management during rice cultivation. They understand that the intermittently flooded method can reduce methane emissions, save water resource and increase the rice productivity.
- Prior to the meeting, most local farmers had never heard of carbon trading, VCS or carbon credits. After the introduction, they strongly agreed that the project should be registered as a carbon reduction project and participate in the carbon trading market.
- Local farmers believe that the project can 1) create jobs; 2) get more benefits from selling carbon credits; 3) reduce methane emissions, save water resource and increase the rice productivity; and 4) improve the social status of women by hiring them to be technicians.
- The local agricultural bureau is very clear about the benefits of the intermittently flooded cultivation method and understands that carbon trading can make projects more sustainable.

Table 2-1 Survey Results Summary Sheet

Question	**Survey Result**

How many people in your family? How much is the annual income? What are the main economic sources?	The average number of people is3.74 in one family and the average annual income is CNY 15,769. The main economic source is planting rice.
Do you think the intermittently flooded water regime is good for rice cultivation?	It is favourable.
What do you know about the benefits of the intermittently flooded water regime?	Reduce methane emissions, save water resource and increase the rice productivity
What industries does your family member work in?	Labor and farming
What kind of production activities does your family do?	Crop farming
What is your educational level?	75% are middle school level, 15% are high school level and the rest are primary school level.
Is the land ownership involved in the project clear?	Yes.
Did you know carbon trading before?	Most people had never known.
Through the staff's introduction to carbon trading, do you support this project's application for development as a carbon reduction project?	Most people had never known.
If this project is successfully applied for development as a carbon reduction project, what benefits do you think can be brought?	Create more job opportunities for economic benefits, improve the local environment, reduce methane emissions, save water resource, and increase the rice productivity.
Do you support hiring women to participate in rice cultivation and management in this project?	Yes.

Do you think there is anything that needs to be improved in the design or implementation of this project? Please provide your valuable comments.	There are some comments came up from farmers: 1. They worried that they cannot afford the self-raised part of construction funds. 2. They worried that they cannot conduct the intermittent flooded water regime well. Firstly, during the stakeholders meeting, the representatives of Hefei Luyu and local agricultural bureaus explained that the government and Hefei Luyu would jointly fund the construction of high standard farmland to reduce the economic burden on farmers. For the second problem, experts from local agricultural bureau train the technicians every year, and the technicians also train farmers every February to master their skills of practicing intermittent flooded water regime. Lastly, the farmers represent that they have no comments.

Therefore, the stakeholders have no opinions on the project implementation, and there is no need to change the project design.

The project proponent has formulated a series of plans to ensure continuous communication with stakeholders to protect the interests of local stakeholders and ensure the good operation of the project.

<u>The mechanism for on-going communication with local stakeholders</u>

Firstly, the technicians are required to patrol the fields every week, and communicate with the farmers and collect their opinions when patrolling the fields. Secondly, the villages are adjacent to each other. If the farmers have any opinions, they can directly report to the local agricultural bureau. Thirdly, there will be a training for farmers once a year, and they can also express their opinions to technicians during the training period. Finally, the telephone number of the contact person of the project should be posted on the bulletin board in each village during the operation of the project, and farmers can also communicate directly with the project proponent by telephone.

- As mentioned above, during the stakeholders meeting before the implementation of this project, the project proponent and local agricultural bureaus had explained all the designs of the high standard farmland construction and the development process of the carbon reduction project. During the operation phase, all the stakeholders have been and will be communicated about the results of monitoring through villagers' meetings.

- Besides, during the stakeholders meeting, all the risks, costs and benefits the project may bring to local stakeholders had been discussed and the corresponding resolutions were also proposed by the project proponent. All the stakeholders had expressed the view that they were informed and accepted.
- Also, the representative of Hefei Luyu, under the supervision of the local agricultural bureau and government, has also informed farmers of all relevant laws and regulations covering workers' rights in the host country.
- The process of VCS Program validation and verification and the validation/verification body's site visit are required to inform the farmers by publishing it on the notice board also with the contact person's information. If there is any negative feedback, a meeting will be immediately held in the village.

2.3 Environmental Impact

According to the Environmental Impact Assessment Law of the People's Republic of China, this project does not require any environmental impact assessments.

2.4 Public Comments

It will be supplemented after the project is publicized.

2.5 AFOLU-Specific Safeguards

1. Stakeholder Identification

This stakeholder's identification starts by listing all the people or groups who might have an influence over or be impacted by a project. The local village committees and village officials were considered as the key informants and focus groups who know best about the local farmers. In June 2017, the project proponent and Anhui Academy of Social Sciences held a consultant meeting with local village committees before the project start, and the main purpose of the meeting was to identify the stakeholders in the project.

1) Village residents: (including 12,892 local farmers within 3,447 households of which 7,876 are females, accounting for about 61.09 percent)

In the south of Lujiang County, a total of 12,892 farmers have been directly affected by the activities of the project. In addition, the rice paddies in the project area belong to these farmers. Hence, the village committees collected the opinions and consent of the farmers in respective villages through face-to-face meetings before deciding to apply to the local governments' and agricultural bureaus for using intermittently flooded method through

participation in the Plan of High Standard Farmland Construction[8] (hereinafter referred to as HSFC). These farmers were also responsible for signing the cooperation agreements with the project proponents to ensure the proper development of the project.

Since June 2017, before the project started, the village committees conducted a survey of the local farmers' willingness to participating in the Plan of HSFC for applying the intermittently flooded method during rice cultivation. This was done through meetings and interviews with farmers. All the farmers agreed to use this advanced cultivation method in the end.

The meeting held on June 2017 was attended by the representatives of Lujiang Agricultural Bureau, the representatives of Hefei Luyu, the representatives of farmers, and the representatives of the village committee. The representatives of Lujiang Agricultural Bureau also organized a meeting to solicit suggestions from farmers for the implementation of project activities and their willingness to participate in rice cultivation.

This project activity has greatly benefited the local farmers and could only carry out with the farmers' consent. Hence, all the farmers within the project area are recognized to be stakeholders in the project.

2) Agricultural Bureau of Lujiang County

The techniques of intermittently flooded method are provided by the local agricultural bureau, which inspects successful rice cultivation. In this respect, the farmers, the committees, the local governments granting permission and local agricultural bureau providing advice and inspections, are all identifies as relevant stakeholders in this project.

3) Local governments of Lujiang County

The local administration is responsible for the local social and environmental management. They are responsible and accountable to all local farmers for any violation of their rights.

4) Village committees of Lujiang County.

They are responsible for collecting opinions from the respective locals and villages with the project proponent or agricultural bureaus.

The results of identified stakeholders will be publicly announced on VCS website as part of the draft PD which can be accessed by everyone, in case there is any other person who may consider themselves as one of the project's stakeholders, they can directly contact the project proponent for consultation.

2. Potential Risks and Measures

[8] This Plan is government-led, involving the construction of ditches and the leveling of rice paddies, and voluntary participation is applied for by farmers

Potential risks to stakeholders	During the implementation of the project, since it is necessary to go to the field every day to observe the growth of rice and the change of water level, drainage and irrigation are carried out from time to time, which increases the chances of farmers encountering dangers, such as slipping while checking the rice in the field.
Measures to mitigate it	All these potential risks should be told to the stakeholders in advance and some simple first aid measures also need to be communicated to farmers during training to reduce the injuries.

Feedback and Grievance Redress Procedure

Throughout the implementation of the project, an anonymous opinion collection box was set up and a commissioner appointed by the project proponent with the phone number was publicized in bulletin in each village. Therefore, if there are any conflicts came up between the local communities and individual villagers, they can contact the commissioner directly. The commissioner shall record and summarize all the conflicts collected and then submit it to the relevant management unit. The management unit should communicate with all the relevant communities and stakeholders to solve the conflict within 5 days. Afterwards, the solution should be proposed within 10 days and the conflicts should be solved within one month.

At the annual stakeholders meeting, parties can appeal directly to the agricultural bureau. In addition, the project proponent shall also conduct a stakeholders satisfaction survey at the meeting.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The small-scale methodology AMS-Ⅲ.AU: *Methane Emission Reduction by Adjusted Water Management Practice in Rice Cultivation/version 4.0* is used. Also, the project proponent shall apply the “General guidelines for SSC CDM methodologies/version 23.0”.

In addition, since the reporting and verification shall be done on the basis of samples of the log-books from the farmers, the *Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities/version 8.0* and the Guideline for *Sampling and Surveys for CDM Project Activities and Programme of Activities/version 4.0* are used.

The TOOL 21“Demonstration of Additionality of Small-scale Project Activities (version 13.1)” is used to demonstrate the additionality.

3.2 Applicability of Methodology

1) As mentioned in Section 3.1, the methodology applied in this project is AMS-Ⅲ.AU (version 4.0) which is applicable under the following conditions:

Conditions required by methodology	Applicability of this project
2. The methodology comprises technology/measures that result in reduced anaerobic decomposition of organic matter in rice cropping soils and thus reduced generation of methane. The methodology includes projects such as: a) Rice farms that change the water regime during the cultivation period from continuously to intermittent flooded conditions and/or a shortened period of flooded conditions; b) Alternate wetting and drying method and aerobic rice cultivation methods; c) Rice farms that change their rice cultivation practice from transplanted to direct seeded rice.	This project activity realized the type (a), changing the water regime during the cultivation period from continuously to intermittent flooded conditions, through the construction of cement ditches for controllable irrigation and drainage.
3. This methodology is applicable under the following conditions: a) Rice cultivation in the project area is predominantly characterized by irrigated, flooded fields for an extended period during the growing season, i.e. farms whose water regimes can be classified as upland or rainfed and deep water are not eligible to apply this methodology. This shall be shown from a representative survey conducted in the geographical region of the proposed project or by using national data. This project area characterization shall also	According to the result of the ex ante investigation report of Lujiang County in 2017[9], rice cultivation in the project area is predominantly characterized by irrigated, flooded fields for an extended period during the growing season. And the pre-season water regime is mainly continuously flooded with no any organic amendments.

[9] The ex ante investigation report in Lujiang County in 2017 from Anhui Academy of Social Sciences

	include information on pre-season water regime and applied organic amendments, so that all dynamic parameters as shown in Table 3-1 below are covered by the baseline study.	
b)	The project rice fields are equipped with controlled irrigation and drainage facilities such that both during dry and wet season, appropriate dry/flooded conditions can be established on the fields;	With the project, the rice fields are equipped with controlled irrigation and drainage facilities such that intermittently flooded method can be conducted.
c)	The project activity does not lead to a decrease in rice yield. Likewise, it does not require the farm to switch to a cultivar that does not been grown before;	The type of rice planted in this project is very common and the project activity is not subject to any local regulatory restrictions, so it will not lead to a decrease in rice yield.
d)	Training and technical support during the cropping season that delivers appropriate knowledge in field preparation, irrigation, drainage and use of fertilizer to the farmer is part of the project activity and is to be documented in a verifiable manner (e.g. protocol of trainings, documentation of on-site visits). In particular, the project proponent is able to ensure that the farmer by himself or through experienced assistance is able to determine the crop's supplemental N fertilization need. The applied method shall assess the fertilizer needs using for example a leaf colour chart or photo sensor or testing stripes. Alternatively, a procedure to ensure efficient	By now since the project activity was started in 2018, experts from Anhui Academy of Agricultural Sciences will train technicians in intermittent irrigation, requiring correct drainage and irrigation at the corresponding stages during rice planting. Every February from 2018 to 2020, farmers are also trained intensively. During the training, it will be emphasized that the application amount of fertilizer should not exceed the recommended amount for Lujiang County by Anhui Academy of Agricultural Sciences, which is 9-10.5kg/mu[10].

[10] The Technical Guidelines for Intermittently Flooded Rice Cultivation Method in Anhui Province, later issued by the Institute of Agricultural Engineering of Anhui Academy of Agricultural Sciences, also emphasized that the optimal amount of nitrogen fertilizer used in Anhui rice paddy fields is 9-10.5kg/ Mu.

fertilization considering the specific cultivation conditions in the project area backed by scientific literature or official recommendations shall be used;	
e) Project proponents shall assure that the introduced cultivation practice, including the specific cultivation elements, technologies and use of crop protection products, is not subject to any local regulatory restrictions;	The intermittent flooded water regime, the optimal amount of nitrogen utilization and the high standard farmland construction introduced in the project area are legal.
f) Except the case where the default value approach indicated as follows, "Emission reductions using IPCC tier 1 approach or default values" is chosen for emission reductions calculations, project proponents have access to infrastructure to measure CH_4 emissions from reference fields using closed chamber method and laboratory analysis;	For the ex ante emission reduction calculation, since "Emission reductions using IPCC tier 1 approach or default values" is chosen for emission reductions calculations, project proponent made measurements by using the closed chamber to determine baseline emission factors for continuously flooded field[11]. For the post-emission reduction calculation, project proponent has already set the closed chamber in baseline and project reference fields respectively, and made the plan of monitoring.
g) Aggregated annual emission reductions of all fields included under one project activity shall be less than or equal to 60 kt CO_2 equivalent.	Those rice paddies belong to the local farmers, covering a total of 14,096 hectares, and 59,043tCO_2e is expected to be generated every year, which is below 60 kt CO_2e. If the emission reductions monitored during the verification excesses the threshold, the project proponent will only claim gap of 60,000 tons according to the Applicability of small-scale methodology.

[11] The Report of Measuring Methane Emission Rate of Paddy Fields with Continuously Flooded Method by Closed Chamber in the south of Lujiang County for early season was completed in August 2017, while that for second season was completed in December 2017

Table 3-1 Parameters for the definition of cultivation patterns

Nr.	Parameter	Type	Values/categories	Source/method
1	Water regime – on-season	Dynamic	Continuously flooded	Baseline: Farmer's information Project: Monitoring
			Single drainage	
			Multiple drainage	
2	Water regime – pre-season		Flooded	
			Short drainage (<180d)	
			Multiple drainage (>180d)	
3	Organic amendment		Straw on-season	
			Green manure	
			Straw off-season	
			Farm yard manure	
			Compost	
			No organic amendment	
4	Soil pH	Static	<4.5	ISRIC-WISE soil property database or national data
			4.5-5.5	
			>5.5	
5	Soil organic carbon		<1%	
			1-3%	
			>3%	
6	Climate		[AEZ][12]	Rice Almanac, HarvestChoice[f]

As described above, this small-scale methodology AMS-III.AU (version 4.0) is applicable to the proposed activity.

[12] Climate zone: use agroecological zone as shown in the Rice Almanac (Third Edition, 2002), or by HarvestChoice.

2) The Tool 21 "Demonstration of Additionality of Small-scale Project Activities (version 13.1) applied in this project is applicable under the following conditions:

Conditions required by methodology	Applicability of this project
4. The use of the methodological tool "Demonstration of additionality of small-scale project activities" is not mandatory for project participants when proposing new methodologies. Project participants and coordinating/managing entities may propose alternative methods to demonstrate additionality for consideration by the Executive Board.	For this project activity, this methodological tool is decided to be used. Besides, Hefei Luyu (as the project proponent) and Shanghai Libra (as the project managing entities) do not plan to propose alternative methods.
5. Project participants and coordinating/managing entities may also apply "TOOL 19: Demonstration of additionality of microscale project activities" as applicable.	This project activity is expected to generate 59,043tCO_2e/ha emission reductions per year which is greatly more than 20 tCO_2e/ha defined under microscale project activities, so it is not applicable to "TOOL 19".

3.3 Project Boundary

Source		Gas	Included?	Justification/Explanation
Baseline	The rice fields where water regime is changed	CO_2	No	Not included in this project
		CH_4	Yes	Baseline emissions consist of the CH_4 emissions.
		N_2O	No	Due to the optimized N fertilization practice regulated by the methodology, N_2O emissions do not significantly deviate from the baseline emissions and hence are not considered.
		Other	No	Not included in this project
Project	The rice fields where water regime is changed	CO_2	No	Not included in this project
		CH_4	Yes	Project emissions consist of the CH_4 emissions, which will still be emitted under the changed water regime.
		N_2O	No	Due to the optimized N fertilization practice regulated by the methodology, N_2O emissions do not significantly deviate from the baseline emissions and hence are not considered.
		Other	No	Not included in this project

The rice paddies applied intermittently flooded water regime in the south of Lujiang County are defined as the project area, also the project boundary where the cultivation method and water regime are changed. The map of the project boundary is provided as the Figure 3-1, and the yellows sections show the specific project areas.

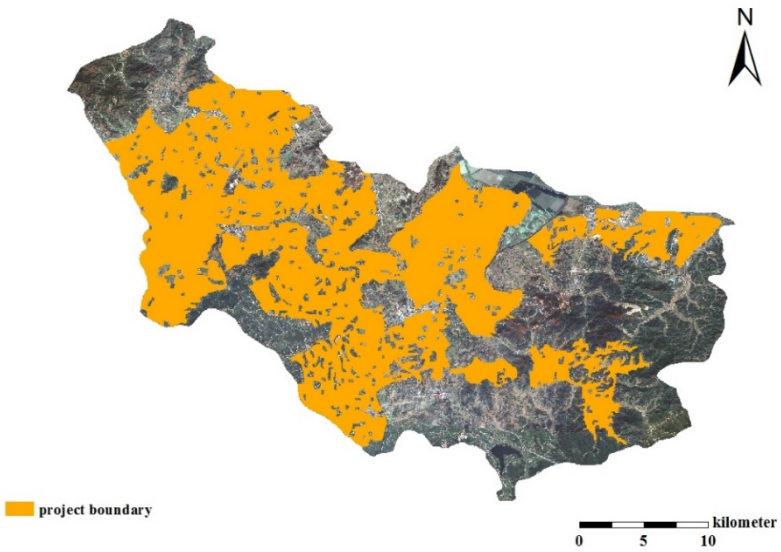

Figure 3-1 the map of the project boundary

3.4 Baseline Scenario

According to the small-scale methodology: *Methane Emission Reduction by Adjusted Water Management Practice in Rice Cultivation*, the baseline scenario is the continuation of the current practice which is continuously flooded water regime without any organic amendment during rice cultivation in the project fields (see further details in Section 3.5).

3.5 Additionality

Investment barrier

In the absence of the project activity, the living standard of farmers in the south of Lujiang County is poor and the economy is depressed, so it is difficult for them to build the cement ditches for timely drainage and irrigation according to the growth need of rice.

Technological barrier

The original water regime used during rice cultivation, continuously flooded method, is more convenient for farmers to practice, because it only requires that the fields should be flooded throughout the whole season and there is no need to pay close attention to the growth status of rice for appropriate drainage and irrigation. Thus, without this project, farmers are more willing to growing rice by old method, although higher emissions would be resulted. Besides, the poor economy also limits their access to advanced technology about intermittently

flooded water regime, which requires regularly drainage and irrigation. However, the south of Lujiang County are also major rice planting areas in Anhui, in the last few decades, they have used continuously flooding method to plant rice. In this case, the rice yield is not satisfied, resulting in lower income. In this cycle, the county could not be developed, and the labor force gradually surplus. As a result, a large proportion of the young workforce choose to leave the hometown for seeking job opportunities in the more developed counties. The lack of economic improvement leads to inadequate health care and inadequate education.

In general, this project has both investment and technological barriers, so it is additional.

3.6 Methodology Deviations

No deviations from the procedures indicated by the methodology have been made.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

As described in methodology AMS-Ⅲ.AU (version 4.0) mentioned above, the baseline scenario is the continuation of the current practice, e.g. continuously flooded rice cultivation in the project fields, the baseline emissions are estimated as follows:

$$BE_y = \sum_s BE_s \tag{1}$$

$$BE_y = \sum_{g=1}^{G} EF_{BL,s,g} \times A_{s,g} \times 10^{-3} \times GWP_{CH_4} \tag{2}$$

Where:

Parameters	Description
BE_y	Baseline emissions in year y (tCO_2e)
BE_s	Baseline emissions from project fields in season s (tCO_2e)
$EF_{BL,s,g}$	Baseline emissions factor of group g in season s ($kgCH_4$/ha per season)
$A_{s,g}$	Area of project fields of group g in season s (ha)
GWP_{CH_4}	Global warming potential of CH_4 (tCO_2e/tCH_4)

g	Group g, covers all project fields with the same cultivation pattern (G = total number of groups)

4.2 Project Emissions

According to the applied methodology AMS-Ⅲ.AU (version 4.0), the project emissions within the project boundary are calculated as follows:

$$PE_y = \sum_s PE_s \tag{3}$$

$$PE_s = \sum_{g=1}^{G} EF_{P,s,g} \times A_{s,g} \times 10^{-3} \times GWP_{CH_4} \tag{4}$$

Where:

Parameters	Description
PE_y	Project emissions in year y (tCO_2e)
PE_s	Project emissions from project fields in season s (tCO_2e)
$EF_{p,s,g}$	Project emission factor of group g in season s ($kgCH_4$/ha per season)

4.3 Leakage

According to the applied methodology AMS-Ⅲ.AU (version 4.0), any effects of the project activity on GHG emissions outside the project boundary are deemed to be negligible and do not considered under this methodology. So, leakage does not need to be considered in this project.

4.4 Net GHG Emission Reductions and Removals

The emission reductions achieved by the project activity shall be calculated as the difference between the baseline and the project emissions, which is also used as post-emission reduction:

$$ER_s = BE_s - PE_s \tag{5}$$

Where:

Parameters	Description

ER_s	Emission reductions in season s (tCO_2e)

According to the applied methodology AMS-Ⅲ.AU (version 4.0), for the ex ante estimation of emission reductions within the project design document prior to the project implementation, project proponent shall refer to own field experiments or estimate baseline and project emissions with the help of national data or IPCC tier 1 default values for emission and scaling factors.

In this project, using the IPCC tier 1 approach but undertaking measurements to determine baseline emission factors for continuously flooded fields, as per the following formula:

$$ER_y = EF_{ER} \times A_y \times L_y \times 10^{-3} \times GWP_{CH_4} \quad (6)$$

$$EF_{ER} = EF_{BL} - EF_P \quad (7)$$

$$EF_{BL} = EF_{BL,c} \times SF_{BL,w} \times SF_{BL,p} \times SF_{BL,o} \quad (8)$$

$$EF_P = EF_{BL,c} \times SF_{P,w} \times SF_{P,p} \times SF_{P,o} \quad (9)$$

Where:

Parameters	Description
ER_y	Emission reductions in year y (t CO_2e)
EF_{ER}	Adjusted daily emission factor (kgCH_4/ha/day). Alternatively, seasonal emission factor (kg CH_4/ha/season) may be determined
A_y	Area of project fields in year y (ha)
L_y	Cultivation period of rice in year y (days/year). This is not applicable when seasonal emission factor is determined.
GWP_{CH_4}	Global warming potential of CH_4 (t CO_2e/t CH_4)
EF_{BL}	Baseline emission factor (kg CH_4/ha/day) or (kg CH_4/ha/season)
EF_P	Project emission factor (kg CH_4/ha/day) or (kg CH_4/ha/season)
$EF_{BL,c}$	Baseline emission factor for continuously flooded fields without organic amendments (kg CH_4/ha/day) or (kg CH_4/ha/season)

$SF_{BL,w}$ or $SF_{P,w}$	Baseline or project scaling factors[13] to account for the differences in water regime during the cultivation period
$SF_{BL,p}$ or $SF_{P,p}$	Baseline or project scaling factors to account for the differences in water regime during the pre-season before the cultivation period
$SF_{BL,o}$ or $SF_{P,o}$	Baseline or project scaling factors should vary for both type and amount of organic amendment applied

However, the baseline emission factor for continuously flooded fields without organic amendments ($EF_{BL,c}$) can be determined ex ante prior to the start of the project activity, in this case, the ex ante value should be used to calculate emission reduction during the crediting period. It should be measured by using closed chamber in three reference fields which are chosen in the project area. The closed chamber measurement requires the involvement of technicians trained by experts from Anhui Agricultural Bureau. This chamber made of commercially available PVC material needs to be used in conjunction with a fixed base. The base made of non-corrosive material and it should have bores in the submerged section to allow water exchange between inside and outside. Besides, the base should be installed at least 24 hours before the first sampling and remains for the whole season. There are three auxiliaries within the chamber, which are thermometer for measuring the temperature inside the chamber, the fan (battery operated) inside the chamber for mixing the inside air during sampling and the sampling port (the rubber stopper placed in a bore of the chamber). After sampling the air inside the chamber, it should be stored in syringe (<24h) or evacuated vial (>24h) for laboratory analysis done by gas chromatograph with flame ionization detector (FID).

The details of the reference fields and the plan for the seasonal methane measurements before the start of the season is shown as following:

Table 4-1 The details of reference fields

Location	Nihe Town, Lujiang County, Hefei City
Area	About 0.37 ha of each
The type of rice	Hybrid rice
Climate	North subtropical humid monsoon climate zone
Soil	pH5.6 —7.5 and the soil organic carbon is 0.95%
Water management	Continuously flooded[14]
Fertilizer treatment	No any organic amendments

[13] For all scaling factor used in this methodology, the average values in 2006 IPCC Guidelines for National Greenhouse Gas Inventories are chosen.

[14] Continuously flooded: fields have standing water throughout the rice growing season and may only dry out for harvest (end-season drainage)

Table 4-2 The plan for the seasonal methane measurements

Field measurement	Laboratory analysis
The base should be buried before the transplanting	The samples should be analysed in laboratory every three times
First sampling should be taken after 24 hours from transplanting	
The measurement interval should be once per week	After final laboratory analysis is completed, the monitoring data of whole cropping season should be integrated and the emission factor should be calculated to complete the experimental report.
The last sampling should be taken 24 hours before harvest	

It is demonstrated by *The Report of Measuring Methane Emission Rate of Double-cropping Rice Paddies with Continuously Flooded Method by Closed Chamber in The south of Lujiang County in 2017* from Anhui Academy of Agricultural Sciences (see further details in Section 5.1 below) that the baseline emission factor for continuously flooded fields without organic amendments ($EF_{BL,c}$) is 179.01 kg CH_4/ha/season for early season and 170.04 kg CH_4/ha/season for second season.

Determination of $SF_{BL,w}$ or $SF_{P,w}$

According to the methodology, the IPCC default for $SF_{BL,w}$ or $SF_{P,w}$ is as follows:

Water regime during the cultivation period		$SF_{BL,w}$ or $SF_{P,w}$
Irrigated	Continuously flooded[15]	1
	Intermittently flooded-single aeration[16]	0.60
	Intermittently flooded-multiple aeration[17]	0.52

[15] Continuously flooded: fields have standing water throughout the rice growing season and may only dry out for harvest (end-season drainage)

[16] Single aeration: fields have a single aeration during the cropping season at any growth stage (except for end-season drainage)

[17] Multiple aeration: fields have more than one aeration period during the cropping season (except for end-season drainage)

For the baseline scenario, the water regime is continuously flooded, so the $SF_{BL,w}$ is 1. As described in Section 1.11, the water regime of this project activity is intermittently flooded with multiple aeration, so the $SF_{P,w}$ is 0.52.

Determination of $SF_{BL,p}$ or $SF_{P,p}$

In addition, IPCC default for $SF_{BL,p}$ or $SF_{P,p}$ is provided in the following table.

Water regime prior to cultivation period	$SF_{BL,p}$ or $SF_{P,p}$
Non-flooded pre-season<180 days (indicating double cropping)	1
Non-flooded pre-season>180 days (indicating double cropping)	0.68

In the project area, all the rice cultivation is double cropping, so both $SF_{BL,p}$ and $SF_{P,p}$ are 1.

Determination of $SF_{BL,o}$ or $SF_{P,o}$

Accordingly, since no amendments are applied under both baseline and project scenario, $SF_{BL,o}$ and $SF_{P,o}$ do not need to be considered.

Taking all the information above, the table below can be reached.

Parameters	Early Season	Second Season
$EF_{BL,c}$(kg CH_4/ha/season)	179.01	170.04
$SF_{BL,w}$	1	
$SF_{P,w}$	0.52	
$SF_{BL,p}$ / $SF_{P,p}$	1	
GWP_{CH_4}	25	
A_y (ha)	14,096	
P.S. The GWP_{CH_4} is taken from the Fifth Assessment report, GHG Protocol		

Under this methodology, any effects of the project activity on GHG emissions outside the project boundary are deemed to be negligible and do not have to be considered, so the leakage of this project activity is zero.

Thus, for early season, the emission reduction should be calculated as follows:

$$EF_{BL} = EF_{BL,c} \times SF_{BL,w} \times SF_{BL,p}$$

$$= 179.01 kgCH_4 * ha^{-1} * season^{-1} \times 1 \times 1$$

$$= 179.01 kgCH_4 * ha^{-1} * season^{-1}$$

$$EF_P = EF_{BL,c} \times SF_{P,w} \times SF_{P,p}$$

$$= 179.01 kgCH_4 * ha^{-1} * season^{-1} \times 0.52 \times 1$$

$$= 93.085 kgCH_4 * ha^{-1} * season^{-1}$$

$$EF_{ER} = EF_{BL} - EF_P$$

$$= 179.01\ kgCH_4 * ha^{-1} * season^{-1} - 93.085 kgCH_4 * ha^{-1} * season^{-1}$$

$$= 85.925 kgCH_4 * ha^{-1} * season^{-1}$$

$$ER_y = EF_{ER} \times A_y \times 10^{-3} \times GWP_{CH_4}$$

$$= 85.925 kgCH_4 * ha^{-1} * season^{-1} \times 14{,}096\ ha \times 10^{-3} \times 25\ t\ CO2e/t\ CH4$$

$$= 30{,}280 tCO_2 e$$

Likely, for the later season, the emission reduction should be calculated as follows:

$$EF_{BL} = EF_{BL,c} \times SF_{BL,w} \times SF_{BL,p}$$

$$= 170.04 kgCH_4 * ha^{-1} * season^{-1} \times 1 \times 1$$

$$= 170.04 kgCH_4 * ha^{-1} * season^{-1}$$

$$EF_P = EF_{BL,c} \times SF_{P,w} \times SF_{P,p}$$

$$= 170.04 kgCH_4 * ha^{-1} * season^{-1} \times 0.52 \times 1$$

$$= 88.42 kgCH_4 * ha^{-1} * season^{-1}$$

$$EF_{ER} = EF_{BL} - EF_P$$

$$= 170.04\ kgCH_4 * ha^{-1} * season^{-1} - 88.42\ kgCH_4 * ha^{-1} * season^{-1}$$

$$= 81.62 kgCH_4 * ha^{-1} * season^{-1}$$

$$ER_y = EF_{ER} \times A_y \times 10^{-3} \times GWP_{CH_4}$$

$$= 81.62\ kgCH_4 * ha^{-1} * season^{-1} \times 14{,}096\ ha \times 10^{-3} \times 25\ t\ CO2e/t\ CH_4$$

$$= 28{,}763 tCO_2 e$$

Therefore, for a whole year, the emission reduction is $30{,}280\ tCO_2 e + 28{,}763\ tCO_2 e = 59{,}043 tCO_2 e$.

The ex ante calculations of baseline and project emissions are shown in excel and the results are summarized in the Table following.

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
14-March -2018 to 13-March-2019	N/A[18]	N/A	0	59,043
14-March -2019 to13-March-2020	N/A	N/A	0	59,043
14-March -2020 to 13-March-2021	N/A	N/A	0	59,043
14-March -2021 to 13-March-2022	N/A	N/A	0	59,043
14-March -2022 to 13-March-2023	N/A	N/A	0	59,043
14-March -2023 to 13-March-2024	N/A	N/A	0	59,043
14-March -2024 to 13-March-2025	N/A	N/A	0	59,043
Total	N/A	N/A	0	413,301

5 MONITORING

5.1 Data and Parameters Available at Validation

According to the methodology, there is no pre-determined data, as long as the monitoring data, but the ex ante calculation method was used in determining $EF_{BL,c}$, and the Ay used to calculate the ex ante emission reduction is only used in the ex ante calculation formula, so the relevant ex ante calculation data are listed in this section.

[18] According to the CDM small-scale methodology: ***Methane emission reduction by adjusted water management practice in rice cultivation (v4.0)***, Para 5.8.1 Ex ante estimation of emission reductions, PP has chosen option 1 for the calculation of Ex ante ER, while the according to the Equation (6) $\mathrm{ER_y = EF_{ER} \times A_y \times L_y \times 10^{-3} \times GWP_{CH_4}}$ in the methodology, the ex ante of ER value is calculated directly but not calculated by Baseline emissions minus project emissions. So PP provided N/A in the table in section 4.4.

Data / Parameter	A_y
Data unit	ha
Description	Area of project fields in year y
Source of data	Field measurement
Value applied	The total area is 14,096 ha
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of Data	The parameter is used to calculate the estimated net GHG removals.
Comments	N/A

Data / Parameter	GWP_{CH_4}
Data unit	t CO_2e/t CH_4
Description	Global warming potential of CH_4
Source of data	The number of GWP_{CH_4} is taken from the IPCC's *Fourth Assessment report*, *GHG Protocol*
Value applied	25
Justification of choice of data or description of measurement methods and procedures applied	Any future revision of the IPCC's assessment report should be taken account.
Purpose of Data	The parameter is used to calculate the estimated net GHG removals.
Comments	N/A

Data / Parameter	$EF_{BL,c}$
Data unit	kg CH_4/ha/season
Description	Seasonal baseline emission factor for continuously flooded fields without organic amendments
Source of data	The Report of Measuring Methane Emission Rate of Paddy Fields with Continuously Flooded Method by Closed Chamber in the south of Lujiang County for early season was completed in August 2017, while that for second season was completed in December 2017
Value applied	(1) 179.01 kg CH4/ha/season for early season rice; (2) 170.04 kg CH4/ha/season for later season rice;
Justification of choice of data or description of measurement methods and procedures applied	The report of Measuring Methane Emission Rate of Paddy Fields with Continuously Flooded Method by Closed Chamber in the south of Lujiang County for early season was completed in August 2017, while that for second season was completed in December 2017.
Purpose of Data	The parameter is used to calculate the baseline emission factor EF_{BL}.
Comments	N/A

Data / Parameter	$SF_{BL,w}$
Data unit	N/A
Description	Baseline scaling factors to account for the differences in water regime during the cultivation period
Source of data	It is chosen from 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
Value applied	1
Justification of choice of data or description of measurement methods and procedures applied	Since the rice is cultivated under continuously flooded condition in baseline scenario, the 1 of value is used.

Purpose of Data	The parameter is used to calculate the baseline emission factor $\mathrm{EF_{BL}}$ and ex ante emission reduction calculation.
Comments	N/A

Data / Parameter	$SF_{P,w}$
Data unit	N/A
Description	Project scaling factors to account for the differences in water regime during the cultivation period
Source of data	It is chosen from 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
Value applied	0.52
Justification of choice of data or description of measurement methods and procedures applied	Since the rice is cultivated under intermittently flooded condition in project scenario, the 0.52 of value is used.
Purpose of Data	The parameter is used to calculate the project emission factor $\mathrm{EF_P}$ and ex ante emission reduction calculation.
Comments	N/A

Data / Parameter	$SF_{BL,p}$
Data unit	N/A
Description	Baseline scaling factors to account for the differences in water regime in the pre-season before the cultivation period.
Source of data	It is chosen from 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
Value applied	1
Justification of choice of data or description of measurement methods and procedures applied	Since the cultivation mechanism in rice filed is double cropping in baseline scenario, the 1 of value is used.

Purpose of Data	The parameter is used to calculate the baseline emission factor EF_{BL} and ex ante emission reduction calculation.
Comments	N/A

Data / Parameter	$SF_{P,p}$
Data unit	N/A
Description	Project scaling factors to account for the differences in water regime in the pre-season before the cultivation period.
Source of data	It is chosen from 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
Value applied	1
Justification of choice of data or description of measurement methods and procedures applied	Since the cultivation mechanism in rice filed is double cropping in project scenario, the 1 of value is used.
Purpose of Data	The parameter is used to calculate the baseline emission factor EF_P and ex ante emission reduction calculation.
Comments	N/A

5.2 Data and Parameters Monitored

Data / Parameter	$A_{s,g}$
Data unit	ha
Description	Aggregated project area in a given season s
Source of data	To determine by collecting the project field sizes in a project database. Project proponent shall set up a database which holds data and information that allow an unambiguous identification of participating rice farms, including the size of field.
Description of measurement	Field measurement

methods and procedures to be applied	
Frequency of monitoring/recording	Every season
Value applied	N/A
Monitoring equipment	GPS or satellite data
QA/QC procedures to be applied	General guidelines for SSC CDM methodologies
Purpose of data	The parameter is used to calculate the baseline emissions from project fields in season s (BE_s).
Calculation method	N/A
Comments	Only compliant farms are considered

Data / Parameter	$EF_{BL,s,g}$
Data unit	kg CH_4/ha per season
Description	Baseline emission factor of group g in a given season s
Source of data	Field measurements in baseline reference fields
Description of measurement methods and procedures to be applied	As per instructions in the appendix (Guidelines for measuring methane emissions from rice fields) and IPCC 2006, volume 4, chapter 5.5.
Frequency of monitoring/recording	Once a week. Regular measurements as per closed chamber method guidance, seasonally integrated
Value applied	N/A
Monitoring equipment	Closed chamber
QA/QC procedures to be applied	The implementation of methane measurement in rice fields shall be conducted by technicians trained by experts from Anhui Academy of Agricultural Sciences. All the data should be cross-checked by technicians and experts.
Purpose of data	The parameter is used to calculate the baseline emissions from project fields in season s (BE_s).

Calculation method	N/A
Comments	N/A

Data / Parameter	$EF_{P,s,g}$
Data unit	kg CH_4/ha per season
Description	Project emission factor of group g in a given season s
Source of data	Field measurements in project reference fields
Description of measurement methods and procedures to be applied	As per instructions in the appendix (Guidelines for measuring methane emissions from rice fields) and IPCC 2006, volume 4, chapter 5.5.
Frequency of monitoring/recording	Once a week. Regular measurements as per closed chamber method guidance, seasonally integrated
Value applied	N/A
Monitoring equipment	Closed chamber
QA/QC procedures to be applied	The implementation of methane measurement in rice fields shall be conducted by technicians trained by experts from Anhui Academy of Agricultural Sciences. All the data should be cross-checked by technicians and experts.
Purpose of data	The parameter is used to calculate the project emissions from project fields in season s (PE_s).
Calculation method	N/A
Comments	N/A

5.3 Monitoring Plan

Monitoring process

(1) Monitoring of farmers' compliance with project cultivation practice (determination of $A_{s,g}$)

In order to determine whether the project fields are cultivated according to intermittently flooded cultivation practice, and thus assure that measurements on the reference fields are representative for the emissions from the project fields, a cultivation logbook shall be

maintained for all project fields. With the help of the logbook, all parameters, as following, that are part of the project cultivation practice shall be documented by the farmers:

(a) Sowing date;

(b) Fertilizer, organic amendments, and crop protection application (date and amount);

(c) Water regime on the field (e.g. "dry/moist/flooded") and dates where the water regime is changed from one status to another;

(d) Yield.

In addition, farmers shall state whether they have followed fertilization recommendations[19] provided with the introduction of the adjusted water management practice.

Since the reporting and verification shall be done on the basis of samples of the logbooks from the farmers, according to the latest version of the "*Standard for sampling and surveys for CDM project activities and programme of activities (version 8.0)*", the process of sampling is shown as follows:

- **Objectives and Reliability Requirements**

In this project, every farmers' household owning the paddy fields is regarded as an isolate unit. This sampling plan is for 3,447 households involved in this project. The project had applied intermittently flooded water regime with the same type, same category and same technology. After the implementation, this new water regime displaced the traditional continuously flooded method during rice cultivation in the project area. The farmers' logbooks should be sampled for assuring the project activity. In this case, the project proponent shall use 90/10 confidence/precision according to the sampling standard mentioned above.

- **Target Population**

From the description, the target population is the related 3,447 households planting the rice.

Table 5-1 the number of farmers in each town in the south of Lujiang County

Name of Town	The number of households
Ketan Town	741
Leqiao Town	761
Nihe Town	1206
Longqiao Town	253

[19] The optimal amount of nitrogen fertilization is 9-10.5kg/mu recommended by Technical Guidelines for Intermittently Flooded Rice Cultivation Method in Anhui Province

Fanshan Town	199
Luohe Town	287
Total	3,447

- **Sample Method**

Since the households are numerous and scattered, the water regime used during rice cultivation is identical, stratified random sampling is adopted in order that each one can be selected with equal probability. The strata should be mutually exclusive: every element in the population must be assigned to only one stratum. The stratification requires that information on the stratification variable, e.g. survey sample household will be changed once per year. Simple random sampling method will be taken in each stratum by using Microsoft Excel.

- **Sample Size**

According to the "*Standard for sampling and surveys for CDM project activities and programme of activities (version 8.0)*", the desired confidence level is 90% and the desired precision is 10%. Based on the statistical principles and sampling survey method, 308 samples should be sufficient to satisfy the desired confidence and precision. For mean value sampling, the required sampling quantity is calculated by the following steps:

$$n_1 = \frac{Z^2\sigma^2}{d^2} \tag{10}$$

Step1:

Where:

Parameters	Description
Z	The symbol used in general formula for confidence intervals. The validation team confirms it is to be 1.645 when confidence interval is 90%
σ	The population standard deviation, which is not available to PP
d	The maximum error of estimate

Step 2: Deformation of basic formula

$$n_1 = \frac{Z^2\sigma^2}{d^2} = \frac{Z^2(\frac{\sigma^2}{X^2})}{d^2/X^2} = Z^2V^2/e^2 \tag{11}$$

Where:

Parameters	Description
V	the coefficient of variation, and $V = \sigma/X$. As population standard deviation σ shall be smaller than the sample mean value X, hence from conservative consideration point of view, making V=1 can get the biggest sample size. It is conservative
e	the relative sampling error, and $e = d/X$, which is the precision. In this case, e=10% as discussed above

Consequently, $n_1 = \frac{Z^2V^2}{e^2} = \frac{1.645^2}{0.01} = 270.6$, and round up to 271.

Step 3: Correction based on population size

$$n_2 = \frac{n_1 N}{n_1 + N} \tag{12}$$

Where:

Parameters	Description
N	The population size, it is 3447 under project context

Therefore,

$n_2 = \frac{n_1 N}{n_1 + N} = \frac{271 \times 3447}{271 + 3447}$ =251.24, and round up to be 252, it takes $n_2 = 252$ is preferable.

Step 4: Correction based on sampling approach

$$n_3 = Bn_2 \tag{13}$$

Where:

Parameters	Description
B	The survey design effect

As discussed in *Procedures for Administering Data Collection and Minimizing Non-Sampling Errors*. The project adopts multi-stage sampling approach. In this case, $B \leq 1$ as per Sampling Design and Methodology. It's conservative consideration.

Thus, $n_3 = Bn_2 = 1 \times n_2 = 252$

Step 5: Correction based on responding rate

$$n_4 = \frac{n_3}{r} \tag{14}$$

Where:

The responding rate is adopted to be less 90% according to investigation report.

Thus, $n_4 = \frac{n_3}{r} = \frac{252}{90\%} = 280$.

Step 6: Correction based on contingency consideration

$$n = 110\% \times n_4 \tag{15}$$

Where:

Consequently, the sample size $n = 110\% \times n_4 = 110\% \times 280 = 308$.

The calculation result for n is 308. Therefore, although all the households are required to complete the logbooks, only 308 sample logbooks from households will be selected from the sampling frame according to stratified sampling method at the beginning of each year during the crediting period. The template of logbook was compiled by Shanghai Libra in accordance with the requirements of methodology. An inclusion of 308 samples in total, the sample size of each township was decided on the method of proportional distribution.

- **Sampling Frame**

In the investigation, sampling frame is worked out independently by taking town as sampling unit. Sampled group will be changed in each monitoring period. Firstly, calculate the ratio of households in every administrative town to the total population of the south of Lujiang County. According to the ratio of every town, calculate the sampling size of every town, and then set the amount of sampling 308 households, the actual sampling size is the ratio of every town multiply by 308. Finally, according to the number of samples needed for each town, the random sampling function of Excel is used to extract from the database mentioned above.

Table 5-2. The sampling size of logbooks from households in each town in the project area

Name of Town	The number of households
Ketan Town	66
Leqiao Town	68
Nihe Town	107
Longqiao Town	23
Fanshan Town	18
Luohe Town	26
Total	308

After the sampling logbooks are collected by the technicians, the expert will check the contents in the logbooks first to confirm whether the nitrogen application amount and drainage and irrigation frequency recorded by the farmers meet the requirements of the project activity, and then hand it to Shanghai Libra for final check, and then complete the monitoring report.

(2) Monitoring of baseline and project emissions (determination of $EF_{BL,s,g}$ and $EF_{P,s,g}$)

According to the applied methodology AMS-Ⅲ.AU (version 4.0), post-emission reduction shall be calculated by the formulas (1) – (5) shown in Section 5.1 and Section 5.2 above. So, $EF_{BL,s,g}$ and $EF_{P,s,g}$ shall be measured by technicians based on the requirements in the appendix (Guidelines for measuring methane emissions from rice fields) and IPCC 2006, volume 4, chapter 5.5. In this project, there is only one field group, thus, three baseline reference fields and project reference fields should be selected respectively for methane emission measurement. Besides, project reference fields shall be established close to the baseline reference fields and begin with the growing season at the same time as required by the methodology that the measurements on project and baseline reference fields are carries out in an equal manner and simultaneously. The emission is the average of the measurement results from the three reference fields.

The seasonally integrated emission factor $BF_{BL,s,g}$ (baseline) and $EF_{P,s,g}$ (project) shall be derived as average value from the three measurements for each group.

Hefei Luyu, as the project proponent, prepared a detailed plan for the seasonal methane measurements before the start of the season. The plan for field measurement and laboratory analysis is shown

Calculation of the emission rate for a plot (reference field)

(1) For each gas analysis, calculate the mass of CH_4 emissions with the help of the following formula:

$$m_{CH_4} = c_{CH_{4,t}} \times V_{Chamber} \times M_{CH_4} \times \frac{1atm}{R \times T_t \times 1000} \quad (16)$$

Where:

Parameters	Description
m_{CH_4}	Mass of CH_4 in chamber at time t (mg)
t	Point of time of sample (e.g. 0,15,30 in case of three samples within 30 minutes)
$c_{CH_{4,t}}$	CH_4 concentration in chamber at time t, from gas analysis (ppm)

$V_{Chamber}$	Chamber volume (L)
M_{CH_4}	Molar mass of CH_4: 16g/mol
$1atm$	Assume constant pressure of 1atm, unless pressure measurement is installed
R	Universal gas constant: 0.08206 L atm/K^{-1}*mol^{-1}
T_t	Temperature at time t (K)

(2) Determine the slope of the line of best fit for the values of over time with the help of software (e.g. Excel):

$$s = \frac{\Delta m_{CH_4}}{\Delta t} \tag{17}$$

Where:

Parameters	Description
s	Slope of line of best fit (mg/min)

(3) Calculate the emission rate per hour for one chamber measurement:

$$RE_{ch} = s \times \frac{60min}{A_{chamber}} \tag{18}$$

Where:

Parameters	Description
RE_{ch}	Emission rate of chamber ch (mg/h*m^2)
ch	Index for replicate chamber on a plot
$A_{chamber}$	Chamber area (m^2)

(4) Calculate the average emission rate of a chamber measurement per plot:

$$RE_{plot} = \frac{\sum_{ch=1}^{Ch} RE_{ch}}{Ch} \tag{19}$$

Where:

Parameters	Description
RE_{plot}	Average emission rate of a plot (mg/h*m^2)
Ch	Number of replicate chambers per plot

(5) Further procedure: from the average emission rates per plot of each chamber measurement, derive the seasonally integrated emission factor by integration of the measurement results over the season length. The simplest way of integration is multiplying the emission rate with the number of hours of the measurement interval (e.g. one week) and accumulating the results of every measurement interval over the season. Convert from mg/m^2 to kg/ha by multiplying with 0.01.

Monitoring team

The monitoring team consists of the project proponent, Shanghai Libra Investment Management Co., Ltd, technicians and experts from the agricultural bureau. Firstly, Shanghai Libra sets the number of plots, and drafts cultivation logbooks template, tables, etc. Secondly, project proponent and Shang Libra confirm the monitoring frequency and notify the technicians and the agricultural bureau. The technicians also need to instruct the farmers and check the famers' logbooks every month. Finally, the monitoring results will be double-checked by experts of the agricultural bureau.

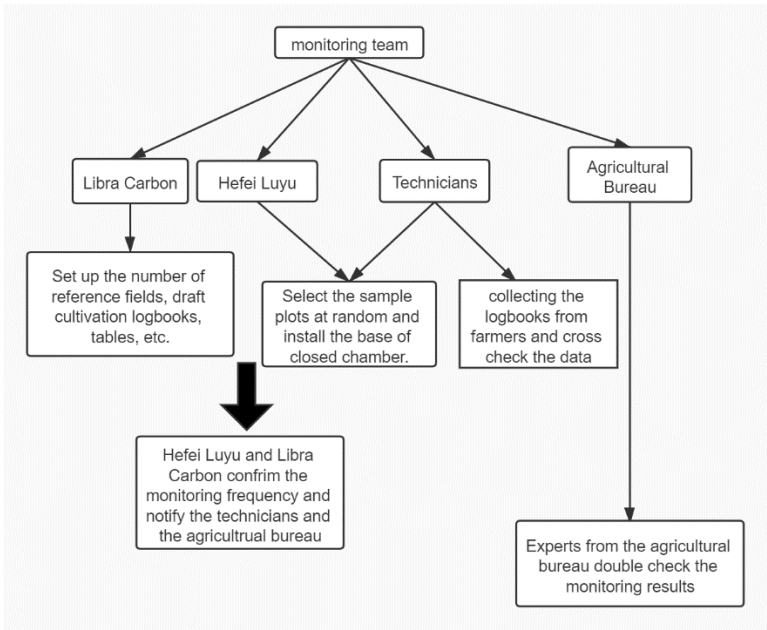

Figure 5-1 The figure of the monitoring team

Determine the reference fields

The reference fields are fixed rice paddies with area of around 0.37 ha[20]. The measurements on project and baseline reference fields are carried out in an equal manner and simultaneously. The baseline reference fields should be selected that they are representative of baseline scenario where double-cropping rice is planted by continuously flooded method without any organic amendments, while the project reference fields should be selected that they are representative of project scenario where double-cropping rice is planted by intermittent flooded method without any organic amendments.

Monitoring frequency

The monitoring frequency should be determined according to the methodology requirements for each parameter in the project after the project registration in order to ensure the continuity of the benefits.

Data management

All data collected as part of monitoring is archived electronically. All information should be stored by the technology department of the project proponent and all the materials have physical copies for backup. All data collected shall be archived at least two years after the end of the last crediting period of the project activity.

QA/QC

A systematic internal review and correction process will be used to assure/control the quality. The technicians are required to collect the logbooks from farmers once a month and cross check the data with experts. Similarly, the process of monitoring is also supervised by experts. When they find some unusual data, they will feed back to technicians and then correct the data before share it with Shanghai Libra. Shanghai Libra will draft the monitoring report based on the raw data and cross-check with the agricultural bureau experts. If there are not any further comments from the experts, Shanghai Libra will finalise the report. All parties are required to reply any questions raised within 30 days.

Emergency procedure

In this project, it is possible to cause equipment damage or missing data due to negligence and improper operation.

First of all, before the start of each growing season, Shanghai Libra should train technicians on how to check whether the equipment is working properly. After that, the technicians should check whether the equipment in the field is in good condition. Secondly, if there is any damage, the replacement should be completed before the land preparation, and the

[20] The Report of Measuring Methane Emission Rate of Paddy Fields with Continuously Flooded Method by Closed Chamber in the south of Lujiang County.

replacement should be recorded by Hefei Luyu and Shanghai Libra to ensure that the replaced equipment meets the requirements of this project. All the equipment should be in place before the start of growing season (land preparation). Thirdly, the technician should pay close attention to weather forecasts during rice planting. If extreme weather, such as heavy rain, is imminent, on-field gas sampling should be carried out before and after the extreme weather to ensure the monitoring frequency, at least once a week, required in the Appendix of methodology. Finally, if data loss or equipment damage occurs during the monitoring process, the corresponding emission reduction will be deducted in the most conservative way.