

**Low Carbon Agricultural Support Project  
Loan No. 2968-VIE (SF)  
Contract No. 12112015/HDTV01-LCASP**

# **QUARTERLY REPORT 2018-Q2**

**Hanoi, 11 October 2018**

**Prepared for  
Central Project Management Unit  
Ministry of Agriculture and  
Rural Development  
by**



**Agrifood Consulting International**

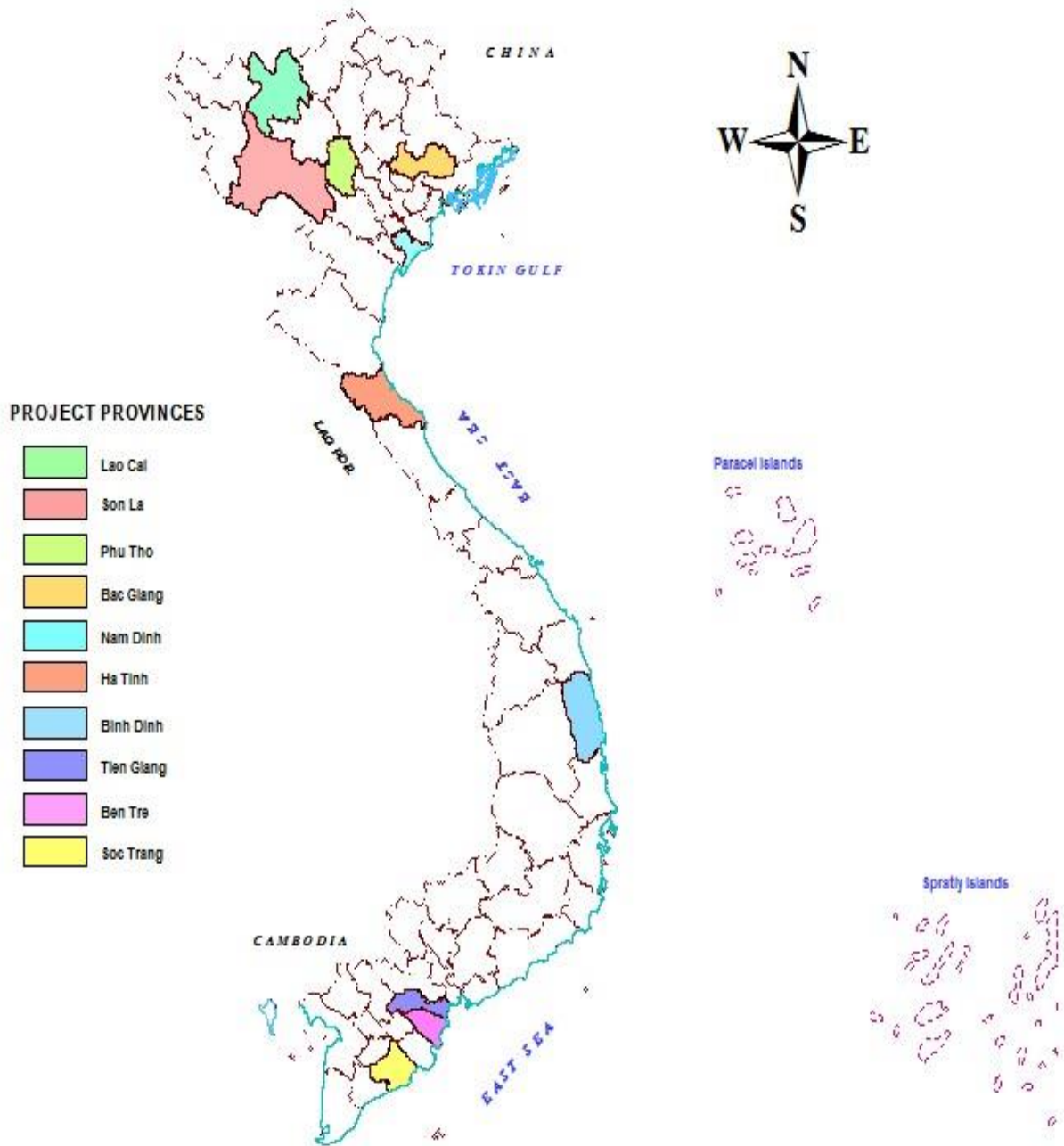
**in association with**

**Asia Development Consultants Joint Stock  
Company (ADConsult)**

## TABLE OF CONTENT

<b>MAP OF PROJECT PROVINCES.....</b>	<b>2</b>
<b>LIST OF ACRONYMS .....</b>	<b>3</b>
<b>1. INTRODUCTION .....</b>	<b>4</b>
<b>2. BASIC INFORMATION OF THE PROJECT .....</b>	<b>4</b>
<b>3. SUMMARY OF TECHNICAL ASSISTANCE ACTIVITIES.....</b>	<b>5</b>
<b>4. TECHNICAL ASSISTANCE PROGRESS BY COMPONENT .....</b>	<b>7</b>
4.1 COMPONENT 1: EXPANDED USE OF LIVESTOCK WASTE MANAGEMENT.....	7
4.3 COMPONENT 3: ENHANCED CSAWMP TECHNOLOGY TRANSFER.....	9
4.4 COMPONENT 4: EFFECTIVE PROJECT MANAGEMENT .....	12
<b>5 SPECIALISTS MOBILIZATION.....</b>	<b>13</b>
<b>6 LIC MANAGEMENT .....</b>	<b>13</b>
<b>7 TECHNICAL ASSISTANCE PERFORMANCE ASSESSMENT .....</b>	<b>15</b>
<b>8 WORK PLAN FOR THE NEXT QUARTER .....</b>	<b>16</b>
<b>9 CONCLUSIONS AND RECOMMENDATIONS.....</b>	<b>18</b>
TABLE 1: STATUS ON THE IEE REPORT PREPARATION .....	12
TABLE 2: SPECIALISTS INPUTS BY DESK OFFICE AND FIELD (APRIL – JUNE 2018) .....	14
TABLE 3: WORK PLAN FOR THE THIRD QUARTER OF 2018 .....	16

### Map of project provinces



## LIST OF ACRONYMS

ACI	Agrifood Consulting International
ADB	Asian Development Bank
AD Consult	Asian Development Consultancy Company
APMB	Management Board of Agricultural projects
BGT	Biogas technology
BP	Biogas plants
BVC	Biogas value chain
CDM	Clean Development Mechanism
CPMU	Central Project Management Board
CSAWMP	Practical management of smart agricultural waste to cope with climate change
DMF	Framework design and monitoring
EM	Ethnic minorities
EMDP	Ethnic Minority Development Plan
EMR	Environmental monitoring report
GAP	Gender Action Plan
GHG	Greenhouse gas
GOV	Vietnamese Government
HDPE	HDPE plastic
FI	Financial institutions
IEE	Preliminary Environmental Impact Assessment
LBP	Large scale biogas plants
LCASP	The project supports low carbon agriculture
LIC	Consultant for project implementation
MBP	Medium scale biogas plant
MARD	Ministry of Agriculture and Rural Development
NOL	No objection
PPMU	Provincial Project Management Board
REA	Rapid assessment of the environment
SBP	A small scale biogas plant
TOR	Terms of Reference
US\$	U.S. dollar
VND	Vietnamese Dong

## 1. INTRODUCTION

This report describes the achievements and performance of Technical Assistance for LCASP conducted by ACI Consultants and ADConsult in the Second Quarter of 2018 (April to June 2018) and the proposed plan for the Third Quarter of 2018.

In this quarter, the LIC consulting team continued to support small and medium sized biogas plants (MBPs), especially prevention of the biogas plant overload, solution for making compost and organic fertilizers from exceeding waste in order to optimize the use of small-scale structures. The installation of separators and generators has been conducted in the project provinces. LIC had consulted with the contractors to calibrate the design drawing of the settling tanks, layout and solutions to improve the settling efficiency of the separators. LIC continued to support the research packages in finalizing the description and technical review reports. Initial Environmental Evaluation (IEE) reports of MBPs, gender and ethnic minority report of the first 6 months of 2018 have been prepared and will be sent to CPMU and ADB for approval.

## 2. BASIC INFORMATION OF THE PROJECT

Although biogas plant technology is known to Viet Nam for quite some time, the current needs for environmental mitigation measures including the reduction of GHG emission require the adoption of improved technologies and measures to minimize animal waste and effective climate smart agriculture waste management practices (CSAWMP). The new technologies and practices are important for all stakeholders in the project. Consequently, LCASP activities are supported with various capacity building and communication programs to be implemented in central, provincial, district and commune levels.

The Project is expected to increase the uptake of CSAWMP as measured by the increased use of clean biogas energy and organic bio-organic fertilizers.

The specific purposes of the project include:

- (i) Improve management of animal waste and bio-slurry while reducing environmental pollution; creating clean energy; bio-organic fertilizer; generating incomes from Clean Development Mechanism (CDM).
- (ii) Increasing the application of CSAWMPs that are effectively certified; greater use of renewable energy and bio-fertilizer from agricultural waste; replicating models in order to reduce greenhouse gas (GHG) emissions and improving the livelihoods and quality of life of rural people.
- (iii) Capacity building of stakeholders and disseminating knowledge and skills of good CSAWMP to beneficiaries.

## Expected Outcome

The Design and Monitoring Framework (DMF) of the Project indicated that by 2018 (from baselines in 2013) the envisaged outcomes in the project areas include:

- At least 70% bio-slurry is converted to organic fertilizers.
- At least 80% energy produced by Biogas Value Chains (BVCs) is utilized
- Daily workload of women and children is reduced by 1.8–2 hours, on average

The four components of the project are

- i) Expanded use of animal waste management infrastructure,
- ii) Credit lines for biogas value chains,
- iii) Enhanced CSAWMP technology transfer and
- iv) Effective project management.

The project covers 10 provinces of Vietnam, which are Son La, Lao Cai, Phu Tho, Bac Giang, Nam Dinh, Ha Tinh, Binh Dinh, Tien Giang, Ben Tre and Soc Trang. The project is implemented for a period of six years from 2013 to June 2019. Based on the Mid-term Review (MTR) in September 2016, the project net loan amount is 67.92 million USD.

### 3. SUMMARY OF TECHNICAL ASSISTANCE ACTIVITIES

Technical assistance in the second quarter of 2018 will focus on addressing technical issues that are still in existence since the first quarter of 2018, particularly (i) overload of the biogas tanks, (ii) support for installation of manure separators and biogas generators, (iii) Initial Environmental Evaluation (IEE) reports of MBPs and other issues and (iv) update progress report on gender and ethnic minority. The main results are summarized as follows:

#### *Biogas technology*

- Introduce the method of using liquid discharge of small-scale biogas plants (SBPs) for crops
- Support PPMUs of Ha Tinh and Son La on technical issues in the construction of MBPs.
- Support PPMU in Phu Tho province to monitor the model of overcoming the overload of MBPs.
- Provide guidance and technical assistance to provinces in the process of developing the application dossiers for registration, appraisal report for construction application and acceptance of MBPs of households in Lao Cai, Ha Tinh, Bac Giang ...
- Continue providing technical assistance to implement the package of electricity generators in households with SBPs in Lao Cai;

- Support the provinces of Phu Tho, Ha Tinh, Lao Cai, Bac Giang, Tien Giang, Binh Dinh on optimizing the use of biogas and bio-slurry from MBPs,
- Continue to support the operation and maintenance of SBPs;

#### *Climate Smart Agriculture Waste Management Practice*

- Survey current status and provide technical assistance on the selection of households to install manure separators and biogas generators, systems of settling tanks for livestock waste, using liquid discharge of biogas plants for crops in Phu Tho, Ben Tre, Binh Dinh, Ha Tinh, and Lao Cai.
- Support and monitor the installation of the models in the provinces and monitor to evaluate the performance of the models.
- Assess the actual situation of livestock waste treatment in Son La and Bac Giang so that there is a basis for proposing the mechanisms, policies and technologies to apply in the project (Appendix 2).
- Review and provide comments on the descriptions and technology review reports of the five research packages.

#### *Training and communication*

- Revise the outline and script of the communication package No. 41;
- Develop materials and lectures on prevention of overloading and effective use of biogas;
- Write a report on the achievements of the project in 2017 (Appendix 1);
- Review and provide comments on training materials for models of manure separators and generators;
- Develop and finalize a survey forms for assessing the impact of researcher training;
- Support the selected units to improve vocational training materials.

#### *Environment Safeguard Policy*

- Revise and finalize IEE reports for MBPs in the provinces;
- Environmental monitoring of MBPs
- Review, provide comments and revise provincial internal environment monitoring reports for the first 6 months of 2018 of the provinces;
- Finalize the periodical environmental monitoring report of the project for the first 6 months.

#### *Gender and Ethnic Minorities Safeguard Policy*

- Continue support for GAP and EMDP updates

## 4. TECHNICAL ASSISTANCE PROGRESS BY COMPONENT

### 4.1 Component 1: Expanded Use of Livestock Waste Management

According to the project design, component 1 consists of five main activities:

- (i) Standardization and dissemination of design package for biogas value chain management;
- (ii) Strengthening the monitoring capacity of relevant agencies to handover and monitor the constructed biogas plants;
- (iii) Financial support for biogas plants;
- (iv) Capacity building in designing, constructing, operating and monitoring biogas plants;
- (v) Strengthening capacity and providing equipment for relevant agencies to manage the national biogas database.

In the above five activities, in the first quarter of 2018, LIC focused on two main activities, namely (i) and (ii).

#### *4.1.1 Standardization and dissemination of design package for biogas value chain management*

The consultants provided technical support to the PPMUs in Ha Tinh and Son La for the selection of households to build MBPs (volume from 51-75m<sup>3</sup>), compiled guidelines for the construction of MBPs and recommended measures for optimized use of biogas (used for cooking, cooking animal feed, sharing for the surrounding households, use of the infrared biogas heaters for young animals, etc.)

The consultants continued to support Phu Tho PPMU, instructing households in Ha Hoa district to operate and maintain the system, overcoming the overload of MBPs in the farms as well as evaluating the effectiveness of MBP overload protection in this model.

The consultants coordinated with the contractors to inspect and monitor the installation of manure separators and biogas generators in Lao Cai, Phu Tho, Binh Dinh, Nam Dinh and Ha Tinh provinces, together with the PPMUs, winners of survey and technical design package to provide technical support for farm owners to build auxiliary facilities (settling tanks, motor houses, waste collection systems, etc.) to accelerate the project implementation schedule.

The consultants proposed a systematic solution to install auxiliary equipment for generators in the models and measures for maintenance and efficient use of the



generators to meet the electricity demand of the farmers (connected to the pump system, lighting system, ventilation fan system, time to use the generators, periodically replacing the filter, oil, grease, etc.).

The consultants compiled a guideline on technical issues in installation of generator systems in farm households with SMPs, and proposed a reasonable installation model to ensure a sustainable system. (The H<sub>2</sub>S filter must be installed in front of all biogas using devices and in front of the gas bags, the system must have safety equipment, etc.).

The consultants reviewed and provided comments on the training materials on instruction for using manure separators and generators of the contractors and assisted the contractors to carry out training activities on the operation and use of these machines.

#### *4.1.2 Strengthening the monitoring capacity of relevant agencies to handover and monitor the constructed biogas plants*

The provincial coordinators often work closely with provincial technicians to inspect and supervise the biogas plants constructed in the project. Some typical examples are:

- The coordinator of Ha Tinh province supported Ha Tinh PPMU to survey, appraise and complete the dossier for the construction of two MBPs, increasing the total number of registered construction of MBPs of the province to 8.
- The coordinator of Binh Dinh province supported Binh Dinh PPMU to survey and appraise 4 households who registered to build biogas plants that met the project's requirements. The provincial coordinator submitted the evaluation to the PPMU for approval.

LIC also reviewed, provided comments and edited the internal environment monitoring reports for 30 MBPs in 9 project provinces, except Son La PPMU.

The Ethnic Minority Development Plan (EMDP) and the Gender Action Plan (GAP) are regularly updated to support the CPMU.

## **4.2 Component 2: Credit Lines for Biogas Value Chain**

*Financial Institutions (FIs) to provide credit lines to Eligible Beneficiaries to finance Biogas Value Chain Infrastructure and other climate-smart agriculture waste management investments which satisfy the Subproject Eligibility Criteria by June 2019.*

No activity was reported this quarter.

### 4.3 Component 3: Enhanced CSAWMP technology transfer

*4.3.1 Utilizing farmer-based research including using biochar and other agricultural wastes as organic fertilizers; applying other efficient low greenhouse gas emission agricultural practices which generate bio-energy, managing waste treatments in aquaculture and other CSAWMP.*

The contracts of two research packages No. 25 and No. 26 were signed at the end of December 2017 and the packages continued to finalize the description and technology review reports. Three research packages (No. 27, 28, 29) were signed at the end of May 2018. The consultants provided technical support to the research contractors as requested by the PPMU and participated in contributing comments to the Inception Reports and detailed descriptions of the 4 research packages. Some key comments are as follows:

- Package No. 25: Need more detailed overview of the types of technologies in the package, especially manure separation technology, especially technology in Asian countries because they have similar husbandry conditions, the cost of these machines is cheaper, better flexibility (small scale) and easy to replace the equipment. At the same time, it is necessary to immediately evaluate the separators installed in the project to detect the inadequacies of equipment and auxiliary systems. In addition, the contractor should consider the possibility of using the results of the package No. 27 in this research package. For earthworm raising technology: the research should immediately select varieties that are appropriate with breeding conditions using pig waste.
- Package No. 26: The contractor omitted the assessment on large scale biogas plants (LBPs), there should be design of the complete works for the localities and farms to install if possible. The designs of the settling tank provided in the description did not show the flexibility to meet the TOR's requirements. The contractor should evaluate existing generators at different scales, within the project as well as outside to find the optimal solution.
- Package No. 27: The contractor should investigate the level of water consumption of livestock producers for different purposes to see which wastes the most water to intervene; this survey should be carried out separately for open cages and enclosed cages. When designing cages, it is necessary to consider the design of the 3-storied cage to utilize the pigs' behavior since they drink hygienic water; the pigs do not bath, so the contractor should re-survey for more appropriate research direction. In addition, the contractor must use straw as the main material in the bio-mattress rather than the sawdust as proposed.
- Package No. 28: The contractor should clarify the advantages and disadvantages of the technologies mentioned in the TOR in order to propose a technology that

is more appropriate to the actual conditions. The straw is no longer burned and disposed of as in the 2013 survey (baseline for the TOR), so additional survey of the straw value chain may be required in some project provinces as well as proposal for changing locations if needed. In terms of mushroom growing technology, it is recommended to propose the variety that able to convert the straw the most, the most advanced mushroom growing technology to increase the straw value chain and to estimate the mushroom market to ensure that using straw for mushroom cultivation is more profitable than that used for other purposes.

#### *4.3.2 Developing livestock waste management models for agricultural production and greenhouse gas emission reduction*

##### *Model of manure separator*

To use the separator effectively, the consultants conducted the following activities:

- Propose method of calculating the settling tank capacity in accordance with the production scale of each farm and write the proposal for overall design of the "continuous" settling tank to collect waste deposited in the model of manure separator;
- Prepare method for monitoring the capacity of the separator, which suggested: (i) Method of recording, monitoring the capacity of separator; (ii) Proposed types of samples to be collected for evaluating the quality of solid waste to use as inputs for organic fertilizer production, as well as proposing sampling methods to ensure objectivity.
- Prepare template for monitoring and evaluating the effectiveness of models of separator in the project provinces;
- Propose the reasons why the separators should be combined with the biogas tank system

##### *Model of generator*

To increase the lifespan of the generators, the Consultant proposed

- Installation of a de-gasification system before the gas enters the generator;
- Determination of the location and spacing of gas bags to be appropriate with actual requirements of the farm;
- Determination the capacity of the generator in accordance with the amount of gas generated;
- It is necessary to install a better quality filter system;

- Manual of biogas generator should be edited in Vietnamese and pasted on the machine to remind the users;
- There should be a warning sign where the generator is placed so that people are careful when using electricity;
- A gas meter should be added to measure the amount of gas produced in the model so that the efficiency of the generator can be calculated more accurately.

#### *4.3.3 Capacity building for researchers, extension staff and farmers including vocational training program, training packages and study tours on CSAWMP*

The PPMUs had organized a number of training courses during this period. Together with the technical consultants, the provincial consultants had actively supported the development of materials and support for training activities.

The consultants prepared a lecture on the use of dry waste extracted from manure presser to produce organic fertilizer - training materials for the model of manure separator and presser as well as lecture on prevention of biogas tank's overload and effective use of biogas.

In order to assess the impact of the training courses, the consultants developed a questionnaire for assessing the impact of training for researchers.

The consultants continued to coordinate with the CPMU to monitor and promote the selection of the agencies/unit to develop the curriculum and the progress of drafting the Vocational Training Program with the Northern College of Agriculture and Rural Development.

#### *4.3.4 Establishing an information system (e-library, map sets on agro-ecological zones and distance learning system) to disseminate awareness and knowledge CSAWMP*

No activity was reported this quarter.

#### 4.4 Component 4: Effective Project Management

4.1 Establish CPMU and PPMUs to be operational by 2013

4.2 Conduct a gender awareness raising workshop for PMUs by 2016.

4.3 Engage consultants for start-up and auditing, and to develop the PPMS, with sex- and-ethnicity-disaggregated data and including gender action plan monitoring by 2015.

This section also includes environmental and gender safeguards.

##### Environment

In the second quarter of 2018, there were 45 registered MBPs, of which the average number of biogas plants that prepared and submitted reports such as IEE, REA, and environmental classification, is 36 MBPs. The consultants completed and submitted to the CPMU environmental safeguard documents of 30 MBPs. Thus, from the end of 2017 to the end of the first quarter of 2018, a total of 15 MBPs has been built, 65 new registered ones (as of the end of June 2018 - Table 2).

**Table 1: Status on the IEE report preparation**

No.	Province	No. of MBPs	IEE status in the 2nd quarter of 2018	
			Preparation stage	Finalized and provided to CPMU
1	Son La	0	0	0
2	Lao Cai	5	5	5
3	Phu Tho	4	4	4
4	Bac Giang	13	8	8
5	Nam Dinh	1	1	1
6	Ha Tinh	13	10	4
7	Binh Dinh	1	1	1
8	Tien Giang	3	2	2
9	Ben Tre	3	3	3
10	Soc Trang	2	2	2
	Total	45	36	30

The 6 month environmental monitoring report of the project was prepared by the Environmental Safeguard Specialist (CPMU), based on the internal environmental monitoring reports of the provinces. Currently, the project's periodical environmental report had been developed and approved by ADB, posted on the Bank's website (<https://www.adb.org/projects/documents/vie-45406-001-emr-2>). Some problems shown in the report include: most of the constructed facilities do not have properly designed settling tanks to treat the slurry discharged from biogas plants, liquid

discharge from the settling tanks does not meet the QCVN 62-MT: 2016/BTNMT. Although LIC experts and slurry treatment specialists proposed several designs to reduce the amount of suspended solid matters in liquid discharge generated by the biogas plants, these designs are not qualified enough and many husbandry households are unwilling to apply due to: lack of construction areas, lack of fund and the efficiency of these tanks have not been tested.

### *Gender and Ethnic Minorities*

The consultants completed the monitoring report for the Ethnic Minority Development Plan (EMDP) in the first 6 months of 2018 and submitted it to ADB for review and approval. At the same time, the consultants also updated the GAP report for Q2-2018 and sent it to the CPMU.

LIC collaborated with CPMUs, PPMUs and contractors to integrate gender indicators into the specific activities of the studies and activities and at the same time guided the provinces where EM communes are available develop EM indicators.

#### *4.4 Undertake baseline surveys in all project provinces with collection and analysis of sex-and-ethnicity-disaggregated data by 2016.*

Completed in early 2016

#### *4.5 Prepare progress reports and submit to ADB on a regular basis by 2018.*

Various reports including technical and quarterly progress reports have been provided to CPMU. In addition, LIC have also sent weekly reports to CPMU on technical progress.

## **5 SPECIALISTS MOBILIZATION**

None of new specialists was mobilized in this quarter. Two consultants, Mr. Manohar Shrestha – the Team Leader and Ms. Ho Thi Lan Huong - Value Chain Consultant, submitted requests for termination of their contracts, hence, LIC did not mobilize these two experts from Q2/2018.

## **6 LIC MANAGEMENT**

LIC team members provided their inputs as requested by CPMU and PPMUs. All Provincial Coordinators supported PPMUs on various activities, coordinating with the relevant Specialists.

#### *Preparation of preliminary evaluation workshop for the first 6 months of 2018 of LIC*

LIC sent letters to all LIC consultants to prepare reports on the performance of the consultants in the first 6 months of 2018 in accordance with the TOR, their outputs and recommendations for TOR adjustment and the reasons given so that LIC can propose for adjustment of the TORs to be appropriate with the actual situation.

#### *Compilation of LIC outputs*

LIC also sent letters to LIC consultants requesting them compile their outputs during the project implementation so that LIC can compile and sent them to the CPMU.

#### *Coordination*

LIC has worked effectively with the stakeholders to implement the project. In addition to the CPMU and the PPMUs, LIC has worked with companies providing separators and generators to assist them in completing work related to the installation of these devices as well as reviews and suggestions for these contractors to complete the training materials.

#### *Report preparation and submission*

In addition to the technical reports, the Q1 2018 report were also be submitted to the CPMU.

#### *Specialists and Provincial Coordinators Input Period*

Inputs from the Specialists and provincial coordinators in terms of office and field work are presented in Table 3 for the period of April-June 2018.

During this quarter, the mobilization time of the specialists reduced significantly as requested by the CPMU, ADB agreed to extend the project until June 2019, however, LIC's contract with the CPMU would expire at 30/11/2018. Hence, LIC should consider extending the contract to carry out the work of the project. If the project duration is extended, the remaining working days of the specialists will be distributed until June 2018. Therefore, starting from Q2/2018, the number of working days of the provincial coordinators also reduced a lot (average of 5-6 working days per month), working days of key specialists reduced (average of 10-11 working days per month).

The total man-months was 13,46, of which the office work was 4.36 man-months and the field work was 9.1 man-months.

**Table 2: Specialists Inputs by Desk Office and Field (April – June 2018)**

Full name	Man-months by desk office	Man-months by field work
Manohar Shrestha	0.00	0.00
Bùi Bá Bổng	0.00	0.18
Henrik B. Moller	0.00	0.00
Nguyễn Văn Bộ	1.36	0.19
Hồ thị Lan Hương	0.00	0.00
Bùi Văn Chính	1.50	0.00
Phạm Thị Vượng	1.50	0.00
Phạm Văn Bình	0.00	0.00
Tạ Hòa Bình	0.00	0.59
Lê Thị Mộng Phượng	0.00	0.45
Nguyễn Ngọc Long	0.00	0.00
Lê Thị Thoa	0.00	0.00
Bùi Thế Hùng	0.00	0.82
Bùi Thị Phương Loan	0.00	0.82
Lê Ngọc Hùng	0.00	0.55
Đặng Thị Phương Lan	0.00	0.86
Tống Khiêm	0.00	0.68
Nguyễn Đình Vinh	0.00	1.32
Đào Văn Thông	0.00	0.00
Bùi Thị Lan Hương	0.00	0.82
Trần Việt Cường	0.00	0.50
Dư Văn Châu	0.00	1.32
<b>Total</b>	<b>4.36</b>	<b>9.10</b>

## 7 TECHNICAL ASSISTANCE PERFORMANCE ASSESSMENT

The common current status of households with biogas plants is the size of biogas tanks is unsuitable with the amount of animal waste to be treated, hence LIC continues to support the design of solutions to prevent overload of SBPs and MBPs in some project provinces by (i) adding a two-compartment settling tank in front of the biogas tank and by natural sedimentation separating solid waste from livestock liquid waste for making organic fertilizers and (ii) separating solid matters in the tanks after biogas tanks, using collected solid matters to make organic fertilizer.

The manure separators and generators continue to be installed in the provinces and many technical issues have been addressed by the LIC team, such as comments for finalizing of designs for settling tanks and slurry collectors for the manure separators, using waste collection system and settling tanks for high efficiency separators. These comments were accepted by the CPMU and the contractors, and based on these comments, the contractors modified the design of the settling tanks.



LIC conducted visits to several models of manure separators in Bac Giang and Son La provinces. The initial results showed that (i) livestock waste treatment has been properly addressed at different levels; (ii) the use of manure separators to make organic fertilizers brought benefit to the farmers, the produced fertilizers were used fully, there was no backlog, this showed that the organic fertilizer market is very promising; (iii) Liquid waste after the separator was loaded into the biogas tanks, hence there was no more overload of biogas tanks and excess of gas and (iv) effective control of water used for cleaning the cages and bathing pigs, the amount of water used in the farms was 15-18 liters/day/head. However, there were some shortcomings that need to be considered and adjusted: (i) investment in manure separator was not suitable with scale of farm; therefore, waste volume is not enough to operate the machine; (ii) installation of separator was inconvenient for packaging that required a lot of labor work.

LIC supported the CPMU, PPMUs organized many workshops and trainings by providing presentations, sharing outputs and experience. In particular, LIC assisted the CPMU in reviewing training materials on the use of manure separators and generators prepared by the contractors.

The preparation of IEE reports for MBPs was delayed. By the end of Q2/2018, 30/45 MBPs have prepared IEE reports. LIC continued to support the PPMUs in finalizing the IEE reports.

Internal Monitoring Report on EMDP for the first 6 months of 2018 and updated GAP monitoring report by the end of June, 2018 was finalized and sent to the CPMU and ADB.

## 8 WORK PLAN FOR THE NEXT QUARTER

The detailed work plan for the third quarter of 2018 is presented in Table 3.

**Table 3: Work plan for the third quarter of 2018**

No.	Activity				Note
		7	8	9	
<b>1</b>	<b>Component 1: Expanded use of animal waste management infrastructure</b>				
1.1	Review of solutions for prevention of overload of SBPs	■			
1.2	TA for the implementation of models of prevention of overload of SBPs and MBPs of the provinces if required		■		
1.3	Support PPMUs in design, construction and	■			

No.	Activity				Note
		7	8	9	
	monitoring of MBPs				
1.4	Support PPMUs in supervision of MBP construction quality				
1.5	Support PPMUs on the treatment system after biogas tanks				
1.6	Support PPMUs on using excess gas from MBPs				
1.7	Update implementation progress and review installation of manure separators				
1.8	TA for PPMUs on manure separators				
1.9	Support contractors on manure separators				
1.10	Support in design of settling tanks				
1.11	Support in evaluating the performance of the manure separators				
1.12	Support for pilot of optimum solution for settling tanks/manure separators				
1.13	Support for operation and maintenance of manure separator system				
1.14	Support PPMUs in checking and supervising the installation of generators				
1.15	Support the contractors in installation of biogas generators				
1.16	Support for optimum use of biogas by-products for crops (Package No. 37)				
<b>2</b>	<b>Component 3: Enhanced CSAWMP technology transfer</b>				
2.2	Support for development of optimum technology for using biogas by-products to make fertilizers				
2.2	Support for development of optimum technology for using livestock waste to make fertilizers				
2.3	Support for development of optimum technology for using crop waste to make fertilizers				
2.4	Support for finalizing biogas technology review report				
2.5	Support for finalizing generator technology review report				
2.6	Support for finalizing biogas filter technology review report				
2.7	Support for development of optimum technology for water saving pig raising				
2.8	Support for research on effective use of crop waste and by-products in value chain				
2.9	Support for development of optimum technology for treatment of waste from shrimp culture				

No.	Activity				Note
		7	8	9	
<b>3</b>	<b>Training and communication</b>				
3.1	Review training materials and support PPMUs and contractors in implementing the training activities				
3.2	Evaluate the effectiveness of training	██████████			
3.3	Identify and design of communication material	██████			
3.4	Follow up and support of communication material	██████████			
<b>4</b>	<b>Environmental safeguard</b>				
4.1	Prepare IEE reports for MBPs	██████████			
4.2	Review and finalize IEE reports	██████████			
4.3	Support for preparation of environmental monitoring report			██████	
4.4	Support CPMU and PPMUs in environmental monitoring	██████████			
4.5	Field survey on IEE		██████████		
<b>5</b>	<b>Other activities</b>				
5.2	Review of the mission report and other reports	██████████			
5.3	Support and participate in workshops organized by CPMU		██████████		
5.4	Support and participate in workshops organized by PPMUs		██████████		
5.5	Write technical documents and upload to LCASP website	██████████			
<b>6</b>	<b>Reporting</b>				
6.1	Quarterly report			██████	

## 9 CONCLUSIONS AND RECOMMENDATIONS

### Conclusions

The construction of small and medium scale biogas plants has been being implemented in the project provinces. The appraisal and approval for the construction of MBPs is regularly updated to timely support the CPMU and PPMUs in implementation and effective management of the constructed works. In addition, provincial coordinators often work closely with provincial technicians to check and supervise the biogas plants constructed under in the project.

The manure separators and biogas generators have been operated in the provinces, but still slow, especially in the Mekong Delta provinces (Tien Giang, Ben Tre and Soc Trang) due the main reasons: (i) the design of the sentiment tank has not met the practical requirements of each farm, (ii) replacement of HHs.

All 5 research packages are ongoing, however, the progress is too slow. Currently, all 5 packages are still on the progress of report preparation and technology assessment report preparation.

The consultants continued to assist the PPMUs and the contractors in compiling training materials and conducting training courses. However, PPMUs as well as the contractors need to complete the evaluation on training in accordance with the overall Training Plan.

The preparation of IEE reports by PPMUs is still behind schedule. The submitted IEE reports should be approved by the CPMU soon.

Provincial consultants have been mobilized in all project provinces. Generally the technical assistance of the LIC is relatively efficient at all stages.

*Recommendation:*

- For the effective application of manure separators and biogas generators there should be close cooperation between CPMU, PPMUs, the LIC and the Contractors.
- During the installation and testing operation of separators and generators, there should be close supervision and monitoring from CPMU, PPMU and LIC should for promptly advice and assistance in technical issues.
- The instructions for using biogas generator in English need to be translated into Vietnamese and stick to the machine to remind the users; a warning banner should be placed on the generators instructing and warning.
- The gas meters should be installed to measure the amount of gas produced from that model so that the efficiency of the generator can be measured more accurately.
- The research packages should connect to the relevant model package at a few locations for better comparison among new technique and equipment.
- The production of organic fertilizer from livestock farmers using manure separators should be connected to the organic fertilizer production business/enterprises.
- Before installing the manure separators, a field survey should be carried out so that the manure can flow into bag after it is separated. It helps reducing labor for packing. An additional equipment can be fitted to spray probiotics in the bag.
- The acceptance of the technology review report of package 25, 26 should be speeded up to meet the schedule.

- There should be a plan for using equipment of package 14: environmental protection and it is recommended that the research packages should use these equipment to perform sample collection and analysis.
- The revised TOR for LIC consultants should be quickly approved.

## APPENDIX

### Appendix 1: Achievements in 2017 of LCASP

#### I. Introduction

This report is prepared on major technical achievements of LCASP to 2017. It covered mainly on the activities that made the technical interventions that can look forward for future actions. The learning from the project can be applied in the biogas plants program of Vietnam.

References were made from CPMU reports, specialist reports, mission reports and field observation, however, detailed technical descriptions are avoided as it has already been reported. A regular GoV/ADB reviews are conducted with the reflection of technical achievements and shortcomings. Such results are tabulated from the MTR and onward.

#### II. Background

Biogas Plants Program is one of the optimistic programs of Government of Vietnam to address greenhouse gas emission reduction. A number of government decisions were made to enhance this program as a part of climate change mitigation measures. Some of the important decisions are

1. MARD decision 3119/QD-BNN-KHCN dated 16 December 2011- approving a program of greenhouse gas emissions reduction in the agriculture and rural development sector up to 2020 (specifies a target of 500,000 biogas installation by 2020)
2. Prime Minister's decision No. 2068/QD-TTg dated 25 November 2015 - development strategy of renewable energy by 2030 with a vision to 2050 (included a target for development of biogas from livestock waste - from 5% in 2015 to about 50% by 2030 and most livestock waste being treated by 2050)
3. Prime minister decision No. 50/2014/QD-TTg dated 4 September 2014 - policies on subsidies for improvements in farmer household animal husbandry in period 2015-2020 (one time subsidy of upto 50% of the expenses of constructing biogas works for treatment of water waste matter, upto VND5 million per household)

It is estimated that there are upto 300,000 biogas plants installed in the country. Other partners in the program are SNV and LIFSAP.

Most of the biogas is used for cooking, wine making, livestock feed making and heating purposes. Households save average VND 250,000 per month on utilities.

The LCAS Project is expected to increase the uptake of climate smart agriculture waste management practices as measured by the increased use of clean biogas energy and organic bio-slurry fertilizers.

The Design and Monitoring Framework (DMF) of the Project indicated that by 2018 (from baselines in 2013) the envisaged outcomes in the project areas include:

- At least 70% bio-slurry is converted to organic fertilizers

- At least 80% energy produced by Biogas Value Chains (BVCs) is utilized
- Daily workload of women and children is reduced by 1.8–2 hours, on average

To the end of the February 2018, altogether 49,466 biogas plants were installed where highest 9,896 (19.5%) is in Binh Dinh and lowest is 2,009 in Son La (4.5%). In case of ethnic minorities, total SBP installation was 4,291 SBPs where highest and lowest were 1,237 in Lao Cai (2.39%) and one in Ben Tre respectively<sup>1</sup>.

### III. Technical Interventions

After the GoV/ADB Midterm review, the DMF target was revised - SBP increase to 51,000 and added 14,000 SBP targeting to ethnic minorities - poor or nearly poor households as per decision No 59/2015/QĐ-TTg dated 19 November 2015. The Subsidy will be VND5 million where ethnic minority should female bread winner.

#### III.1 Biogas Plants

With expected increase of the uptake of climate smart agricultural waste management practices with the increased use of clean biogas energy and organic bio-slurry fertilizers, LACSP is able to support the livestock farmers with biogas plants of various capacities. Among the small (9-20 m<sup>3</sup>), medium (<20 to 500 m<sup>3</sup>) and large (<500 to 800m<sup>3</sup>) scale biogas plants, while high number of installation is SBPs (with the achievement of 82.7% against the target), all LBPs are installed (total number of 2 LBPs achieving 100%).

##### *Small scale Biogas Plants*

SBP are brick dome design KT1, KT2 and KT3.1 and composite models. The project installed mostly KT1 followed by KT2 models. LCASP installed SBP designs are with quality and easy to operate. Proper training was provided to farmers and masons before commencing the work that had contributed to smooth maintenance and operation of SBPs.

Other than some connecting pipes maintenance and pressure gauge have to followed and monitor on a regular basis for effective use of SBPs. Still some of the farmers are not following properly.

##### *Medium Biogas Plants*

Technical document such as guiding construction, operation and maintenance is used by masons and PPMUs. It included the construction of six types of MBPs including KT1, KT2, KT31 bio-digesters, plug-flow digester, medium size UASB and medium size HDPE digesters. LIC team shared the experiences dealing the technical issues on a timely manner especially in Son La, Lao Cai, Binh Dinh, Phu Tho, Nam Dinh, Bac Giang, Ben Tre and Tien Giang provinces. Seven types of KT2 bio-digester with different volumes (50-200 m<sup>3</sup>) were developed as the design of KT2 bio-digesters with different volumes were not complete. It should be noted that the technology on MBPs needs to further develop in Vietnam and have to deal technically by specific sites.

<sup>1</sup> CPMU 2018

There is a target to install 49 MBPs with project subsidies with a volume of 50 – < 500 m<sup>3</sup> (in case of 1000 pigs if separators installed) or 50 – 500 pigs without separators.

For MBPs, output based systematic planning is necessary meeting the milestones over time. There are a number of steps to be followed involving various stakeholders. Major milestones are feasibility study with technical design, in-depth consultation with the participating farming households on the investment commitments and sustainable farming, environment related obligations and completion of IEE; and construction, operation and maintenance. Concerned stakeholders should take the responsibilities with output based results.

Guidelines on the MBP construction, covered KT2 bio-digesters, was prepared and widely used in the field especially in Lao Cai, Son La, Phu Tho, Bac Giang, Nam Dinh and Ha Tinh provinces. The documents are effective in the field conditions of the project sites and well adapted by the technicians, masons and others.

An innovative technical application, masonry type MBP had been constructed in Moc Chau district, Son La province. This is first of its kind, however, this is still in preliminary stage in Vietnam.

Design proposal with overloading solutions of MBP at the farm of Mr. Bui Duc Tuyen, Xuan Ang commune, Ha Hoa district, Phu Tho province had been completed and planned to implement as pilot testing in the year.

### *Large Biogas Plants*

Altogether two LBPs were constructed in Nam Dinh province meeting 100% target of the project. The LBPs are made from HDPE for large livestock farms. However, these biogas plants are not functioning well especially maintenance is the major issues. Most of the HDPE were tear out due to storm, gas leakage and low investment from the owner. Technological issues are also some of the constraints that the owner is not able to get support on time.

As the biogas generation is not fully utilized, the owner still does not see the importance of biogas use. The biogas use is limited to cooking only as compare to volume of biogas production from LBPs. Main grid supported power is commonly used by these farms resulting to low biogas use. Overall this has resulted to low importance of LBPs. In addition, most of the LBP owners are still not keen in the effective bio-slurry and effluent use and there are no effective fertilizer and compost productions. With the lack of end use of the by-products from LBP installation (biogas and effluent use), LBP operation and maintenance is in limbo.

A comprehensive biogas and bio-slurry/effluent use program is necessary with clear understanding by the owner attracting the investments.

Overall LCASP contributed a favourable environment in biogas plants development as ADB Review Mission noted that “benefit and impact from SBP observed especially environmental



improvement and socio-economic conditions". Farm size also increased beyond 5-10 pigs<sup>2</sup>. Overall the biogas plants need to combine with separators and generators for integrated waste management solutions.

The investment cost for the construction of MBP and LBP ranges from VND50 to VND100 million. Intended National Determined Contribution (INDC) is VND10 million for MBP and VND20 million for LBP. This low incentive of INDC is not attracting farming households to install MBP and LBP.

Lack of planned biogas use as compare to high gas production is not attracting the farming households and they need a comprehensive program for medium and large scale biogas plants.

Most of the masons are experience on SBPs and very low experience on MBP and LBP. So the investing farming households are not confident to invest in these biogas plants. In addition, maintenance of HDPE is another issue. Most of the LBPs are not effectively maintained in the project provinces.

Subsidy amount has been increased to VND50 million for MBP after MTR in September 2016. This ICMD should made available only for the full use of the biogas produced. It also strongly encouraged for industrial sized farms to install MBP and LBP.

Biogas plants management database is complicated. LCASP worked closely with NBP where DSTE was also involved. LCASP is supporting NBP on selling of carbon credit to potential markets. LCASP pursued to be focal point on carbon credit (biogas) in the country but still need to function.

### **Technical Issues**

#### *Overloading of Bio-digester*

Over loading of the digester was encountered by the farmers mainly due to over feeding of animal waste to digesters due to increase in the number of livestock as compare to the suitable number of livestock as envisaged at the time of bio-digester design. The case differs by project province to province where some of the provinces do not encounter such issues. So the issue is solely depends upon the number of livestock instead of bio-digester design flaws.

To overcome such issues, additional sedimentation tanks are built before and/or after biogas digester. Where the number of animals increased, the farmers continued to feed all wastes to the digester creating unwanted overloading of the digester. If the bio-slurry is not properly digested that will emit GHG creating adverse environmental problems. Additionally, gas production will be low with high sulphur content and low CH<sub>4</sub> concentration. In extreme case, gas quality and gas production will be very poor as fuel<sup>3</sup>. Volatile fatty acid (VFA) convert the organic matter to methane and methane will increase if overloading occurs. Technical designs with various options were made and pilot testing had

<sup>2</sup> ADB Mission, March 2018

<sup>3</sup> International CSAWMP Specialist, Mission Report, March 2018

been proposed in Phu Tho, Bac Giang, Nam Dinh and Son La. Though the pilot designs were completed, however, the implementation was delayed. The result of the testing is still waiting and can assess the efficiency of the technical intervention to overcome overloading. This design can adjust a suitable amount of waste water discharging into biogas plant applying technology to filter solid waste from bio-slurry.

There is also an innovative technology testing in Nam Dinh addressing overloading of MBPs. A pilot model included 4 to 6 sedimentation tanks with a total volume of 24 m<sup>3</sup> for a farm size of 1000 pigs. Two storage tanks of volume 10 - 15 m<sup>3</sup> for biogas effluent treatment will also build behind the biogas plant. However, it still needs to restructure the system for effective solid waste removal, and effluent treatment tank behind the biogas plant is small.

#### *Biogas Use*

Demonstrations are to be implemented for effective bio-slurry use. However, the most of the demonstrations are not yet implemented and have to see the conversion of livestock waste to fertilizer production and biogas production. At the end result, there will liquid bio-slurry to use as liquid fertilizer. The technology has not yet developed well spreading the bio-slurry as fertilizer in terms of nutrient contents and value. Depending upon the terrain some farmers used drip irrigation by gravity supply.

Though the MBPs are installed but there is no proper mechanism to use the biogas production. There is only partial use of the biogas production and rest are emitted to environment. The only option to restrict the emission to environment is the flaring. There are some biogas owners who sell the gas to neighbours.

The gas should be used for heating lamps for piglets, alcohol production, feed preparation, bio-generators and others.

Sulfer cleaning is essential to use the biogas for power production. It protects the engine lifetime. Amount of gas use is high in Ben Tre (more than 50%) (500-100 pigs) and it varies from below 10% to 100% in Lao Cai and Phu Tho. Gas consumption in Nam Dinh is below 30%. Generally, LCASP gas use is below 25%.

Biogas production and the gas composition are important to assess the performance and efficiency of digesters.

Dimension of the digester size per animal plays a major role. Digester size should be 0.5 m<sup>3</sup> to 1 m<sup>3</sup> per animal with the sulfur content as the function of digester size.

### **III.2 Biogas Use**

Biogas energy is mostly used for cooking in rural farming households. Having clean energy it had contributed to improvement of women health and labour saving contributing to low pressure to forest products utilization. However, biogas use is still at primary level in Vietnam.

LCASP supported the livestock farming households with capacity building, proper communication and information with field assistance. Benefits and investment opportunities are widely discussed and exposed to understand by participating farmers. The report on biogas power generator “calculation of capacity and cost-benefits” that provide a basis for the selection of effective gas utilization from small and medium biogas plants including technical and economic analysis was helpful and contributed to decide on the biogas installation by the farmers.

Women in the family played a vital role on the biogas installation decision recognizing the direct benefit to family, especially women. In general, O&M of SBPs and MBPs are well maintained by women family of the households.

Simplified biogas production calculation and alternative fuel solutions were provided with a set of indicators to guide PPMU including templates for calculation of daily biogas production and consumption by different utilization were also prepared. Such templates were followed in Lao Cai, Son La, Ha Tinh and Binh Dinh provinces.

It is recommended to farmers to use infrared biogas lamps to warm piglets and young poultry. Lamps are manufactured in Vietnam with reasonable price; however, its use is still low. Using the industrial biogas stoves to cook animal feed is efficient contributing to short cooking time. Some of the households still use stoves without pressure gauges that should be avoided.

Livestock waste has not been properly treated, especially liquid fraction. Many biogas plants, especially medium and large one are releasing gas into the environment.

### ***III.3 Biogas Generators***

Ben Tre demonstration on small bio-engine and electricity use for heating and cooking is an innovative solution to livestock waste management. ADB recommend disseminating such successes. The packages should be integrated for best practices for livestock waste management.

The project made positive impact on the environment improving livestock waste management practices at household level and community levels. ADB mission noted that there are some improvements on environment from the project. Bio-slurry treated through sedimentation tanks and/or use of bio-slurry as fertilizer could not meet with the national standard No. QCVN 62-MT: 2016/BTNMT, regulated for quality of livestock effluent and QCVN 08-MT-2015/BTNMT, regulated for quality of surface water. It still needs to review for effective implementation.

### ***III.4 Manure Separators***

Mechanical screw press separators selected in LCASP, Cri-man (Italian) and Bauer (Austrian) were selected. These separators are very reliable and cost efficient, however, “the efficiency

is high only when treating slurry with a dry matter at 6% or above”<sup>4</sup>. The challenge to meet the dry matter of 6% or above in the Vietnamese condition is the fact that pig liquid slurry is very dilute, dry matter content of less than 1%, due to high use of water for pig washing and cooling. To get the dry matter at desired level for the manure separators, sediment tanks have to install for natural sedimentation.

Suspended solids in the liquid can settle with the greater density than the liquid. There are dissolved solids and suspended solids in the dry matter where only suspended solids can settle.

Sediment tanks are preferred generally longer and narrower. There are pre-sedimentation and main sedimentation tanks (Ben Tre). The dimension of the pre-sedimentation is 1m x 1m x 0.9m and main sedimentation tank is 3m x 3m x 2.7m.

At the moment, average daily water use is about 25 to 45 m<sup>3</sup> and loaded to the sedimentation tank with a detention period of 1 to 1.9 days, higher than the recommendation. It shows that the sedimentation tanks are too big as compare to a number of pigs and pre-sedimentation tank is not necessary.

In Bac Giang, sedimentation tank (rectangular shape with 2 chambers) is 6m x 2.5 m x 3.5m. This is used for sedimentation and separation of solid manure. The amount of manure is for the farm is 43 m<sup>3</sup>/day giving 11.1 hour detention period which is higher than the recommendation but still at reasonable level.

**Table 1: Comparison of Manure Separators (LCASP)**

Information	Cri-man Manure Separator 260/50Mini	Baucer Manure Separator
Capacity	5-8 m <sup>3</sup> /hour	15 m <sup>3</sup> /hour
Screen Size	0.5 mm	0.5 mm
Engine maximum capacity	3 Kw	3 Kw
Materials treated	0.20 kwh/ton (treatment capacity of 7 m <sup>3</sup> /hour and 50% of engine capacity used)	0.21 kwh/tons (treatment capacity of 10 m <sup>3</sup> /hour and 70% load)
Materials treated (1.5 kw for pump and mixing in average)	0.4 kwh/tons	0.46 kwh/tons

Separation efficiency is important to consider for the best result. Some of the parameters to calculate separation efficiency are weight of separated solid phase, concentration of component in fraction, dry matter concentration in %, liquid slurry weight (kg) and concentration of component in liquid slurry and dry matter concentration in %. The maximum efficiency for dry matter by sedimentation will be about 80%. Conversely, a separation efficiency of more than 35% is not realistic. Factors influencing the production of solid fraction are

<sup>4</sup> International CSAWMP Specialist, Mission Report, March 2018

1. Efficiency of sedimentation and separation
2. Amount of dry-matter produced in the farm
3. Dry-matter concentration in the solid fraction

Sedimentation efficiency depends upon particles retained in the sediment tank. Separation efficiency depends on the dry-matter concentration in the sediment tank, which preferably should exceed 6%.

In Vietnamese conditions, the amount of faeces and urine are about 2.5 kg per animal (50 kg average weight) per day with average dry matter content of 10%. A measurement in Bac Giang on the amount of the solid fraction showed that one farm is on 30% line and other farm is way above the line indicating efficient separation.

Sediment tank should be built on the basis of the farm size instead of uniformity in all sizes of farms. Sediment tanks should be 3 to 5 times longer (length and depth) than the width (for 1000 fattening pigs with average weight 50 kg).

Already built bigger size tanks compare to the number of animals, addition of organic bulk materials should be added to increase the solid fraction and making suitable dry matter concentration for separation in the sedimentation tanks (2 or more times per week). Bulk material could be straw, rice husk, sawdust, coconut residues could be added in the tank.

A model for calculation of separation efficiency has been developed in Excel.

### III.5 Bio-slurry and Effluent

As of DMF target, LCASP have to convert 70% of bio-slurry to organic fertilizers. Several research and demonstrations are designed to test and demonstrate on low carbon agriculture waste management practices in Vietnam. Demonstration by manure separator application (Package 32) already started in the project provinces. Rest of the research and demonstrations are still under process to implement.

There are 38 composting plants in Vietnam, highest in HCMC (13 in number). Only Binh Dinh, Phu Tho and Soc Trang do have such plants under LCASP provinces<sup>5</sup>.

The farmers have small land holdings and need to take bio-slurry to other farms or sell to big farms. There is transport restriction as well by environmental law. There is also legal barrier to use bio-slurry to use as liquid fertilizer for crops. Bio-slurry use depends upon type of crops cultivated, amount of crop rotation per annum, climate conditions and others. Nitrogen uptake by a crop is less than 500 kg/ha/year. The estimated amount of nitrogen excreted by one pig is 0.05 g/day. Minimum area needed is 500 kg per ha.

In project area the bio-slurry is used for crops such as vegetables, fruits pomelo and orange, grass, elephant grass, Bio-slurry is not used in the rice cultivation.

For irrigation, bio-slurry is mixed with water let through pipes by the gravity to nozzles.

---

<sup>5</sup> Final report, Financial Business Planner Specialist June 2017

#### IV. Research and Demonstrations

Low carbon agricultural waste management practices related research and demonstrations were identified since early 2016. CPMU in consultation with the Department of Science, Technology and Environment (DSTE) developed a research strategy which included 77 research topics with the research activities to be carried out by MARD's research institutes. With detailed scoping and identifying the research gaps in the agricultural waste management, research and demonstrations topics were identified with the target areas in the LCASP provinces. Seven topics of the research agenda are as follows.

**Table 2: List of Research Topics**

Package	Research
25	Research on organic fertilizer production from livestock waste and bio-slurry by value chain
26	Research on improved technology and effective biogas utilization within the biogas value chain
27	Research on the water saving pig farming technology
28	Research on effective utilization of crop waste by value chain
29	Research on the treatment of sludge sediment in shrimp farming
42	Piloting technology for special designed organo-mineral fertilizers production from livestock waste and bio-slurry for key crops in Vietnam
43	Establishing comprehensive system of production and supply of microbial activators for organic fertilizer production from agricultural waste and bio-slurry

With the revision of the TOR and NOL release, the research packages are still at the implementation stage. First three packages had been awarded to implementing agencies, however, actual ground work still need to be undertaken.

Contrary to the research packages, demonstration on manure separators (Package 32) has been implemented with the installation of manure separators. Other demonstration packages (Table2) are still under implementation process. Manure separator is described in section 3.4.

**Table 3: List of Demonstration Topics**

Package	Demonstrations
32	Supply of manure separating system to treat livestock waste to produce material for organic fertilizer demonstration
33	Supply of manure separating system to treat livestock waste to produce material for organic fertilizer demonstration
34	Supply of biogas generator and manure separating system for comprehensive management of livestock waste demonstration
35	Supply of mobile manure separating system to treat livestock waste to produce

	material for organic fertilizer demonstration at household scale
36	Supply of biogas generator system for demonstration
37	Supply of utilization system for treatment of biogas digested effluent demonstration as the fertilizer of the crops
38	Supply of utilization system for treatment of cattle dung as the feedstock for red worm raising demonstration

Research and demonstrations are site specific technological testing to overcome various technical challenges resolving technical issues. With the participation of the farming households, the adaptive research and applied demonstrations are closely interact with the participating households for effective result to scaling up. Due to last year of the project for such undertaking in 2018, the LCASP lost the opportunity to scale up and wider application of the technological interventions. In case of research, there must be at least two iterations for the best research results.

#### V. Environmental Monitoring

Regular environmental monitoring was followed with physical observation during the project period. Environmental monitoring by random check is kept to 5%, however, it exceed to 7.8% (GoV/ADB MTR). Biogas plants especially SBPs are robustly maintained with safety and technical efficiency. Some codes are not visible or damaged, and information is not correct to update database.

There are 35 analysis indicators according to National Livestock Environment Standard of Vietnam after the biogas treatment. Amount of CO<sup>2</sup> emission per 1 m<sup>3</sup> of LCASP biogas digester is 0.54 ton.

No environmental equipment were used due to lack of availability (Package 14 on the environmental equipment purchase is still in the process). Environmental monitoring equipment consists of mobile and stationary equipment for water and air quality testing. Sometime Geotech 5000 analyzer was used to measure the gas quality but not on a regular basis. The environmental monitoring was carried out by PPMU staff with the support of CPMU and LIC. Six-monthly environmental monitoring reports were provided to ADB on a regular basis.

Environmental assessment should focus on reduction of livestock effluents to the water sources, improving livestock waste management practices, reduce agricultural pollutants and GHG emissions. Awareness generation and capacity building are equally important to farming households, technicians and general public.

LCASP database is through NBP after the purchase of the software. The carbon credit is by central government instead of LCASP separately. It still needs to secure CER credits for biogas plants supported by the project.

With the 49 MBPs to install during the project period, IEE is necessary to complete on time with effective environmental mitigation measures. Technical assistance with training to staff of CPMU and PPMU; and orientation of Provincial Coordinators were provided. A model IEE of Binh Dinh province was approved by ADB where other provinces also followed the IEE in the same model.

However, the progress is slow mainly due to

1. Frequent change of MBP sites due to fluctuation of number of livestock
2. Change in the interest of the investment by the owner
3. Site feasibility related issues and frequent design change

Overall environmental monitoring and IEE preparation are slow and need to complete at a desired level.

## **VI. LCASP Contributions to LCAWM**

A milestone has been achieved by LCASP in the installation of SBPs in the project provinces. More than 50% of the target had been met in the installation of biogas plants of various sizes. All the plants are efficiently used with safety and maintenance. Women member of farming households are keenly involved in the maintenance and operation of the biogas. Sanitation around some of the plants is still an issue. Whereas project funded LBPs lacks maintenance and now not in operation, MBPs installation is still in progress. Though number issues are faced that are resolving in due course of time, however, given the time constraints of the project period, MBP installation target should be completed rapidly.

LCASP biogas plants are now tied up with NBP database with regular update. LCASP biogas plants are recorded with coding system developed by NBP that was also followed by SNV and LIFSAP.

Capacity building to farming households and technicians are followed on biogas construction, operation and maintenance of various sizes and models with guidelines and other materials. Efficient construction of SBPs with safety measures are result of the effectiveness of the training. Training materials with various communication productions (Hand books, brochures, leaflets, technical books, posters, billboard, radio and TV) are supported to stakeholders. A number of technical documents are prepared and disseminated during the project period. Though the implementation of research and demonstrations are still behind, training on CSAWMP is conducted targeting to farming households and technicians.

Overloading issue of SBP and MBP was addressed with the innovative technical intervention and pilot tested. Testing results are still in waiting due to late implementation and it is hoped that these technical interventions will contribute to overcome the overloading issues. Bio-slurry use is generally applied but there are many constraints in its applications due to environmental regulation, small farming size and lack of knowledge on bio-slurry use. Water



use in pig raising is high in Vietnam while it should be limited to 30 litre/head/day. This has created not only dilution of the effluents but also overloading of bio-digesters.

With DMF target of at least 70% bio-slurry to be converted to organic fertilizers, a sample data have to be collected in the project provinces assessing bio-slurry use converting to organic fertilizers. Some of the farming households already started dry manure production.

Biogas use is commonly for the cooking with some animal heating purpose and feed cooking. The gas is also used for brewery and alcohol making. Biogas generator use is very low and not much popular among the households mainly due to corrosion from sulfur. More biogas will generate once 49 MBPs will be installed and it will be a challenge for the effective utilization of the biogas. Having short balance of the project period, research and demonstrations should be expedited for the result application for biogas effectiveness to meet “at least 80% energy produced by Biogas Value Chains (BVCs) is utilized”.

Major activities with the implementation of research and demonstration took a longer time period than expected. With the remaining balance of the project period, implementation of research and demonstration packages period is getting short. There must be two iterations in the research application for a satisfactory results and its application.

Environmental monitoring is commonly conducted by visual observation without the support of environmental monitoring equipment. Provision of such equipment is far behind though the purchase award has been already completed (Package 14). Very few MBPs are installed so far and so as the IEE of each MBP have to complete on time mitigating the environmental issues.

Baseline survey, project physical auditing, BVC credit market study and business planning and finance study, and policy and institutional study had been completed. e-library and distance learning establishment contract had been awarded, however, its approach and server related issues are still some of the issues faced.

## Appendix 2: Evaluation of livestock waste treatments in Bac Giang and Son La

### 1. Solution of livestock waste treatment in Moc Chau district, Son La province

#### 1.1 Manure separators

Currently, manure separators were installed in 20 dairy farmers in Moc Chau District. These are made-in-China machines and the separation rate is from 15-20%. According to the survey, on average one cow produces 35 kg of waste per day, in which solid waste accounts for one third; the total amount of waste collected 4 times in one day is about 7 m<sup>3</sup>.

The waste collected into the pit was separated by the separator. After separating, the probiotics was used to mix into the output for 21 days, then bagged and sold with the price of 2,000 VND/kg. The untreated manure was sold with the price of 1,500 VND/kg. The organic fertilizer was sold quickly upon requirement of cropping season. Until now, the machine has been working normally.

In addition to separators, these households have biogas tank to collect liquid waste after separation. Biogas was used for cooking.

#### 1.2 Composting tank

This solution was handed-over by the Institute of Agricultural Environment. Solid waste was collected and brought to the composting tank. Compositing time was 30-45 days.

Solid waste was collected manually then transferred to a solid waste tank (30m<sup>3</sup>) and mixed with probiotics. Manure was composited for 3 months for sale. The compost price was 300,000 VND/ m<sup>3</sup>. Liquid waste was put directly into the tank and then flowed to the treatment tank. The waste was treated with EM then flowed to the air compressors tank. The waste was stored in the air compressor tank for 7 days then flowed out to the canal for irrigation.

The use of solid waste/compositing tanks took a long time, take several times on stirring, the price of compost was low.

### 2. Solution of livestock waste treatment in Bac Giang

According to assessments by localities, crop residues were mostly burnt in the field (80-90%), the rest was used for chicken raising and mushroom planting. Therefore, the most concern was the management of livestock waste. Common management measures being applied in the locality include: livestock waste was used to feed the BP, a small part was used to produce organic fertilizer (10%), directly put into fish ponds or for farming (chicken manure). People have not paid attention to the use of organic fertilizer due to the lack of labor, high cost and the economic efficiency did not match the cost. Most of the people who have biogas plants fed all livestock waste into the plants, thus causing environmental pollution due to overload. Biogas was not used up and was discharged into the environment. Liquid waste was discharged into the ditches in the village. According to the province's proposal, in order to encourage people to use livestock waste to produce organic fertilizers, the state should issue the policies like agriculture extension or support farmers to

apply water saving technology, or encourage the construction of biogas ditch systems to collect wastes after biogas and treat them before discharging into the environment.

In order to apply effective livestock waste treatment solutions, the LCASP has assisted Bac Giang province in implementing several models applying separators. The delegation has visited 3 pig farms using Austrian separators supported by the LCASP project. These separators were installed in December 2017 and were working well. All these farms applied pig raising using water saving (17-20 liters of water per day per head), resulting in high manure separation efficiency. Waste collected was put into the tank, then put to the separators.

After separation, manure were packed and sold to the farmers with prices ranging from 800-1,200 VND/kg. In Truong Thanh Farm, the compost was prepared with Tien Long 1 probiotics for 45 days in a composting tank with aeration system. The compost was packed in bags and sold to Yen Dung Vegetable Cooperative with the price of 2,000 VND/kg. On average, Truong Thanh Farm produced 18-20 tons of organic fertilizer per month. The farm would like to apply for product certification to sell this fertilizer to the market, however the cost of certification is very high. The company has discussed with Thai Nguyen University of Agriculture and Forestry on the cooperation to produce of organic fertilizer with the standards of organic fertilizer produced by Thai Nguyen University of Agriculture and Forestry. However, the license fee is of 100,000VND / ton.

The above data showed that the manure after separated if not mixed with probiotics was sold with the price of 800 -1,200 VND/kg, if mixed with probiotics and directly sold to the people with the price 1,500 VND/kg and if it was composited and contracted with a company, the price can be higher 2,000 VND/kg.

The above pig farms all had biogas plants; the gas was used for cooking, some surplus gas farms was shared to surrounding households.

### **3. Comments and recommendations**

#### **3.1 Comments**

Via field surveys in two provinces, LIC would like to present following results:

- Active activities in livestock waste control/management:
- + Livestock waste control has received concerns of different levels: state management agencies, husbandry farms, farms, companies.
- + The use of manure separators to produce compost has brought effectiveness to farmers. The production was consumed which showed promising market for compost. The households chose to buy Chinese machines due to its low price, no technical problem found so far, although the separation efficiency was only about 15-20%. The LCASP-assisted separators imported from Austria supporting large scale livestock farms in Bac Giang have been installed and operated efficiently.
- + With the application of separators, after separating, liquid waste flowed into the biogas plants, helped reducing overloaded biogas and excess gas.

- + Pig raising households using the LCASP separators can control the amount of water used for pig bathing, and the amount of water used for washing was 15-18 liters / head / day.
- Problems in applying technology in livestock waste treatment found through field surveys:
  - + The investment in separators was not suitable with the scales of farms, for example the number of pig was not enough for efficient machine operation. Operating time was also not standardized to improve the efficiency.
  - + The installation of separator should be convenient for separating automatically into each bag instead of stacking; this will cost a lot of labor later for bagging; spraying probiotics can be added together when bagging.
  - + About compost production: small-scale compost production is difficult to control in terms of quality; the sources of probiotics are almost uncontrolled in terms of origin and biological effect.

### **3.2. Recommendation**

- In terms of policy
  - + Manure separation is a new technology and advanced, but to operate the machines effectively, it is recommended to increase amount of solids in the waste and no later than 4-5 days. It is recommended that CPMU instructs contractors to design ancillary works for effective operation of separator.
  - + European separators are of high quality, but the prices are too high compared to the financial capacity of livestock and farms, so it is necessary to support interest rates or form group of HHS as proposed by Moc Chau Dairy Joint Stock Company.
  - + The production of organic fertilizer in households or farm is of low effectiveness because of low connection to businesses. Obstacles here are the collection and transportation of raw materials from livestock farms to high-cost organic composting companies as well as the regulations on the transportation of unprocessed animal manure. Therefore, it is necessary to have policies to solve these obstacles and create conditions for households and farms to connect with organic fertilizer producers.
  - + The gas sharing model for is an effective model, so policy should be developed to support this model extension. However, there should be a mechanism to manage the fire and explosion so that gas can be shared safely.
  - + The practice shows that the use of bio-slurry to irrigate plants has gained good results, however at present there is no technical standard for this liquid fertilizer as well as policies encourage the utilization waste, so most of the current waste flows into the environment, causing pollution.
- Some suggestions on technology application
  - + About compost: the micro-organism supply system should be established to serve the production of micro-organism compost/bio-organic compost and to improve the composting tank technology.

- + Pig raising applying water saving method: In order to limit the amount of water for pig bathing, it is recommended to design the 2-3 level stables with the lowest level installed with faucets, due to pigs' behavior (pee right after drinking and go back to high level to rest). This design will help limiting the amount of water, one discharge and two waste cleaning per day.
- + About manure separator: Before installation, a field survey should be conducted so after the manure separated, it can be put in bags, reducing labor for packaging. An additional unit can be installed to spray probiotics to the bags. The machine using time should also be optimized.
- + The research package should give priority for development of water saving technologies and solutions for waste collection and treatment, especially liquid waste used for plants.
- + The model of mobile manure separator is feasible, so it is recommended to research.