Project Administration Manual

Project Number: 45406
Loan Number:
October 2012

Socialist Republic of Viet Nam: Low Carbon Agricultural Support Project

Contents

Abbreviations

ADB	=	Asian Development Bank
ADF	=	Asian Development Fund
AFS	=	audited financial statements
AP	=	affected people
APMB	=	Agricultural Projects Management Board
BVCM	=	biogas value chain management
CEA	=	Committee for Ethnic Affairs
CPMU	=	Central Project Management Unit
CQS	=	consultant qualification selection
CSAP	=	Climate Smart Agriculture Practices
CSB	=	commune supervision board
CSAWMP	=	Climate Smart Agricultural Waste Management Practices
DARD	=	Department of Agriculture and Rural Development
DLP	=	Department of Livestock Production
DMF	=	design and monitoring framework
DONRE	=	Department of Natural Resources and the Environment
EA	=	executing agency
EARF	=	environmental assessment and review framework
EGM	=	effective gender mainstreaming
EIA	=	environmental impact assessment
EMDP	=	ethnic minority development plan
EMP	=	environmental management plan
ESMS	=	environmental and social management system
GACAP	=	governance and anticorruption action plan
GAP	=	gender action plan
GDP	=	gross domestic product
GHG	=	greenhouse gas
IA		imprest account
IARS	=	imprest account reconciliation statement
ICB	=	international competitive bidding
IEE	=	initial environmental examination
IPPF	=	indigenous people planning framework
LIBOR	=	London interbank offered rate
LBP	=	large biogas plant
MARD	=	Ministry of Agriculture and Rural Development
MBP	=	Medium-sized biogas plant
MOF	=	Ministry of Finance
MONRE	=	Ministry of Natural Resources and Environment
NCB	=	national competitive bidding
NGOs	=	nongovernment organizations
PAM	=	project administration manual
PIU	=	project implementation unit
RRP	=	report and recommendation of the President to the Board
SBD	=	standard bidding documents
SBP	=	small biogas plant
SOE	=	statement of expenditure
TSU	=	Technical support unit

I. PROJECT DESCRIPTION

A. Project's Rationale, Location and Beneficiaries[1]

1. Viet Nam's agriculture sector constitutes approximately 20% of gross domestic product (GDP), 25% of exports (2010), and provides employment for 70% of rural households.[2] Livestock's share of the agriculture sector increased from 19.3% in 2000 to 27.1% in 2009. The number of farmers and medium to large scale enterprises raising livestock is steadily increasing. This growth is contributing to economic prosperity as well as poverty reduction in rural communities. However, livestock production, is seriously stressing the environment. Discharging untreated livestock waste carries high levels of pathogens which pollutes water resources; endangers both human and animal health; and emits greenhouse gases (GHG).[3] Furthermore. in Viet Nam, agriculture is the highest contributor of GHGs (50%), followed by energy (25%); forestry (19%); and industry (4%). In terms of agricultural activities, the highest source of GHG emission is rice cultivation (45%), followed by livestock raising (35%).

2. The Government of Viet Nam (the Government) intends to progressively adopt climate-smart agricultural waste management practices (CSAWMP) by promoting the use of biogas plants to treat agricultural and rural household waste. Properly constructed BPs have important benefits by (i) reducing human and livestock disease outbreaks; air, water and soil pollutants; and firewood consumption; (ii) increasing savings of time and money, quantity and quality of organic fertilizer use, and access to rural income-enhancing carbon credit schemes; and (iii) producing biogas that can be used as renewable clean energy (gas and electricity); as well as bio-slurry, a clean organic fertilizer. Transformation of agricultural and rural household waste into clean energy and fertilizers through the use of biogas plants is referred herein as the biogas value chain (BVC).

3. Viet Nam has about 8.5 million farmers and 21,000 enterprises raising livestock. However, of the waste produced from livestock, only 3% is used as organic fertilizer and 15% is used to produce biogas. Biogas plants are commonly categorized by the size of their digesters: (i) small biogas plants (SBPs) are up to 50 cubic meters (m^3) in size; (ii) medium biogas plants (MBPs) are 51–1,000 m^3; and (iii) large biogas plants (LBPs) are greater than 1,000 m^3. The number of farms with SBPs increased from about 2,000 in 1990 to 500,000 in 2010. However, this is still well below the government's target of two million SBPs and 21,000 medium and large biogas plants (MLBPs) by 2020. For the 21,000 livestock enterprises, less than 1,000 MBPs and LBPs have been constructed. In the ten Project provinces, it is estimated that 162,350 SBPs, and 167 MBPS and LBPs have been constructed. This only accounts for an estimated 11% of the MBP and 3% of the LBP market potential. Also, no MBPs or LBPs have been constructed in Ben Tre and Tien Giang Provinces; and in Binh Dinh Province, 77% of livestock farms are without biogas plants. The progress in meeting the government targets for biogas plants is constrained by (i) lack of affordable medium- and long-term financing for building livestock waste management infrastructure; (ii) inadequate CSAWMP knowledge transfer and development; and (iii) poor CSAWMP uptake.

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[1] The project preparation was funded by technical assistance attached to ADB. 2009. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the Socialist Republic of Viet Nam for the Quality and Safety Enhancement of Agricultural Products and Biogas Development Project*. Manila (Loan 2513-VIE).

[2] Sector Assessment [RRP Linked Document (LD) 3] and the Country Economic Indicators (RRP LD8).

[3] GHGs arising from agri-waste mainly comprises of methane (CH_4, 60-75%) and carbon dioxide (CO_2, 33-19%). CH_4 is 21 times more potent than CO_2, but compared to other hydrocarbon fuels, burning methane produces less CO_2 for each unit of heat released (International Fund for Agricultural Development. 2008. *Livestock and Climate Change.* Rome).

4. The project completion report of the Efficient Utilization of Agricultural Wastes Project in the People's Republic of China demonstrated that biogas plant investments are viable over the 6 years of project duration, as lower energy costs and greater use of organic fertilizers boosted household incomes by about 86% (or about 15% annually).[4] In Viet Nam, households using SBPs can save about $168 million annually on fuel. Savings accruing from the use of bio-slurry instead of chemical fertilizers are also substantial, but vary with farming systems and management practices. The Viet Nam Biogas Survey 2011, conducted by the Biogas Program Development funded by the Netherlands Government, noted that the biogas plants also yielded social, environmental, and health benefits for rural communities.

5. The Project objectives are fully aligned with the government's Third Socioeconomic Development Plan 2012-2015, which promotes resource sustainability. The Five-Year Plan for Agriculture Development, 2011–2015 of the Ministry of Agriculture and Rural Development (MARD) prioritizes programs to better control livestock disease and improve natural resource management. The project supports MARD's Action Plan on Climate Change, by strengthening adaptation and mitigation measures. The relevant policy frameworks addressed by the project include National Environment Strategy (2001–2020) and National Target Program on Economical Use of Energy (2006-2015). The project is consistent with the Asian Development Bank (ADB) country partnership strategy, 2012–2015, and is included in the country operations business plan, 2012–2014, which envisage continuing support to conserving and sustainably using natural resources as well as climate change mitigation.[5] ADB's 'Energy for All' initiative will give technical inputs to project design and implementation relating to the project target to increase access to energy for rural areas.

6. **Lessons learned.** The project design incorporates lessons from the experiences of ADB and other development partners in Viet Nam and other countries.[6] Based on these experiences, the project introduces updated biogas technologies and business models suitable to Vietnamese conditions. Assessments of credit lines and capacities of financial intermediaries to deliver credit for financing biogas plant construction showed that it will be desirable and feasible to use financial intermediary networks to deliver predictable and affordable financing to eligible project beneficiaries.[7]

7. Key lessons learned from the experience of these and other projects include: (i) SBP construction technology is well-established, but there is need to improve BVC management (BVCM) to realize the full potential economic and environmental benefits; (ii) technical guidelines and procedures should be simplified to facilitate timely subloan approval and disbursement; (iii) access to credit improves the livelihoods of project beneficiaries with significant increases in income; and (iv) there are pros and cons on charging market interest rates to farmers for agriculture and rural investments. The previous and ongoing projects show that the market interest rate does not constrain farmers from investing in BPs, timely access to credit and technical know-how are the main constraints. The key lessons have been incorporated into Project design, as further elaborated in paragraphs 8 and 9 below.

8. The biogas plant design has been improved by including an environmental package as an additional value chain infrastructure. It includes installation of foot baths to reduce

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[4] ADB. 2010. Completion Report: *Efficient Utilization of Agricultural Wastes Project in China.* Manila.

[5] ADB. 2012. *Country Partnership Strategy: Viet Nam, 2012–2015.* Manila; ADB. *Country Operations Business Plan: Viet Nam, 2012–2014.* Manila.

[6] Development Coordination (RRP LD 6).

[7] Assessments of Credit Lines and Financial Intermediaries (RRP LD 16).

transmission of disease organisms into farm areas, improved livestock drainage sewers, installed storage tanks to hold the bioslurry before applying it to the fields as organic fertilizer, and facilities to fully utilize the potential surplus of gas and electricity. The Project also introduces a credit line to finance construction of MLBPs. Technical guidelines have been simplified to facilitate timely subloan approval. The guidelines are contained in the Appendix, Guidelines for Biogas Value Chains and have been cleared with the Government and financial intemediaries before signing the Loan, Project and Subsidiary Loan Agreements. Access to credit for beneficiaries has also been improved through the following ways: (i) financial intermediaries have agreed to offer more flexibility in collateral requirements such as accepting one collateral in the form of group guarantees, or for several loans; (ii) the sub-borrowers can freely choose trained masons and recommended contractors to construct BVC infrastructure and issue compliance certificates, etc.; and (iii) charging market interest rates is not an issue for farmers because there is now increased flexibility in collateral requirements, which was one of the primary stumbling blocks for farmers taking up loans in previous projects, not market interest rates.

9. **Coordination with the Netherlands Government's biogas program.** The coordination efforts with other donors' funded biogas projects will also be improved, especially with the Biogas Development Program (BPD) funded by the Netherlands Government. Unless otherwise agreed by ADB and the Government (following discussions between MARD, ADB, the Netherlands' Government, the World Bank and other stakeholders), as required in the on-going Quality and Safety Enhancement of Agricultural Products and Biogas Development Project (QSEAP), the project shall utilize the database originally developed by the BPD. This database provides a comprehensive tracking mechanism to ensure coordination and accountability for biogas related investments and provides associated evidence needed for accessing carbon markets. LCASP will utilize this existing common database for the entire project duration. In addition, it is agreed that unless otherwise agreed by ADB and the Government (following the discussions referred to above) this database shall be put into immediate use for all ADB supported biogas projects including QSEAP. Further refinements in the database (to reflect improvements recommended following the above discussions) shall be made with the prior approval of MARD and ADB.

10. **Coordination and harmonization with other development partners.** Cooperation between the government, ADB and other development partners in the development of a commercially viable market for biogas plants shall be strengthened by promoting a coordinated and market-based institutional arrangement and supporting measures to ensure improved coordination, complementary, efficiency and sustainability of existing and future biogas plant initiatives in Viet Nam. In particular, the Project will ensure that:

(i) a common database for small biogas plants will be used (in accordance with paragraph 9 above);

(ii) the Project shall help to: (a) consolidate, manage and monitor the database described above; (b) encourage the establishment of an institution to act as certifying body for biogas quality controllers; and (c) facilitate nation-wide training to companies and end-users;

(iii) the current project-based subsidy arrangements shall be replaced with a common country-wide incentive for carbon market development (ICMD[8]) arrangement at a uniform market-based rate across the country. If necessary, the rate can be revisited annually and its total value will be based on actual CER/VER market rates and will include both cash support as well as the in-kind value of other program support to the small biogas plant owner (e.g. quality control, training, promotion, other support);

(iv) in the spirit of the "Hanoi Core Statement on Aid Effectiveness", complementarities between biogas plant projects supported by ADB and other development partners shall be explored to ensure that investments do not overlap but instead are complementary, efficient and contribute to a long term sustainable institutional arrangement for the development of biogas plants in Viet Nam. Such initiatives will include facilitating improved cooperation in ensuring complementarities in terms of geographical coverage.

11. Furthermore, the Project will (i) work under the coordination of the Agriculture Project Management Board (APMB) as one umbrella institution; (ii) use one database to effectively monitor the progress and the quality of constructed biogas plants, avoid potential double counting and improve access to various carbon markets; (iii) use the same technicians, masons, training materials to harmonize the programs; (iv) allow beneficiaries from other donors' funded projects to gain access to the credit line under the project; and (v) empower a coordinating entity to work with relevant agencies for sustainable biogas program in Viet Nam.

12. The Viet Nam Bank for Agriculture and Rural Development (VBARD) and Central People's Credit Fund (CCF) are found to have an acceptable loan portfolio quality, with less than 5% overdue outstanding loans and a demonstrated ability to reach beneficiaries. As presented in the completion report of the Tea and Fruit Development Project, $26.5 million of credit (about 88% of ADB loan portfolio) was delivered through VBARD and CCF.[9] These financial intermediaries successfully served 67,314 sub-borrowers, with a 98% repayment rate. In the ongoing ADB financed QSEAP, the same financial intermediaries are delivering $12.1 million of credit.[10] About 43% of the credit was disbursed within a sixteen-month period.

13. The proposed Project will be implemented in the 10 provinces of Bac Giang, Ben Tre, Binh Dinh, Ha Tinh, Lao Cai, Nam Dinh, Phu Tho, Soc Trang, Son La, and Tien Giang. These provinces are selected based upon the: (i) prevailing density of livestock (and hence potential demand for biogas plants); (ii) existence of and support for safe livestock zones; (iii) willingness of the provincial governments to provide counterpart funds; and (iv) complementarity with similar initiatives by other partners.

14. The project impact will be less agriculture-related pollution, as measured by better water quality due to reduced presence of livestock waste effluence. The project outcome will be greater CSAWMP uptake, as measured by increased use of clean biogas energy and organic bio-slurry fertilizers.

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[8] ICMDs are divided into technical compliance for BP construction and compliance with environmental safeguards, budgeted at VND1.2 million and VND 1.8 million, respectively, for each SBP; and certain incentives for MBPs and LBPs as described in detail in the Guidelines for Biogas Value Chains (Appendix).

[9] ADB. 2009. *Completion Report: Tea and Fruit Development Project in Viet Nam.* Manila (Loan 1781-VIE).

[10] ADB. 2009. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the Socialist Republic of Viet Nam for the Quality and Safety Enhancement of Agricultural Products and Biogas Development Project.* Manila (Loan 2513-VIE).

15. The four Project outputs will be: (i) expanded use of livestock waste management infrastructure; (ii) credit lines for biogas value chains; (iii) enhanced CSAWMP technology transfer; and (iv) effective project management. These outputs are described below.

1. Expanded Use of Livestock Waste Management Infrastructure

16. The Project will (i) support construction of about 36,000 SBPs, 40 MBPs and 10 LBPs; (ii) empower biogas plant operators, masons, technicians, engineers, contractors, and biogas relevant agencies to follow good BVC management practices; (iii) promote the transition of BVC management from being led by government to being led by the private sector; and (iv) support the government's efforts to access existing and future markets for carbon credits.[11]

17. To support national policies, strategies and programs aimed at compliance with biogas plant technical and environmental standards, the project will provide to incetives for carbon market development (ICMD) to BVC owners. The provisions of ICMD will accelerate the rate of BVC investments and is consistent with good practice used by development partners involved in similar projects. ICMDs will also stimulate public-private partnership, so that public investment in pollution control measures can leverage greater private investments.

18. The government intends to recover the ICMD outlays from the income earned through carbon markets. The project is expected to reduce carbon dioxide (CO_2) equivalent emissions of 150,000 tons annually. The project will support MARD's existing coordination and management entity to become a viable carbon market coordinator. The entity will work closely with farmer, biogas and other associations to (i) expand the use of a common database, which contains information about BVC owners and those trained to deliver services for the construction and operation of biogas plants;[12] (ii) register biogas plant activities in potential carbon markets; (iii) monitor BVC-generated salable and sustainable carbon credits; and (iv) disseminate guidelines on accessing carbon credits and revenue sharing to BVC owners and other stakeholders. The ongoing QSEAP, in coordination with the biogas program funded by the Netherlands Government, has been exploring revenue from several carbon markets. The Project will also explore access to voluntary carbon markets. [13]

2. Credit Lines for Biogas Value Chains

19. Identified financial intermediaires are not short of liquidity, but their mobilized funds are mostly short term, and they are only permitted to utilize 30% of these funds to finance medium- and long-term loans. The project will provide credit lines through financial intermediaries to small-scale farmers as well as medium-sized and large livestock enterprises to facilitate access to medium- and long-term financing (up to 10 years) to expand and improve BVC infrastructure. The credit lines will enable more rural people to participate in the formal financial system, thus providing opportunities to access credit for additional productive purposes. Linking BVC owners and financial intermediaries is expected to accelerate progress towards achieving Viet Nam's national biogas targets. The proposed credit lines will help familiariaze financial intermediaries with this previously untapped market segment, and promote geographic outreach of financial intermediaries to rural household enterprises. The project will provide appropriate management

[11] A carbon credit is a generic term for any tradable certificate or permit representing the right to emit one metric ton of CO_2, or the mass of another GHG equivalent to one metric ton of CO_2.

[12] The database was created by the Department of Livestock and and is currently used for the biogas development program funded by the Government of the Netherlands.

[13] Carbon Market Assessment Report (RRP LD 17) provides detailed plans for carbon market development in Viet Nam.

and technical capacity building to financial intermediary loan officers to serve this market. Credit lines for BVC infrastructure will initially flow through VBARD and CCF, which are state-owned. Participation of other financiers, including private financial intermediaries, will be explored and encouraged during project implementation. Financial intermediaries will prepare transparent and financially sound criteria for the selection of sub-borrowers to enhance loan targeting and repayment.

3. Enhanced CSAWMP Technology Transfer

20. The project will disseminate established CSAWMP to beneficiaries and research those areas where good practice is not well established. Viet Nam has established CSAWMP in several areas. They are supported by guidelines that are ready for immediate dissemination to enterprises, communes, villages and farmers. The project will improve the skills and knowledge of stakeholders for managing agricultural wastes through dissemination campaigns, commune pilot demonstrations, short training courses, study tours, e-libraries, radio and television programs, DVDs and information posters. Additionally agro-ecological maps will be updated.

21. Some areas of CSAWMP in Viet Nam still require research for specific environmental and geographic conditions. The project will support research activities in two stages by elaborating a research strategy to provide coherent direction to project research activities; and extending research into practice. The project will prepare a CSAWMP research strategy, which will (i) define the government's long-term objectives to manage agricultural wastes; (ii) assess current knowledge and practice, along with relevant institutional issues; (iii) define and prioritize research, dissemination and mainstreaming gaps that need to be bridged; and (d) outline the activities needed to fill the gaps. Accordingly, the project will carry out research and disseminate the findings to practitioners, and mainstream them into standard practice. Research activities may include use of non-livestock agricultural wastes for producing bioenergy and organic fertilizers and application of low GHG emission practices in agriculture (including aquaculture).

4. Effective Project Management

22. The government will provide skilled central and provincial personnel. The project will engage specialist consultants and contractors to supplement technical and management knowledge and skills. Coordination with relevant organizations will be a management priority. MARD will use a project performance management system with sex- and ethnicity-disaggregated data to accurately monitor project progress.

II. IMPLEMENTATION PLANS

A. Project Readiness Activities

23. Table 1 presents the Project readiness activities and its filter is given in Table 2.

Table 1: Completion of Project Readiness Activities

Indicative Activities	2012		2013			Who Responsible*
	Nov	Dec	Jan	Feb	Mar	
Advance contracting actions	X					SEER/MARD/SBV
Establish project implementation arrangements				X		MARD/DARD
ADB Board approval		X				SEER
Loan signing			X			SEER/OGC/MOF
Government legal opinion provided				X		MARD/MOF
Government budget inclusion			X			MARD/MOF
Loan effectiveness					X	SEER/OGC

DARD = Department of Agriculture and Rural Development (Provincial); MARD = Ministry of Agriculture and Rural Development of Viet Nam; MOF = Ministry of Finance of Viet Nam, OGC = Office of the General Counsel (ADB), SBV = State Bank of Viet Nam; SEER = Southeast Asia Department, Environment, Natural Resources and Agriculture Division (ADB).
Source: Asian Development Bank staff estimates.

Table 2: Project Readiness Filters
(as of Loan Negotiations, 15-16 October 2012)

No.	Key Project Preparation Elements	At Project Identification	By Fact-Finding	Status at Loan Negotiation	Remarks
1	Project priority	Included in ODA requesting list	Included in COBP	Agreed by ADB and the Government	
2	Government - PDO	Drafted for Prime Minister approval	Will incorporate updates from FFM-MOU in the revised draft	Approved by the Prime Minister	
3	ADB concept paper	Submission for ADB Vice President approval	Approved by ADB Vice President	Approved by ADB Vice President	
4	ADB RRP and its linked documents	Drafted	Completed, other than the Financial Institution Assessments [and integrity due diligence checklists] which will be completed before Staff Review Meeting	Completed and approved by the negotiation teams both from ADB and the Government	
5	Government – FS	Drafted	Drafted	Approved by the Minister of MARD	
6	ADB – PAM	Drafted	Completed	Completed	
7	Counterpart funds (Government and FIs)	Proposed	Proposed	Committed	
8	Establishment of CPMU and ten PPMUs	Drafted	Drafted and completed before loan effectiveness	Target to be completed by December 2012	
9	Environmental impact assessment, EMDP, Gender Action Plan	Drafted	Completed	Completed	
10	Consultant recruitment	Drafted	Drafted	Processing non-committal based recruitments	

B. Overall Project Implementation Plan

24. The Project will be implemented over a period of six years.

Activity Milestones	2012	2013	2014	2015	2016
LOAN APPROVAL					
LOAN EFFECTIVENESS					
1 Expanded use of livestock waste management infrastructure					
1.1 Train and certify contractor/masons through relevant agencies for construction of BVCM facilities by 2013.					
1.2 Standardize and disseminate design package for BVCM by 2013.[a]					
1.3 Develop training modules for CSAWMP stakeholders by 2014.					
1.4 Register program of activities for SBPs by 2013 and for MLBPs by 2014 for relevant carbon markets					
1.4.1 program of activities for SBPs					
1.4.2 program of activities for MBPs and LBPs					
1.5 Monitor use of biogas plants with adequate environmental facilities by 2018.					
1.6 Strengthen relevant agencies to handover the monitoring of constructed biogas plants by 2018.					
1.7 Monitor annual attributable CO_2 reduction and issuance of carbon revenue from the certified emission reduction by 2018.					
1.8 Provide capacity building to biogas associations to continuously manage biogas development by 2018.					
2 Credit lines for biogas value chains					
2.1 Encourage the selected two financial intermediaries to provide credit lines by 2018					
2.2 Encourage other financial intermediaries to finance BVC management infrastructure by 2016					
2.3 Coordinate training program between CPMUs, PPMUs and financial intermediaries by 2017					
2.4 Monitor the disbursement of incentive for carbon market development through financial intermediaries by 2018					
3 Enhanced CSAWMP technology transfer					
3.1 Organize farmer-based research using biochar and other agricultural wastes as organic fertilizers; applying other efficient low greenhouse gas emission agricultural practices which generate bioenergy; managing waste treatments in aquaculture and other CSAWMP by 2018.					
3.2 Establish an information system, e-library, journals and databse for sharing CSAWMP research and training by 2018.					
3.3 Train staff in efficient, CSAWMP, including organizing overseas study tours by 2018.					
3.4 Develop training programs and textbooks and syllabus for training farmers on appropriate techniques for CSAWMPs; provide vocational training for farmers by 2015.					
3.5 Upgrade CSAWMP-based map sets for 7 agro-ecological regions to forecast the direct impact of climate change (sea level rise, salt sea intrusion, flood, drought) and provice support for agricultural planning by 2014.					
3.6 Develop livestock waste management models for agricultural production and greenhouse gas emissions reduction by 2016.					
3.7 Train extension staff and farmers in low-carbon agricultural production technologies to promote application of the technologies in agricultural production by 2018.					
4 Effective project management					
4.1 Establish CPMU and PPMUs to be operational by 2013.					
4.2 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 2013.					
4.3 Explore all potential carbon markets by 2014.					
4.4 Undertake baseline surveys in all project provinces with collection and analysis of sex- and ethnicity-disaggregated data by 2014.					
4.5 Conduct a gender awareness raising training workshop for PMUs by 2016.					
4.6 Organize biogas owners and CSAWMP participants through relevant agencies.					
4.7 Prepare progress reports and submit to ADB on a regular basis by 2018.					

ADB = Asian Development Bank, BP = biogas plant, BVC = biogas value chain, BVCM = biogas value chain management, CME = coordinating and managing entity, CPMU = central project management unit, CSAP = climate s
CSAWMP = climate smart agricultural waste management practices, FI = financial intermediary, ICMD = incentives for carbon market development, MLBP = medium and large biogas plant, POA = program of activities, PPMS =
management system, PPMU = provincial project management unit, SBP = small biogas plant, VGS = voluntary gold standard

[a] Including viable technical and financial BP models to communes, private sector, FI front line staff, private sector banks, and other development partners active in the subsector.

Source: ADB and Government staff estimates.

III. PROJECT MANAGEMENT ARRANGEMENTS

A. Project Stakeholders – Roles and Responsibilities

Project Stakeholders	Management Roles and Responsibilities
Executing Agency (EA): Ministry of Agriculture and Rural Development (MARD) through the Agriculture Project Management Board (APMB) which will establish a Central Project Management Unit (CPMU)	The CPMU will be responsible for overall Project management and coordination including: (i) liaise with provincial people's committees (PPCs), Departments of Agriculture and Rural Development (DARDs), financial intermediaries and other stakeholders for project management and implementation issues; (ii) manage and coordinate the inputs of the technical support unit (TSU) staff; (iii) coordinate with the Ministry of Industry and Trade for renewable energy coordination; (iv) coordinate with the Ministry of Natural Resources and Environment (MONRE) on policy, strategy, regulations and enforcement related to waste management; (v) provide guidance and coordinate all implementing agencies to implement the Project Performance Management System (PPMS); (vi) monitor project schedules, funds flow and participation of various beneficiaries in the project activities; (vii) undertake periodic review missions; midterm project reviews both independently and jointly with ADB; (viii) establish and manage one imprest account for the ADB loan; (ix) consolidate sub-accounts, one for each of the 10 PPMUs and one for TSU; (x) arrange for counterpart financing in accordance with the Loan Agreement; (xi) recruit consulting services, procure civil works contracts, vehicles and equipment at the national level and assist PPMUs for similar services at PPMU level; (xii) recruit safeguard consultants for preparation of social, gender and environmental safeguard assessments for eligible project investments; plan with PPMUs, monitor and report to ADB on progress of Gender Action Plan and EMDP implementation on regular basis. (xiii) recruit service providers to carry out technical transfer dissemination activities (output 2); (xiv) recruit research entities to carry out research related activities (output 2); (xv) monitor effectiveness of safeguard implementation procedures and also project conformity with ADB anti-corruption policies and accountability mechanism; (xvi) analyze the measurable benefits of the capacity building and training programs to beneficiaries; (xvii) review compliance with agreed procurement plan and procedures;

Project Stakeholders	Management Roles and Responsibilities
	(xviii) based on agreed procurement plan, forecasts and monitor progress of contract awards, disbursements and other expenses; and (xix) arrange project account audits, synthesize PPMU's reports and prepare consolidated project progress reports including audit and project completion report.
Technical Support Unit (TSU)	Departments of Livestock Production (DLP); the Department of Science Technology and Environment (DSTE); the Department of Renewable Energy under the Ministry of Industry and Trade, the MONRE, Department of Crop Production, National Institute of Animal Husbandry, Vietnam Academy of Agricultural Sciences will provide technical and advisory support to the CPMU for biogas value chain development and CSAWMP. They will also advise the CPMU on policy issues and guide the CPMU to ensure sector coordination. The CPMU will provide the incremental costs incurred by the TSU through a sub-account, established in the TSU.
Implementation Agencies (IA): Provincial People's Committees (PPCs)	Overall responsibility for management and implementation at provincial level including: (i) approval of provincial level based investment reports, including provincial counterpart fund allocation; and (ii) approval of procurement plan for each procurement package processed in the provinces.
Department of Agriculture and Rural Development (DARD) in each participating province	DARD will be the investment owner of the procurement packages allocated in the province. It will be responsible for approval of implementation and operation arrangements for the delegated procurement packages.
Provincial Project Management Units (PPMUs) in each participating province	The PPMUs will be responsible for overall management and coordination of the activities at the provincial level including: (i) financial management of project funds allocated to the province through a sub-account established for each PPMU; (ii) procurement of goods and civil works under the national competitive bidding (NCB) and shopping procedures; (iii) provide monitoring input to the PPMS; (iv) implement the Environmental Management Plans (EMPs), Ethnic Minority Development Plan (EMDP) and Gender Action Plans (GAPs) and regular report to CPMU on the three plans' implementation progress; (v) coordinate the technical assistance provided by project implementation consultants; (vi) coordinate with representatives of the commune, biogas owners' and users' associations, and other stakeholders. This will include organizing public consultations and carrying out implementation monitoring by the associations; (vii) coordinate with the dissemination and research service providers; (viii) certify BP construction and environmental packages are

Project Stakeholders	Management Roles and Responsibilities
	constructed in compliance with established standards and specifications; and (ix) supervise the delivery of extension services to the BP investors.
Financial intermediaries: VBARD and CCF	(i) Administer the credit lines from the ADB loan to support the biogas plants construction; (ii) each financial intermediary will establish an imprest account; (iii) facilitate the CPMU to flow the incentive fund for carbon market development to the bank accounts of eligible biogas owners; (iv) coordinate with PPMUs to monitor one database for biogas plant management; (v) ensure their staff to work closely with CPMU, PPMUs and consultant teams to mainstream biogas plant financing as regular products; (vi) recycle or revolve repayments from onlending to other eligible subborrowers; and (vii) follow properly the guidelines set in the loan, subsidiary loan and project agreements in financing biogas plants.
Financier Asian Development Bank (ADB)	(i) Provide financing of the project cost as in the Loan Agreement; (ii) monitor project implementation arrangements, disbursement, procurement, consultant selection, and reporting; (iii) monitor schedules of activities, including funds flow; (iv) review compliance with agreed procurement procedures; (v) analyze the outcomes of the capacity building and training programs; (vi) monitor effectiveness and implementation of safeguard procedures and implementation of Gender Action Plan; (vii) monitor project conformity with ADB anti-corruption policies; accountability and public communication; (viii) undertake a periodic review missions; and (ix) undertake midterm project review jointly with the Government
Coordination with Other Donors including the Government of Netherlands, the World Bank and other financiers	(i) Use one database (that is currently used by biogas program in the Department of Livestock, funded by the Netherlands Government to monitor biogas plant progress, avoid double counting and facilitate access to various carbon markets; (ii) coordinate effective uses of trained masons, technicians and other sources; (iii) collaborate through Coordinating and Managing Entity in boosting access to carbon markets and sustainable management of revenues earning from carbon credits; and (iv) empower relevant agencies to improve private sector participation for biogas plant development.

Source: Asian Development Bank and Government of Viet Nam.

B. Key Persons Involved in Implementation

Executing Agency **MARD** International Cooperation Department	Officer's Name: Nguyen Thi Tuyet Hoa Position: Deputy Director General Telephone: +84 4 38433400, :+84 4 37330752 Email address: tuyethoa.htqt@mard.gov.vn Office Address
CPMU	Officer's Name: MSc. Nguyen The Hinh Position: Vice Director General of Agriculture Project Management Board Telephone: +84 4 37920061, 0913.247.782 Email Address: nguyenthe.hinh@gmail.com Office Address: 8th Floor, Building 2, No.16, Thuy Khue Street, Tay Ho District, Hanoi, Viet Nam
ADB Division Director	Javed H. Mir Director, Environment, Natural Resources and Agriculture Division Telephone No.: +63 2 632 6234, Email address: jhmir@adb.org
Mission Leader	Agustina Musa Financial Management Specialist Southeast Asia Department, Office of the Director General Telephone No.: +63 2 632 5547, Email address: amusa@adb.org

Source: Asian Development Bank and Government of Viet Nam.

C. Project Organization Structure

25. MARD will be the executing agency and will delegate overall responsibility to its Agriculture Projects Management Board (APMB). APMB will establish a CPMU responsible for central level project coordination that will be assisted by a technical support unit (TSU). The implementing agencies will be the provincial people's committees (PPCs) of the 10 participating provinces, and the two financial intermediaries, VBARD and CCF, which have been assessed as complying with criteria as set out in the ADB Operations Manual section on financial intermediation loans (footnote 7).[14] The effectiveness of the project agreements for the financial intermediaries will be processed independently from the loan effectiveness. Each PPC will act through its Department of Agricultural and Rural Development (DARD), which will establish a provincial project management unit (PPMU) responsible for province-specific, day-to-day project management. MARD and the implementing agencies have demonstrated adequate financial and management capacity, and experience to implement the project, having implemented several significant externally-funded projects, including ADB projects. During project implementation, the CPMU will establish synergies with QSEAP for knowledge transfer and capacity sharing.

26. The PPMUs will work closely with relevant stakeholders to disseminate technical and financial CSAWMP information to communes and private sector investors. A budgetary allocation is made for the facilitation and coordination costs in each of the participating provinces. Three imprest accounts will be established: one for the CPMU; and one for each of the two financial intermediaries. Eleven sub-accounts will be established, one each for the 10 PPMUs and one for the TSU. The government will provide project staff capable of using standard government accounting and financial management systems. The government, through the CPMU, will allocate financial incentives to eligible households and enterprises as an ICMD. The ICMD will be credited to BVC owners' accounts at financial intermediaries once technicians certify that the BVC infrastructure meets relevant construction and environmental standards.

[14] ADB. 2003. Financial Intermediation Loans. *Operations Manual.* D6/BP. Manila.

27. The TSU will provide technical and advisory support to the CPMU for BVC management development and CSAWMP. The TSU will also advise the CPMU on policy issues and guide the CPMU to ensure sector coordination. The CPMU will provide the incremental costs incurred by the TSU in support of the project. The terms of reference for each representative of the TSU will be determined during project implementation and shall be subject to the concurrence of ADB.

28. At the provincial level, the project implementing responsibilities will be decentralized to the PPCs. One Vice Chairperson from each PPC will be assigned for overall responsibility for implementation coordination in their respective province.

29. Each DARD shall establish a provincial project management unit (PPMU), led by a full-time project manager. Key PPMU staff will be selected based upon their qualifications and experience in the management of similar projects. A sufficient number of full-time staff[15] will be appointed to carry out day-to-day PPMU operation and to coordinate the work of technical experts. At the commune levels, the PPMUs will coordinate closely with the representatives of the commune, biogas owners and users associations, and other stakeholders. This will include organizing public consultations and carrying out implementation monitoring by the associations.

[15] Chief accountant of the PPMU will be appointed by DARD to work on a part time basis.

IV. COSTS AND FINANCING

A. Detailed Cost Estimates by Expenditure Category

30. The detailed cost estimates by expenditure category is shown in the table below.

Items	(VND Billion) Total	($ Million) Total
I. Investment Costs		
A. BVCM and CSAWMP Supports	111.30	5.30
B. Credit lines for BVCM Construction	882.00	42.00
C. Incentives for Carbon Market Development	174.50	8.31
D. Equipment	21.00	1.00
E. Vehicles	8.30	0.40
F. Training and Workshops		
ADB financed T&W	63.07	3.00
Government financed T&W	8.40	0.40
Subtotal	71.47	3.40
G. Consulting Services	61.68	2.94
H. Research and Development		
ADB financed R&D	129.82	6.18
Government financed R&D	23.40	1.11
Subtotal	153.22	7.30
I. Organizing CSAWMP Technology Transfer		
ADB CSAWMP	72.00	3.43
Government CSAWMP	21.00	1.00
Subtotal	93.00	4.43
J. unallocated	2.20	0.10
Total Investment Costs	1,578.67	75.17
II. Recurrent Costs		
A. Incremental Operating Costs		
ADB financed IOC	48.65	2.32
Government financed IOC	2.10	0.10
Subtotal	50.75	2.42
B. Staff salaries/allowances	22.83	1.09
Total Recurrent Costs	73.58	3.50
Total BASELINE COSTS	1,652.25	78.68
Physical Contingencies	57.20	2.72
Price Contingencies	90.64	0.19
Total PROJECT COSTS	1,800.10	81.59
Interest During Implementation	53.25	2.41
Total Costs to be Financed	1,853.35	84.00

1. Cost t Estimates

31. The Project is estimated to cost $84.00 million (Table 3). The government has requested a loan in various currencies equivalent to SDR48,1700,000 from ADB's Special Funds resources (regular terms) to help finance the Project. The Asian Development Fund (ADF) loan

will have a 32-year term, including a grace period of 8 years, an interest rate of 1.0% per annum during the grace period and 1.5% per annum thereafter, and such other terms and conditions as set forth in the loan agreement. Interest charges on the loan are to be capitalized.

Table 3: Project Investment Plan ($ million)

	Item		Amount[a]	%
A.	**Base Cost**			
	1.	Livestock Waste Management Infrastructure	15.43	18.4
	2.	Credit Lines for Biogas Value Chains	42.00	50.0
	3.	CSAWMP Technology Development Transfer	16.72	19.9
	4.	Project Management	4.43	5.3
		Subtotal (A)[b]	78.58	93.5
B.	**Contingencies**[c]		3.01	3.6
C.	**Financing Charges During Implementation**[d]		2.41	2.9
		Total (A+B+C)	**84.00**	**100.00**

[a] Includes taxes and duties of $1.53 million, to be financed by both ADB and the government. It is confirmed that (i) the amount of taxes and duties is within the reasonable threshold identified in the country partnership strategy, (ii) the amount does not represent an excessive share of the investment plan, (iii) taxes and duties apply only in respect to ADB-financed expenditures, (iv) financing of the taxes and duties is material and relevant to the success of the project, and (v) ADB loan will finance transportation and insurance costs.
[b] In mid-2012 prices.
[c] Physical contingencies computed at 0% for the credit lines and at 10% for all other expenditure categories. Price contingencies computed at 0.5% on foreign exchange costs and at 7.0% on local currency costs; includes provision for potential exchange rate fluctuation under the assumption of a purchasing power parity exchange rate.
[d] Includes interest charges of 1% per annum during project implementation.

Source: Asian Development Bank.

2. Financing Plan

32. The financing plan is presented in Table 4.[16] The Government will finance $3.70 million equivalent from national and provincial budgets to cover expenses for government staff salaries, training and workshops, research and development, and taxes and duties related to these expenses. The government will bear the foreign exchange risk. An additional counterpart budget of $6.30 million equivalent will be provided by the participating financial intermediaries as a contribution to the credit lines for expanded use of livestock waste management infrastructure.

Table 4: Financing Plan
($ million)

Source	Amount	Share of Total (%)
Asian Development Bank[a]	74.00	88.1
Government of Viet Nam	3.70	4.4
Financial intermediaries (state owned)	6.30	7.5
Total	84.00	100

[a] Bank charges related to operations of imprest accounts will be financed from the loan proceeds. ADB will partly finance the recurrent cost including transport and insurance due to limited government budget (current tight money policy).

Source: Asian Development Bank.

33. The Ministry of Finance (MOF) will enter into subsidiary loan agreements with financial intermediaries that will extend subloans ($35.7 million, about 48% of ADB Loan) to eligible beneficiaries. The relending from MOF to the financial intermediaries will be denominated in

[16] Additional financing from the Nordic Development Fund (NDF), Korea Eximbank, German development cooperation through KfW and the Government of the Netherlands is being explored.

Vietnamese Dong with the foreign exchange risk to be borne by the government. Terms and conditions of the relending from MOF to partner financial intermediaries will be decided by the government and agreed by ADB. Unless otherwise agreed between ADB and the government, normal interest rate applicable to funds from the government's development assistance will be used for the subsidiary loans.

34. Relending from MOF to financial intermediaries with terms up to 20 years with 6 years grace period will help the financial intermediaries sustain medium- and long-term loan portfolios and facilitate fund mismatch risk management. The financial intermediaries agreed that MOF's interest rate for the onlending to financial intermediaries will be ADB's lending rate plus exchange rate risk premium (currently about 6%) plus 0.2% service cost. The financial intermediary subloans will be made in strict accordance with selection criteria agreed between the government and ADB ("eligibility criteria" including minimum number of livestock, technical engineering, construction and environmental compliance for the construction of biogas plants, and collateral according to prudential requirements by the State Bank of Viet Nam) and will otherwise carry such terms and conditions as are currently applied by the financial intermediaries, with any amendments to be agreed with ADB from time to time. The interest rate for subloans to beneficiaries will be determined based on market rates (currently up to 15%). Technical, environmental and other criteria related to biogas plants and the criteria for the selection of beneficiaries, each as agreed with ADB, will be added to partner financial intermediaries' standard eligibility criteria to ensure the project's targeted clientele is reached. For the credit line provided for the construction of biogas plants, ADB will finance 85% and the financial intermediaries will finance 15%. The disbursement of the credit line will be subject to the financial intermediaries' entry into (i) a project agreement with ADB; and (ii) a subsidiary loan agreement with the government on terms and conditions satisfactory to ADB.

B. Allocation and Withdrawal of Loan Proceeds

35. The table on allocation and withdrawal of loan proceeds is given in Table 5.

Table 5: Allocation of Loan Proceeds

Category				ADB Financing
		Amount Allocated (SDR)		Percentage and Basis for Withdrawal from the Loan Account
No.	Item	Category	Subcategory	
1	BVCM and CSAWMP Civil Works	3,450,000		100% of total expenditure claimed
2	Credit lines for BVCM Construction through FIs*	23,239,000		85% of total expenditure claimed
3	Incentives for Carbon Market Development	5,288,000		100% of total expenditure claimed
4	Equipment	651,000		100% of total expenditure claimed
5	Vehicles	260,000		100% of total expenditure claimed
6	Training and Workshops	1,974,000		100% of total expenditure claimed
7	Consulting Services	1,926,000		100% of total expenditure claimed
8	Research and Development	4,069,000		100% of total expenditure claimed
9	Organizing CSAWMP Technology Transfer	2,258,000		100% of total expenditure claimed
10	Incremental Operating Costs	1,525,000		100% of total expenditure claimed
11	Interest During Implementation	1,570,000		100% of total expenditure claimed
12	Unallocated	1,960,000		
	Total	**48,170,000**		

BVCM = biogas value chain management, CSAWMP = climate smart agricultural waste management practices.
* Subject to the conditions for withdrawal of the credit line managed by FIs as indicated in para. 34 above.
Source: Government and ADB Staff Estimates.

C. Detailed Cost Estimates by Financier

36. The detailed cost estimates by financiers are given below ($ million).

Items	ADB Amount	ADB %	Financial Intermediaries Amount	Financial Intermediaries %	The Government Amount	The Government %	Total Amount	Total %	Duties & Taxes
I. Investment Costs									
A. BVCM and CSAWMP Supports	5.30	100.0	-	-	-	-	5.30	7.2	0.30
B. Credit lines for BVCM Construction	35.70	85.0	6.30	15.0	0.00	-	42.00	50.0	0.00
C. Incentives for Carbon Market Development	8.31	100.0	-	-	-	-	8.31	9.9	0.00
D. Equipment	1.00	100.0	-	-	-	-	1.00	1.3	0.11
E. Vehicles	0.40	100.0	-	-	-	-	0.40	0.5	0.04
F. Training and Workshops									
ADB financed T&W	3.00	100.0	-	-	0.00	-	3.00	4.0	0.17
Government financed T&W		-	-	-	0.40	100.0	0.40	0.5	0.02
G. Consulting Services	2.94	100.0	-	-	0.00	-	2.94	3.9	0.16
H. Research and Development									
ADB financed R&D	6.18	100.0	-	-	0.00	-	6.18	8.2	0.34
Government financed R&D		-	-	-	1.11	100.0	1.11	1.3	0.03
I. Organizing CSAWMP Technology Transfer									
ADB CSAWMP	3.43	100.0	-	-	0.00	-	3.43	4.5	0.19
Government CSAWMP		-	-	-	1.00	100.0	1.00	1.2	0.03
Total Investment Costs	66.26	88.7	6.30	8.1	2.51	3.2	75.07	92.6	1.40
II. Recurrent Costs									
A. Incremental Operating Costs									
ADB financed IOC	2.32	100.0	-	-	0.00	-	2.32	3.1	0.13
Government financed IOC		-	-	-	0.10	100.0	0.10	0.1	0.00
B. Staff salaries/allowances		-	-	-	1.09	100.0	1.09	1.3	0.00
Total Recurrent Costs	2.32	68.4	-	-	1.19	31.6	3.51	4.5	0.13
Total PROJECT COSTS	68.58	87.7	6.30	7.7	3.70	4.5	78.58	97.1	1.53
Contingencies/unallocated	3.01	-	-	-	-	-	3.01	-	0.00
Interest During Implementation	2.41	100.0	-	-	-	-	2.41	2.9	0.00
Total Disbursement	74.00	88.1	6.30	7.5	3.70	4.4	84.00	100.0	1.53

Source: Government and ADB Staff Estimates.

D. Detailed Cost Estimates by Outputs/Components

37. Detailed cost estimates by outputs and components are shown in the table below.

Items	Livestock Waste Management Infrastructure	Credit Lines for Biogas Value Chains	CSAWMP Technology Transfers	Project Management	Total ($ million)
I. Investment Costs					
A. Credit lines for BVCM Construction	0.00	42.00	0.00	0.00	42.00
B. Incentives for Carbon Market Development	8.31	0.00	0.00	0.00	8.31
C. BVCM and CSAWMP Supports	0.00	0.00	5.30	0.00	5.30
D. Equipment	0.50	0.00	0.00	0.50	1.00
E. Vehicles	0.00	0.00	0.40	0.00	0.40
F. Training and Workshops					
ADB financed T&W	0.60	0.00	2.17	0.23	3.00
Government financed T&W	0.20	0.00	0.20	0.00	0.40
Subtotal	0.80	0.00	2.37	0.23	3.40
G. Consulting Services	2.70	0.00	0.00	0.24	2.94
H. Research and Development					
ADB financed R&D	1.91	0.00	4.22	0.05	6.18
Government financed R&D	0.61	0.00	0.50	0.00	1.11
Subtotal	2.52	0.00	4.72	0.05	7.30
I. Organizing CSAWMP Technology Transfer					
ADB CSAWMP	0.00	0.00	3.43	0.00	3.43
Government CSAWMP	0.50	0.00	0.50	0.00	1.00
Subtotal	0.50	0.00	3.93	0.00	4.43
J. unallocated	0.00	0.00	0.00	0.10	0.10
Total Investment Costs	15.33	42.00	16.72	1.13	75.17
II. Recurrent Costs					
A. Incremental Operating Costs					
ADB financed IOC	0.00	0.00	0.00	2.32	2.32
Government financed IOC	0.10	0.00	0.00	0.00	0.10
Subtotal	0.10	0.00	0.00	2.32	2.42
B. Staff salaries/allowances	0.00	0.00	0.00	1.09	1.09
Total Recurrent Costs	0.10	0.00	0.00	3.40	3.50
Total BASELINE COSTS	15.43	42.00	16.72	4.53	78.68
Physical Contingencies	0.57	0.00	1.81	0.34	2.72
Price Contingencies					
Inflation					
Local	0.66	0.00	2.17	0.62	3.45
Foreign	0.02	0.00	0.01	0.01	0.03
Subtotal Inflation	0.67	0.00	2.18	0.63	3.48
Devaluation	-0.63	0.00	-2.07	-0.60	-3.30
Subtotal Price Contingencies	0.05	0.00	0.11	0.03	0.19
Subtotal	16.05	42.00	18.64	4.91	81.59
Financial Charges During Implementation	0.47	1.24	0.55	0.15	2.41
Total Project Costs	**16.52**	**43.24**	**19.19**	**5.05**	**84.00**

Source: Government and ADB staff estimates.

E. Detailed Cost Estimates by Years

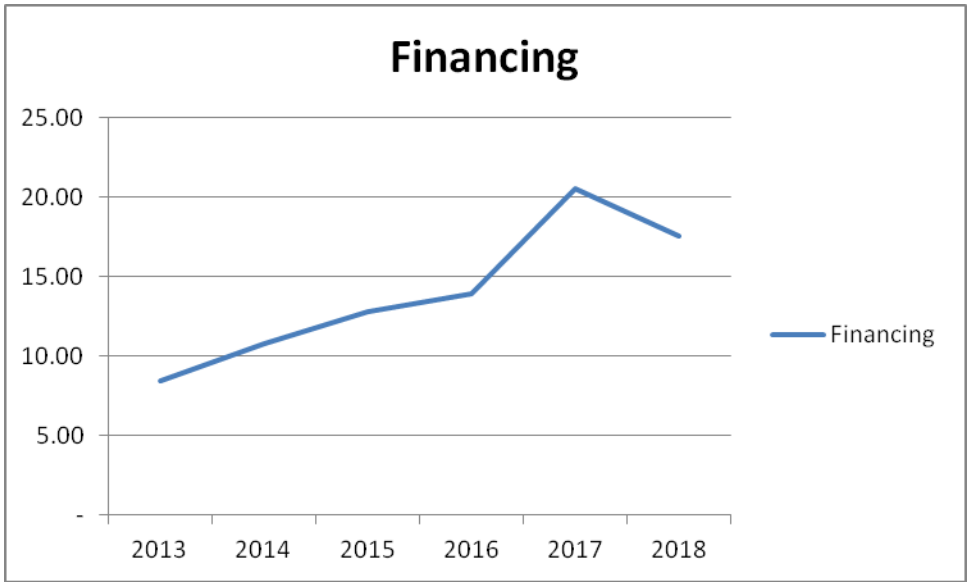
38. Detailed cost estimates by years are given in the table below.

Items	Base Cost						
	2013	2014	2015	2016	2017	2018	Total
I. Investment Costs							
A. BVCM and CSAWMP Supports	0.53	0.80	0.80	1.06	1.06	1.06	5.30
B. Credit lines for BVCM Construction	1.43	4.20	6.30	6.97	12.60	10.50	42.00
C. Incentives for Carbon Market Development	0.25	0.83	1.25	1.41	2.49	2.08	8.31
D. Equipment	0.75	0.25	-	-	-	-	1.00
E. Vehicles	0.40	-	-	-	-	-	0.40
F. Training and Workshops							
ADB financed T&W	0.57	0.62	0.57	0.57	0.41	0.26	3.00
Government financed T&W	0.07	0.07	0.07	0.07	0.07	0.07	0.40
Subtotal	0.64	0.69	0.64	0.64	0.47	0.33	3.40
G. Consulting Services	0.96	0.66	0.39	0.39	0.29	0.26	2.94
H. Research and Development							
ADB financed R&D	1.06	1.06	1.08	1.06	1.06	0.86	6.18
Government financed R&D	0.20	0.20	0.20	0.20	0.17	0.17	1.11
Subtotal	1.26	1.26	1.27	1.26	1.22	1.03	7.30
I. Organizing CSAWMP Technology Transfer							
ADB CSAWMP	0.57	0.57	0.57	0.57	0.57	0.57	3.43
Government CSAWMP	0.17	0.17	0.17	0.17	0.17	0.17	1.00
Subtotal	0.74	0.74	0.74	0.74	0.74	0.74	4.43
J. unallocated	0.10	-	-	-	-	-	0.10
Total Investment Costs	7.06	9.42	11.38	12.45	18.87	15.99	75.17
II. Recurrent Costs							
A. Incremental Operating Costs							
ADB financed IOC	0.39	0.39	0.39	0.39	0.39	0.39	2.32
Government financed IOC	0.02	0.02	0.02	0.02	0.02	0.02	0.10
Subtotal	0.40	0.40	0.40	0.40	0.40	0.40	2.42
B. Staff salaries/allowances	0.18	0.18	0.18	0.18	0.18	0.18	1.09
Total Recurrent Costs	0.58	0.58	0.58	0.58	0.58	0.58	3.50
Total BASELINE COSTS	7.64	10.00	11.96	13.04	19.46	16.58	78.68
Physical Contingencies	0.56	0.47	0.42	0.46	0.43	0.39	2.72
Subtotal Price Contingencies	-0.00	0.01	0.02	0.04	0.05	0.06	0.19
subtotal	8.20	10.49	12.40	13.54	19.94	17.03	81.59
Interest during implementation	0.24	0.31	0.37	0.40	0.59	0.50	2.41
Total Costs	**8.44**	**10.80**	**12.77**	**13.94**	**20.53**	**17.53**	**84.00**

Source: Government and ADB Staff estimates.

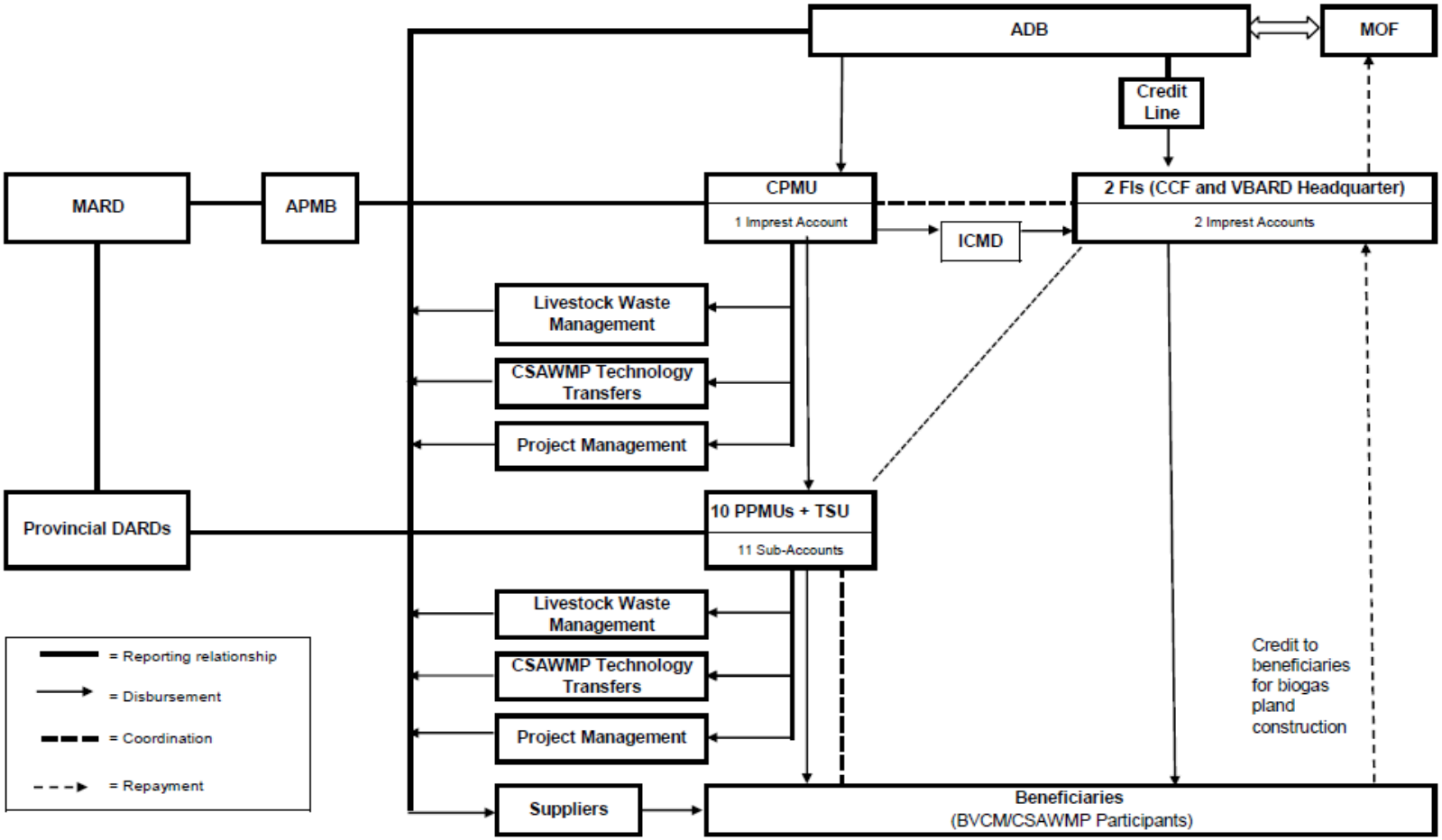
F. Contract and Disbursement S-curve

39. The contracts and disbursement S-curve for the Project is shown below.



G. Fund Flow Diagram

40. The fund flow diagram, shows the funds will flow from ADB and the Government to implement the Project activities.



ADB = Asian Development Bank, APMB = Agriculture Projects Management Board, BVCM = biogas value chain management, CCF = Central People's Credit Fund, CPMU = central project management unit, CSAWMP = climate smart agriculture waste management practices, DARD = Department of Agriculture and Rural Development, FI = financial intermediary, IA = imprest account, ICMD = incentives for carbon market development, MARD = Ministry of Agriculture and Rural Development, MOF = Ministry of Finance, PPMU = provincial project management unit, TSU = technical support unit, VBARD = Vietnam Bank for Agriculture and Rural Development.

V. FINANCIAL MANAGEMENT

A. Financial Management Assessment

41. The detailed financial management assessment is given in RRP SD 15. The project finance and accounting functions will be performed by qualified and experienced staff both at central level and in participating provinces. In addition, the project will provide training and written guidelines, especially in ADB procedures, particularly to the new PPMUs that have no experience in ADB funded projects.

42. The project will prepare terms of reference (TORs) that define duties, responsibilities, lines of supervision, and limits of authority for all officers, managers, and staff. The following responsibilities will be performed by different units or persons:

(i) authorization to execute a transaction;
(ii) recording of the transaction; and
(iii) custody of assets involved in the transaction.

43. The bank reconciliation will be prepared by someone other than those who approve payments. Accounting software must be capable of generating reports identifying expenditures in accordance with project components, expenditure accounts, disbursement categories, and sources of funds. A project financial manual will be prepared to be applicable for the project and acceptable to ADB.

44. Controls will be in place concerning the preparation and approval of transactions, ensuring that all transactions are correctly made and adequately explained. The chart of accounts will be able to account for and report on project activities and disbursement categories. The cost allocations to the various funding sources will be made accurately and in accordance with established agreements. The general ledger and subsidiary ledgers will be reconciled and in balance. Provisions have been made for the development of custom designed accounting software to standards acceptable to ADB for PPMUs that can accommodate electronic transfer of accounting data from PPMUs to the CPMU to facilitate timely reporting.

45. All accounting and supporting documents will be retained on a permanent basis in a defined system that allows authorized users easy access. Regular monitoring and internal audit functions will be built up to monitor transactions along the line from central government to provincial, and subproject levels. Such control procedures will be documented in the project finance and administration manual.

B. Disbursement

1. Disbursement of ADB Loan

46. The Loan proceeds will be disbursed in accordance with ADB's *Loan Disbursement Handbook* (2012, as amended from time to time),[17] and detailed arrangements agreed upon between the government and ADB. Except as ADB may otherwise agree, the Borrower shall establish, and cause to be established, immediately after the effective date, (i) three imprest accounts at commercial banks acceptable to ADB, one to be managed by the CPMU and one each to be managed by the financial intermediaries. Eleven sub-accounts are expected to be

[17] Available at: http://www.adb.org/documents/loan-disbursement-handbook.

established at commercial banks acceptable to ADB—for the TSU and for each PPMU—soon thereafter. The imprest accounts shall be established, managed, replenished and liquidated in accordance with the ADB *Loan Disbursement Handbook* (2012, as amended from time to time) and detailed arrangements agreed upon between the Borrower and ADB. The imprest accounts shall only be used for the purposes of the Project.

47. The request for initial advance to each imprest account should be accompanied by an Estimate of Expenditure Sheet[18] setting out the estimated expenditures for the first six (6) months of project implementation, and submission of evidence satisfactory to ADB that the imprest account has been duly opened. For every liquidation and replenishment request of the imprest account, the borrower will furnish to ADB (i) Statement of Account (Bank Statement) where the imprest account is maintained, and (ii) the Imprest Account Reconciliation Statement (IARS) reconciling the above mentioned bank statement against the EA and FI records.[19]

48. A sub-account is required by TSU to ensure flexibility and less dependence on CPMU in managing the project activities allocated under TSU. The sub-account for the TSU shall only be used for the purposes of meeting day-to-day operational expenses and recurrent costs of the TSU. The disbursement from the TSU's sub-account will be substantiated by the full suite of documentary evidence required by ADB. The PPMUs and TSU will prepare liquidation and replenishment requests for their sub-accounts. These will be submitted to the CPMU, which will consolidate the requests before sending them to the Ministry of Finance (MOF). The use of sub-accounts and all disbursements will be made in accordance with ADB's *Loan Disbursement Handbook* (2012, as amended from time to time).

49. The currency of the imprest accounts shall be Dollar. The aggregate amount to be deposited into the CPMU's imprest account shall not exceed US$3,500,000. The maximum amount to be deposited into each PPMU's sub-account shall not exceed expenditures for the following 6 months project implementation. The maximum amount to be deposited into each financial intermediary imprest account shall not exceed US$1,700,000. The maximum amount to be deposited into the TSU's sub-account shall not exceed $46,000.

50. The statement of expenditures (SOE) procedure may be used to reimburse eligible expenditures and to liquidate advances provided in accordance with the ADB's *Loan Disbursement Handbook* (2012, as amended from time to time) and detailed arrangements agreed upon between the Borrower and ADB. Any individual payment to be reimbursed or liquidated under the SOE procedures shall not exceed the equivalent of $100,000.

51. **Free limit.** As stated in the Project Agreement, each financial intermediary shall submit for prior review and clearance by ADB, each subloan proposal financing the construction of a large biogas plant (LBP) for which the principal amount of the subloan borrowed by an eligible beneficiary exceeds $187,000. The free limit is equivalent to the SOE ceiling of $187,000, the highest cost for the construction of an LBP. Each financial intermediary shall submit withdrawal applications directly to ADB with copy to CPMU.

52. The government, through the CPMU, will allocate financial incentives to eligible households and enterprises to support carbon market development. The ICMD will be credited to BVC owners' accounts at financial intermediaries after technicians determine that the BVC

[18] Available in Appendix 10B of the *Loan Disbursement Handbook.*
[19] Follow the format provided in Appendix 10C of the *Loan Disbursement Handbook.*

infrastructure has met appropriate construction and environmental standards as shown in the Appendix, Guidelines for Biogas Value Chains.

53. Payments made directly from CPMU and PPMUs will be supervised by the Treasury (at central and provincial levels respectively) upon receipt of payment documents. Based on the payments that have been authorized by the provincial treasury, each PPMU will prepare withdrawal applications with associated payment documents/statements and the sub-account balance sheet (using the CPMU format) and submit these to the CPMU. Upon receipt of reimbursement applications and payment documents from PPMUs, the CPMU will prepare an aggregated withdrawal application and submit to the MOF for endorsement. Authorized withdrawal applications will be forwarded to ADB for processing and for replenishment to the imprest accounts. Before the submission of the first withdrawal application, the borrower shall submit to ADB sufficient evidence of the authority of the person(s) who will sign the withdrawal applications on behalf of the borrower, together with the authenticated specimen signatures of each authorized person. The minimum value per withdrawal application is US$100,000, unless otherwise approved by ADB. The borrower is to consolidate claims to meet this limit for reimbursement and imprest account claims. Withdrawal applications and supporting documents will demonstrate, among other things that the goods, and/or services were produced in or from ADB members, and are eligible for ADB financing.

C. Accounting

54. The financing units established in the CPMU, financial intermediaries, TSU, and each PPMU involved in Project implementation will maintain records and accounts that identify goods and services from loan proceeds, financing resources received, expenditures incurred, and use of government counterpart funds. These accounts will be established and maintained in conformity to the Government's accounting laws and regulations and in accordance with sound accounting principles and standards acceptable to ADB. The CPMU and each financial intermediary will be responsible for (i) preparing disbursement projections, (ii) requesting budgetary allocations for counterpart funds, (iii) collecting supporting documents, (iv) collecting and verifying replenishment requests from the PPMUs (for the CPMU) and provincial branches (for the financial intermediaries), and (v) preparing and sending withdrawal applications to ADB.

55. The CPMU Director and the Chief Accountant will be responsible and accountable to the Central Treasury and ADB for managing the budget and for all expenditures related to the project in accordance with the conditions of the Loan Agreement, Government and ADB regulations, and other legal documents. Similarly, the respective financial intermediary Project Director and Chief Project Accountant will be responsible and accountable to the Ministry of Finance and ADB for managing the budget and for all expenditures related to the project in accordance with the conditions of the Subsidiary Loan Agreement, Project Agreement, Government and ADB regulations, and other legal documents.

56. Pursuant to ADB's Safeguard Policy Statement (2009) (SPS),[20] ADB funds may not be applied to the activities described on the ADB Prohibited Investment Activities List set forth at Appendix 5 of the SPS. All financial institutions will ensure that their investments are in compliance with applicable national laws and regulations and will apply the prohibited investment activities list (SPS Appendix 5) to subprojects financed by ADB.

[20] Available at: http://www.adb.org/documents/safeguard-policy-statement.

D. Auditing

57. The CPMU will review and consolidate the accounts and records and have them audited annually in accordance with sound accounting practices by the sovereign audit agency of the Government or other auditors acceptable to ADB. Audit coverage will include a statement verifying whether or not the funds disbursed by ADB were used for the purposes for which they were provided, as well as separate opinions on (i) utilization of the imprest fund and the statement of expenditures procedure; and (ii) compliance with financial covenants specified in the loan agreements and project agreement.

58. Audit reports, management letter, and related financial statements will be submitted to ADB in the English language not later than 6 months after the end of the fiscal year to which they relate, or the Project closing date if earlier. ADB informed the Government of its policy on submission of audited accounts (covering failure of submitting audited accounts and financial statements by the due date). Formal warning will be issued, and disbursements suspended, for accounts more than 6 months overdue. ADB reserves the right to verify the Project's financial accounts to confirm that the share of ADB's financing is used in accordance with ADB's policies and procedures.

59. Compliance with these financial reporting and auditing requirements will be monitored by review missions and during normal project supervision, and followed up regularly with all concerned, including the external auditor. ADB shall impose the following measures should the CPMU and/or the FIs fail to submit within the due date:

(i) **Within 6 months after the due date**: Processing of requests for new contract awards and disbursement such as replenishment of imprest accounts, processing of new reimbursement, and issuance of new commitment letters will be put on hold.

(ii) **Within 12 months after the due date**: Disbursement may be suspended.

VI. PROCUREMENT AND CONSULTING SERVICES

A. Advance Contracting

60. All advance contracting will be undertaken in conformity with ADB's *Procurement Guidelines*[21] (April 2010, as amended from time to time) and ADB's *Guidelines on the Use of Consultants* (April 2010, as amended from time to time).[22] The issuance of invitations to bid under advance contracting will be subject to ADB approval. The borrower, MARD, and PPMUs have been advised that approval of advance contracting does not commit ADB to finance the Project.

61. **Advance contracting.** To facilitate rapid start up, the government and ADB agreed to a number of advance actions to expedite (i) the establishment of a functional CPMU with sufficient number of qualified and experienced staff; (ii) short-listing for recruitment of loan implementation consultants (LIC); and (iii) recruitment of several individual consultants by the CPMU for start-up activities and other supporting activities.

62. Advance action for the recruitment of LICs after Loan Negotiations will be carried out up to the preparation of short-listing of companies. Advance procurement action is necessary to ensure consultants are available to support the early stages of project implementation. The Government was advised that ADB approval of advance procurement action will not in any way commit ADB to approve the proposed loan, and ADB financing will be dependent upon compliance with all aspects of ADB procedural requirements, including compliance of the Government with relevant provisions of the loan and project agreements and ADB guidelines. The Government was also advised that ADB will not finance expenditures paid by the Government prior to loan effectiveness, even if advance contracting is approved by ADB.

B. Procurement of Goods, Works and Services

63. All procurement under the ADB loan will be undertaken in accordance with ADB's *Procurement Guidelines* (April 2010, as amended from time to time). All procurement to be financed exclusively by counterpart fund will be undertaken in accordance with government guidelines.

64. Procurement of civil works packages and goods and services will be carried out by the CPMU and the PPMUs. Although it is not expected that any large civil works and goods contracts will be awarded given the nature of the work to be carried out, any civil works packages valued at more than $5.0 million equivalent and packages for goods valued at more than $0.5 million equivalent will be procured following international competitive bidding (ICB) procedures. Civil works packages valued at less than $5.0 million equivalent but more than $100,000 equivalent, and packages for goods valued at less than $1.0 million equivalent but more than $100,000 equivalent, will be procured following national competitive bidding (NCB) procedures (one stage, one package and two envelopes). For goods packages valued below $100,000 equivalent, shopping procedures acceptable to ADB will be followed. For works packages valued below $100,000 equivalent, shopping procedures acceptable to ADB will be followed.

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[21] Available at: http://www.adb.org/documents/procurement-guidelines.

[22] Available at: http://www.adb.org/documents/guidelines-use-consultants-asian-development-bank-and-its-borrowers.

C. Project Procurement Plan

65. Before the start of any procurement, ADB and the Government will review the public procurement laws of the central and state governments to ensure consistency with ADB's *Procurement Guidelines.* The Project's detailed procurement plan is given below. All detailed packages in the procurement plan will need clearance by ADB prior to advertising of the packages and/or any contract awarded to supplier.

Basic Data

Project Name: Low Carbon Agricultural Support Project	**Loan (Grant) Number:** xxxx
Country: Viet Nam **Loan Amount :** $74.00 million	**Executing Agency:** Ministry of Agriculture and Rural Development (MARD)
Date of First Procurement Plan: 24 April 2012	**Date of this Procurement Plan:** 16 October 2012

1. Process Thresholds, Review and 18 Month Procurement Plan

a. Project Procurement Thresholds

66. Except as the Asian Development Bank (ADB) may otherwise agree, the following process thresholds shall apply to procurement of goods and works.

Table 6: Procurement of Goods and Works

Method	Threshold
International Competitive Bidding (ICB) for Works	Above $5,000,000
International Competitive Bidding for Goods	Above $500,000
National Competitive Bidding (NCB) for Works	Below $5,000,000 and above $100,000
National Competitive Bidding for Goods	Below $500,000 and above $100,000
Shopping for Works	Up to $ 100,000
Shopping for Goods	Up to $ 100,000
Community participation	Up to $50,000
Direct Purchase	—

b. ADB Prior or Post Review

67. Except as ADB may otherwise agree, the following prior- or post-review requirements apply to the various procurement and consultant recruitment methods used for the project. (See *Procurement Guidelines* [2010, as amended from time to time], Appendix 1 and *Guidelines on the Use of Consultants* [2010, as amended from time to time], para. 1.16.)

Table 7: Procurement Method and Review

Procurement Method	Prior or Post	Comments
Procurement of Goods and Works		
ICB Works	Prior	
ICB Goods	Prior	
NCB Works	Prior	
NCB Goods	Prior	
Shopping for Works	Prior	
Shopping for Goods	Post	
Direct Purchase	Prior	

Table 7: Procurement Method and Review

Procurement Method	Prior or Post	Comments
Direct Contracting	—	
Recruitment of Consulting Firms		
Quality- and cost-based selection (QCBS)	Prior	
Quality-based selection (QBS)	Prior	
Other selection methods: Consultants qualifications (CQS), least-cost selection (LCS), fixed-budget selection (FBS), and single-source selection (SSS)	Prior	
Recruitment of Individual Consultants		
Individual Consultants	Prior	

c. Goods and Works Contracts Estimated to Cost More than $1 million

68. The following table lists goods and works contracts for which procurement activity is either ongoing or expected to commence within the next 18 months.

Table 8: Goods and Works Contracts Estimated to Cost More than $1 million

General Description	Contract Value ($ million, cumulative)	Procurement Method	Pre-qualification of Bidders (Yes/No)	Advertisement Date (quarter/year)	Comments
Credit lines for BVCM construction[a]	$42.000	commercial practices by end-users acceptable to ADB (through financial intermediaries)	No	2Q of 2013	Financial intermediaries will provide sub-loans to the end users
36,000 SBPs[b]	28.670				
40 MBPs[c]	8.940				
10 LBPs[c]	4.390				

BVCM = biogas value chain management, CME = coordinating and managing entity, SBP = small biogas plant, MBP = medium biogas plant, LBP = large biogas plant.

Notes:

[a] At least 15% funded by financial intermediaries' own resources and maximum of 85% funded by ADB loan.

[b] At least 143 certified technicians and 264 certified masons available in 10 selected provinces.

[c] About 22 contractors are available, and about 1,000 MLBP in Viet Nam (about 167 in 10 participating provinces) have been constructed on turnkey basis.

Source: Government and ADB staff estimates.

d. Consulting Services Contracts Estimated to Cost More Than $100,000

69. The following table lists consulting services contracts for which procurement activity is either ongoing or expected to commence within the next 18 months.

Table 9: Services Contracts Estimated to Cost More Than $100,000

General Description	Contract Value ($ million, cumulative)	Recruitment Method	Advertisement Date[a] (quarter/year)	International or National Assignment	Comments
Project Auditing	0.519	LCS	1Q 2013	National	The TORs will need clearance
Carbon market development	0.500	individuals	1Q 2013	International and National	

Table 9: Services Contracts Estimated to Cost More Than $100,000

General Description	Contract Value ($ million, cumulative)	Recruitment Method	Advertisement Date[a] (quarter/year)	International or National Assignment	Comments
Project management consulting	2.137	QCBS (Cost Ratio 80:20)	1Q 2013	International	By ADB prior to any recruitment action for the packages.
LCASP Facilitator	0.600	QCBS (Cost Ratio 80:20)	2Q 2014	National	
Project Start-up Support Consultants	0.250	individuals	1Q 2013	International and National	

LCS = least-cost selection, QCBS = quality- and cost-based selection , tbd = to be determined

[a] ADB will post notices describing each consulting assignment in the *Business Opportunities* section of ADB's website before short-listing. The minimum posting time for each assignment is 30 days. The website includes a link to a standard expression of interest (EOI) form for loans that firms can download, fill out, and send directly to the EA. The EA may, in addition, advertise in local newspapers and international trade publications.

Source: Government and ADB staff estimates.

e. Goods and Works Contracts Estimated to Cost Less than $1 Million

70. The following table shows smaller-value goods, works and consulting services contracts for which procurement activity is either ongoing or expected to commence within the next 18 months.

Table 10: Goods and Works Contracts Estimated to Cost Less than $1 Million

General Description	Value of Contracts ($ million cumulative)	Number of Contracts	Procurement / Recruitment Method	Comments	Remarks
Vehicles	0.400	1	NCB	CPMU	Need clearance by ADB prior to advertising of the packages and/or awarded any contract to suppliers
Furniture	0.125	1	NCB	CPMU	
Office equipment	0.600	1	NCB	CPMU	
Computers/Software[a]	0.400	2*	NCB	CPMU	

CPMU = central project management unit, NCB = national competitive bidding.

[a] Will be segregated for hardware and maintenance and software installment, for the Project management information system, technology dissemination, database management for component 1 and 2, carbon market development at central, 10 provinces and participating districts

Source: Government and ADB staff estimates.

2. Project Procurement Plan

a. Indicative List of Packages Required Under the Project

71. Table 11 provides an indicative list of all procurement (goods works and consulting services) over the life of the proposed Project that will be fully funded by ADB.

Table 11: Procurement Plan of LCASP ($ '000) Funded by ADB[a]

General Description	Estimated Value ($'million)	Estimated number of contract	Procurement method	Comment
Credit lines for SBPs	28.670	36,000	Commercial practices acceptable to ADB	Directly by end users (through financial interemediariess)
Credit lines for MBPs	8.940	40		
Credit lines for LBPs	4.390	10		
Office equipment for project management	0.600	1	NCB	The TORs will need clearance by ADB prior to any recruitment action for the packages. need clearance by ADB prior to advertising of the packages and/or awarded any contract to suppliers
Computers/Software[b]	0.400	2	NCB	
Furniture	0.125	1	NCB	
Dissemination/medias	1.000	20	Shopping	
Cars (8 units)	0.400	1	NCB	
Project Auditing	0.519	1	LCS	
Carbon market development specialist	0.500	2	Individuals	
Project management consulting	2.959	1	QCBS	
Project evaluation consultant	0.100	2	Individuals	
Organizing CSAWMP Technology Transfer[c]	3.468	tbd	tbd	
Start up Consultants	0.250	3	Individuals	

ADB = Asian Develoment Bank, CSAWMP = climate-smart agricultural waste management practices, LBP = large biogas plant, LCS = least cost selection, MBP = medium-sized biogas plant, NCB = national competitive bidding, QCBS = quality and cost based selection, SBP = small biogas plant, TOR = terms of reference.

Notes:

[a] The inclusion of the following items will be discussed during project implementation: E-Library, small rice irrigation works, upgrading agri-waste management facilities, baseline survey consultant, surveys and designs pf biogas plants, CSAWMP applied research projects, BVCM demonstrations, CSAWMP demonstrations. The CPMU shall submit detailed breakdown o costs for the above items.

[b] For the project management information system, technology dissemination, database management carbon market development at central, 10 provinces and participating districts.

[c] $0.6 million out of $3.468 million will be used for LCASP facilitators, and the remaining amount to be allocated for CSAWMP demonstrations, subject to ADB approval

Source: Government and ADB staff estimates.

3. National Competitive Bidding

a. General

72. The laws to be followed for national competitive bidding shall be those set forth in the Law on Procurement No. 61/2005/QH11 of 29 November 2005 and the Construction Law No. 16/2003/QH11 of 26 November 2003, and with the processes described in Decree No. 111/2006/ND-CP of 29 September 2006, with the clarifications and modifications described in the following paragraphs required for compliance with the provisions of ADB's *Procurement Guidelines.*

b. Registration

(i) Bidding shall not be restricted to pre-registered firms and such registration shall not be a condition for participation in the bidding process.

(ii) Where registration is required prior to award of contract, bidders:

(a) shall be allowed a reasonable time to complete the registration process; and (b) shall not be denied registration for reasons unrelated to their capability and resources to successfully perform the contract, which shall be verified through post-qualification.

(iii) Foreign bidders shall not be required to register as a condition for submitting bids.

(iv) Bidder's qualification shall be verified through the post-qualification process.

c. Eligibility

(i) National sanction lists may only be applied with ADB approval.[23]

(ii) A firm declared ineligible by ADB cannot participate in bidding for an ADB-financed contract during the period of time determined by ADB.

d. Prequalification and Post Qualification

(i) Post qualification shall be used unless prequalification is explicitly provided for in the loan agreement and/or procurement plan. Irrespective of whether post qualification or prequalification is used, eligible bidders (both national and foreign) shall be allowed to participate.

(ii) When prequalification is required, the evaluation methodology shall be based on pass/fail criteria relating to the firm's experience, and technical and financial capacity.

(iii) Qualification criteria shall be clearly specified in the bidding documents. All specified criteria (and only specified criteria) shall be used to determine whether a bidder is qualified. The evaluation of the bidder's qualifications should be conducted separately from the technical and commercial evaluation of the bid.

(iv) In carrying out the post-qualification assessment, the employer and/or purchaser shall exercise reasonable judgment in requesting from a bidder, in writing, missing factual or historical supporting information related to the bidder's qualifications, and shall provide a reasonable amount of time (minimum of 7 days) for the bidder to respond.

e. Preferences

(i) No preference shall be given to domestic bidders or domestically manufactured goods.

(ii) Regulations issued by a sectoral ministry, and provincial and local regulations that restrict national competitive bidding procedures to

[23] Section 52 of ADB's integrity principles and guidelines (ADB. 2006. *Integrity Principles and Guidelines*. Manila) allows ADB to sanction parties who fail to meet ADB's high ethical standards based on the decisions of third parties; such a decision can only be made by the integrity oversight committee on the basis of ADB's own independent examination of the evidence. As such, the process should follow the normal assessment and investigative processes prescribed by the guidelines.
Available: http://www.adb.org/Documents/Guidelines/Integrity-Guidelines-Procedures/integrity-guidelines-procedures-2006.pdf

a class of contractors or a class of suppliers shall not be applicable.

(iii) Foreign bidders shall be eligible to participate in bidding under the same conditions as local bidders, and local bidders shall be given no preference (either in the bidding process or in bid evaluation) over foreign bidders. Similarly, bidders located in the same province or city as the procuring entity shall not be given preference over bidders located outside that city or province

f. Advertising

(i) Invitations to bid (or prequalify, where prequalification is used) shall be advertised in the Government Public Procurement Bulletin. In addition, the procuring agency should publish the advertisement in at least one widely circulated national daily newspaper or freely accessible, nationally known website, allowing a minimum of 28 days for the preparation and submission of bids and allowing potential bidders to purchase bidding documents up to at least 24 hours prior to the bid submission deadline. Bidding of national competitive bidding (NCB) contracts estimated at $500,000 or more for goods and related services or $1,000,000 or more for civil works shall be advertised on ADB's website via the posting of the procurement plan.

(ii) Bidding documents shall be made available by mail, or in person, to all who are willing to pay the required fee, if any.

(iii) The fee for the bidding documents should be reasonable and consist only of the cost of printing (or photocopying) the documents and delivering them to the bidder. (Currently set at VND1 million, increase subject to ADB approval).

g. Standard Bidding Documents

(i) The Borrower's standard bidding documents, acceptable to ADB, or ADB's standard bidding documents shall be used. The bidding documents shall provide clear instructions on how bids should be submitted, how prices should be offered, and the place and time for submission and opening of bids.

(ii) Bidders shall be allowed to submit bids by hand or by mail and/or courier.

h. Bid Opening

(i) A copy of the bid opening record shall be promptly provided to all bidders who submitted bids.

i. Bid Evaluation

(i) Merit points shall not be used in bid evaluation.

(ii) Bidders shall not be eliminated from detailed evaluation on the

basis of minor, non-substantial deviations.[24]

(iii) Except with the prior approval of ADB, no negotiations shall take place with any bidder prior to the award, even when all bids exceed the cost estimates.

(iv) A bidder shall not be required, as a condition for award of contract, to undertake obligations not specified in the bidding documents or to otherwise modify the bid as originally submitted.

(v) Bids shall not be rejected on account of arithmetic corrections of any amount. However, if the Bidder that submitted the lowest evaluated bid does not accept the arithmetical corrections made by the evaluating committee during the evaluation stage, its bid shall be disqualified and its bid security shall be forfeited.

j. Rejection of All Bids and Rebidding

(i) No bid shall be rejected on the basis of a comparison with the owner's estimate or budget ceiling without ADB's prior concurrence.

(ii) Bids shall not be rejected and new bids solicited without ADB's prior concurrence.

k. Participation by Government-owned Enterprises

73. Government-owned enterprises shall be eligible to participate as bidders only if they can establish that they are legally and financially autonomous, operate under the Enterprise Law and are not a dependent agency of the contracting entity. Furthermore, they will be subject to the same bid and performance security requirements as other bidders.

l. Non-eligibility of Military or Security Units

74. Military or security units or enterprises belonging to the Ministry of Defense or the Ministry of Public Security shall not be permitted to bid.

m. Participation by Foreign Contractors and Suppliers, Joint Ventures and Associations

(i) Foreign suppliers and contractors from eligible countries shall, if they are interested, be allowed to participate without being required to associate or form joint ventures with local suppliers or contractors, or to subcontract part of their contract to a local bidder.

(ii) A bidder declared the lowest evaluated responsive bidder shall not be required to form a joint venture or to sub-contract part of the supply of goods as a condition of award of the contract.

(iii) Licenses allowing foreign contractors to operate in Viet Nam would be provided in a timely manner and will not be arbitrarily

[24] A minor, non-substantial deviation is one that, (i) if accepted, would not (a) affect in any substantial way the scope, quality, or performance specified in the contract; or (b) limit in any substantial way, the rights of the contracting entity or the obligations of the bidder under the proposed contract; or (ii) if rectified, would not unfairly affect the competitive position of other bidders presenting substantially responsive bids.

withheld.

n. Publication of the Award of Contract Debriefing

(i) For contracts subject to prior review, within 2 weeks of receiving ADB's "No-objection" to the recommendation of contract award, the borrower shall publish in the Government Public Procurement Bulletin, or a well-known and freely accessible website, the results of the bid evaluation, identifying the bid and lot numbers, and providing the (a) name of each bidder who submitted a bid; (b) bid prices as read out at bid opening; (c) name and evaluated prices of each bid that was evaluated; (d) names of bidders whose bids were rejected and the reasons for their rejection; and (e) name of the winning bidder, the price offered, and the duration and summary scope of the contract awarded.

(ii) For contracts subject to post review, the procuring entity shall publish the bid evaluation results no later than the date of contract award.

(iii) In the publication of the bid evaluation results, the borrower shall specify that any bidder who wishes to ascertain the grounds on which its bid was not selected should request an explanation from the procuring entity. The procuring entity shall promptly provide an explanation regarding why the bid was not selected, either in writing and/or in a debriefing meeting, at the option of the borrower. The requesting bidder shall bear all costs of attending such a debriefing. The discussion will address only the bidder's bid, and not the bids of competitors.

o. Handling of Complaints

75. The national competitive bidding documents shall contain provisions acceptable to ADB describing the handling of complaints in accordance with Article 47 of Decree No. 111/20006/DD-CP, read with Articles 72 and 73 of Law on Procurement No. 61/2005/QH11.

p. ADB Member Country Restrictions

76. Bidders must be nationals of ADB member countries, and offered goods, works, and services must be produced in and supplied from ADB member countries.

q. Fraud and Corruption

77. ADB will sanction a party or its successor, including declaring them ineligible, either indefinitely or for a stated period of time, to participate in ADB-financed activities if it at any time determines that the firm has, directly or through an agent, engaged in corrupt, fraudulent, collusive, or coercive practices in competing for, or in executing, an ADB-financed contract.

r. Right to Inspect and/or Audit

78. Each bidding document and contract financed by ADB shall include a provision requiring bidders, suppliers, and contractors to permit ADB or its representative to inspect and have audited (by ADB-appointed auditors) their accounts and records relating to the bid submission

and contract performance.

D. Consulting Services

79. All consultants, nongovernment organizations (NGOs), and other services to be financed by the ADB loan will be recruited according to ADB's *Guidelines on the Use of Consultants* (April 2010, as amended from time to time).[25] The TORs will need clearance by ADB prior to any recruitment action for the packages.

1. Consultants' and Other Inputs

Table 12. Consultants and Other Service Providers

Title	Person	Person-Month		Total	Method
		International	National		
I. Audit Firm					
1. Audit Director	1	6	0	6	Firm
2. Audit Manager	1	0	12	12	QCBS
3. Audit Senior/ Team Leader	1	0	12	12	
4. Auditors	2	0	24	24	
Subtotal	**5**	**6**	**48**	**48**	
II. Project Management Consultants					Firm
1.Team Leader (Management/Finance)	1	30	0	30	QCBS
2. BVCM Development Specialist (Deputy Team Leader)	1	0	48	48	
3. CSAWMP Specialists	2	4	48	52	
4. Design Research Strategy	2	2	4	6	
5.Gender and Ethnic Minority Specialists	2	3	30	33	
6.Environment Safeguard Specialist	1	0	36	36	
Subtotal	**9**	**39**	**166**	**205**	
III. LCASP Facilitation Services[a]					
A. Consultants					
1.Central coordinator	1	0	60	60	
2.Provincial LCASP Coordinator[b]	10	0	600	600	
Total consultants[c]	11	0	660	660	
B. Supporting Staff					
1. CPMU Finance/Administration staff	1	0	60	60	
2.PPMU Finance/Administration staff	10	0	600	600	
3.PPMU commune facilitator[d]	30	0	600	600	

Note:

[a] ADB Loan will only finance 11 consultants as the LCASP facilitators. They are the Central Coordinator and Provincial LCASP Facilitators (one for each province). Finance/Administration supports and commune facilitators will be funded by the Government. They will be recruited from the Government staff who will work under CPMU and 10 PPMUs.

[b] One coordinator per province will lead three commune facilitators and Finance/Administration Support

[c] One package for one NGO or a firm to serve 10 provinces.

[d] Three commune facilitators per province, one commune facilitator will cover up to 60 communes

Source: ADB and the Government's staff estimates.

[25] Checklists for actions required to contract consultants by method available in e-Handbook on Project Implementation at: http://www.adb.org/documents/handbooks/project-implementation/.

Table 13: By Individual Consultants

Title	Provider (person)	Person-Month		Total	Method
		International	National		
Carbon Market Consultants	2	12	28	40	Individual
PAM Development Specialist	1	0	3	3	
Procurement Specialist	1	0	14	14	
Training Implementation Specialist	1	0	8	8	
Database Specialist	1	0	8	8	
Project Evaluation Specialists	2	2	4	6	
Total	**8**	**14**	**65**	**79**	

Source: Government and ADB staff estimates.

2. Audit Firm

a. Introduction

80. The Central Project Management Unit (CPMU) of Viet Nam Low Carbon Agricultural Support Project (LCASP) requires an auditor to carry out the audit services for the years from 1 January 2013 to 30 June 2019. The firm will audit the Project Accounts Annual Financial Statements (AFS) intermittently on annual basis. This describes the assignment scope and terms of these services.

b. General Background

81. LCASP is implemented under the Loan Agreement No. xxxx –VIE(SF) signed on xx December 2012 between the Asian Development Bank (ADB) and the Socialist Republic of Viet Nam. The total Project's cost is US$84.0 million equivalent which is financed by ADB and counterpart funds of the central and provincial governments, financial intermediaries, and beneficiaries (financial intermediaries and beneficiaries counterpart funds are sole for construction of biogas digesters). Project implementation period is 6 years, from 2013 to 2018; effectiveness dates from 1 January 2013. The Project is expected to be completed by 30 December 2018, and loan financial closing date shall be 30 June 2019.

82. As the Project Executing Agency, the Ministry of Agriculture and Rural Development (MARD) shall have the overall responsibility for the implementation of the Project. The Central Project Management Unit (CPMU) established in the Agricultural Projects Management Board (APMB) shall be responsible for overall Project coordination and management activities under the Project.

83. The Subsidiary Loan to eligible household beneficiaries for BP construction in the Project provinces which will be carried out by the FIs concerned including VBARD and CCF. Each of the Provincial Project Management Units (PPMUs) established in Department of Agriculture and Rural Development (DARD) of each project province shall be responsible, at the provincial level, and financial intermediaries shall act in the capacity of an implementing agency under the project.

84. The Loan proceeds and other fund sources for financing eligible items of expenditures under the Project shall be disbursed in accordance with the ADB's *Loan Disbursement Handbook* (2012, as amended from time to time) and the relevant financial regulations of the Government. Imprest accounts are to be established, of which one to be managed by CPMU and two to be managed by each financial intemediary. Subsequently, a sub-account will be

established and managed by each implementing agency. ADB's statement of expenditures procedure shall be used for reimbursement of eligible expenditures for, and liquidation of advances provided into each of the imprest accounts (including sub-accounts) established under the Project, in accordance with ADB's *Loan Disbursement Handbook* (2012, as amended from time to time) and detailed arrangements agreed upon between the Borrower and ADB.

85. All parties involved in Project implementation, including the financial intermediaries, shall maintain records and separate accounts for the Project, which shall clearly identify the expenditure categories, financing resources received, expenditures incurred, and the use of local funds. These records and accounts have to be established and maintained in accordance with sound accounting principles and internationally accepted accounting standards; and audited annually in accordance with sound accounting practices by an independent auditor to be engaged by CPMU in accordance with ADB's *Guidelines on the Use of Consultants* (2010, as amended from time to time), through least cost selection (LCS) method.

c. Audit Objectives

86. The primary objective of the annual financial statement (AFS) audit is to enable the auditor to express an independent opinion on whether the AFS presents fairly, in all material respects the financial position of the Project as of 31 December yearly, starting from Project effectiveness from 1 January 2013 and to the end of project, and financing resources and expenditures in project's financial years in accordance with Viet Nam and International accounting standards.

87. Secondary objectives include provision of auditor's separate opinions on: (i) utilization of the project's imprest fund and sub-accounts; (ii) the statement of expenditures, including whether the amount claimed is duly supported and verified; (iii) whether the CPMU, PPMUs and partner financial intermediaries are operating the imprest fund in accordance with ADB procedures; and (iv) compliance with financial covenants specified in the loan agreement and the relevant Subsidiary Loan Agreements.

d. Delivery of Opinions and Reports

88. The auditor will provide the following opinions and reports to the CPMU (with copies to ADB):

(i) an audit report includes a statement verifying whether or not the funds disbursed by ADB and other funding sources were used for the purposes for which they were provided;
(ii) the Auditor's opinion on the use of the imprest fund (including sub-accounts) and statement of expenditures procedures under the Project; and
(iii) management letter relating to the Project.

e. Reports to be Audited

89. **Audit at Project Implementing Units including CPMU, and PPMUs.** Audit of project accounts annual financial statements comprises:

(i) A report on received and used funding sources in which ADB's funds and counterpart funds are separated;

(ii) An expenditure report: presents main project components, main activities and main expenditures that are cumulated from the project commencement to the report's date. These expenditures are compared with the provisions in accordance with covenants of the Project. The auditor shall record in the report the expenditures that are identified as invalid which have been recorded in withdrawal applications and reimbursed. Attached with the project financial reports is a progress table which records each withdrawal application with its reference number and the amount of each withdrawal application. Total withdrawal amount as regulated for the expenditures reports should be part of the general collation sheet of the disbursement amount from ADB fund;
(iii) Report on imprest fund: operation of imprest fund and sub-accounts: (a) advance and additional amounts from ADB for the imprest fundt and sub-accounts and interest fees; (b) payment amounts for contractors, suppliers, advance and additional amounts for imprest fund and sub-accounts, including the amount in the additional withdrawal applications; and (c) balance on the last day of each fiscal year.

90. **Audit at FIs** includes:

(i) Credit amounts through imprest fund; report on imprest fund and activities on imprest fund;
(ii) Financial statements including balance sheet, statement of incomes and expenses and related statements to the sub-loan prepared by the financial intermediaries in accordance with accepted audit standards;
(iii) Each BVCM facility to be financed by the loan proceeds under the project is provided at the ratios as stipulated in the Loan Agreement and other relevant legal documents.

91. Copies of the audited accounts and auditor's report will be submitted to ADB within 6 months after the end of each financial year under the project.

92. The Management Letter and Annual Audit Report will be provided in the English and Vietnamese languages with 10 copies respectively submitted to the CPMU.

f. Auditing Period

93. Audit of Financial Statement will be implemented in 7 periods:

(i) Period 1: from the commencement date of the project to 31 December 2013; and
(ii) Period 2: in the fiscal year from 1 January 2014 to 31 December 2014; and
(iii) Period 3: in the fiscal year from 1 January 2015 to 31 December 2015; and
(iv) Period 4: in the fiscal year from 1 January 2016 to 31 December 2016; and
(v) Period 5: in the fiscal year from 1 January 2017 to 31 December 2017; and
(vi) Period 6: in the fiscal year from 1 January 2018 to 31 December 2018; and
(vii) Period 7: in the fiscal year from 1 January 2019 to close of project.

g. Audit Location

94. For the purpose of annual audit preparation, auditors will work at CPMU, 10 PPMUs and financial intermediaries from the central to the local units.

h. Audit Scope

95. **Auditing Standards and Program.** The audit must comply with Viet Nam Auditing Standard and International Standards consistently applied in Viet Nam, as well as existing regulations on financial, accounting and auditing.

96. The audit program will consider the risk of material misstatements resulting from fraud or error. It should include procedures that are designed to provide reasonable assurance that material misstatements (if any) are detected.

97. **Accounting Policies and Changes.** The auditor should comment on the entity's accounting standards and confirm the extent to which the agreed accounting standards, have been applied. In particular, the auditor should note the impact on the AFS arising from any material deviations from agreed accounting standards. The auditor should also comment on any material accounting policy changes, either during a financial year, or from one year to another.

98. **Imprest Account.** The imprest account reflects (i) deposits and replenishment received from financiers; (ii) payments substantiated by withdrawal applications; and (iii) the remaining balance at financial year-end. The auditor will examine whether the Imprest account has been maintained in accordance with the provisions of the Loan Agreement No. xxx VIE(SF) and relevant Subsidiary Loan Agreements.

99. The auditor must form an opinion on whether the imprest account was used in compliance with Account activity and the year-end balance. The auditor should examine the eligibility and correctness of financial transactions during the period under review account balances at the end of the period, the operation and use of the imprest account in accordance with the financing agreement, and the adequacy of internal controls for this particular mechanism.

100. **Statement of Expenditures (SOEs).** The auditor will audit all SOEs used as the basis for the submission of withdrawal applications for additional funds to ADB. These expenditures should be compared for project eligibility with the relevant financing agreements (and with reference to the RRP and other project documents for guidance when considered necessary). Where ineligible expenditures are identified as having been included in withdrawal applications and reimbursed against, these should be separately noted by the auditor. The annual audit report should include a separate paragraph commenting on the accuracy and propriety of expenditures withdrawn under SOE procedures, and the extent to which ADB can rely on those SOEs as a basis for credit disbursement. Annexed to the AFC should be a schedule listing individual SOE withdrawal applications by specific reference number and amount.

101. **Compliance with Financial Covenants**. The auditor will confirm compliance with each financial covenant contained in the Loan Agreement and relevant Subsidiary Loan Agreements. Where present, the auditor should indicate the extent of any noncompliance by comparing required and actual performance measurements for each financial covenant for the financial year concerned.

102. **Use of Funds for the Purpose Intended**. The auditor will confirm, or otherwise, that: (i) All external funds have been used in accordance with the Loan Agreement and relevant Project Agreement, with due attention to economy and efficiency, and only for the purpose for which the financing was provided; and (ii) goods and consulting services financed have been procured in accordance with the relevant financing agreements.

103. **Record Keeping.** The auditor will pay particular attention to whether all necessary supporting documents, records, and accounts have been kept in respect of all project activities. All parties involved in Project implementation, including MARD, Ministry of Finance (MOF) and the financial intemediaries, maintain records and accounts for the project, which shall clearly identify the goods, works and consulting services financed by the Loan Proceeds, financing resources received, expenditures incurred and the use of local funds; and these records and accounts are established and maintained in accordance with sound accounting principles and internationally accepted accounting standards.

104. **Internal Control Systems.** The auditor will assess the adequacy of the project financial management systems, including internal controls, including whether: (i) proper authorizations are obtained and documented before transactions are entered into; (ii) accuracy and consistency are achieved in recording, classifying, summarizing and reporting transactions; (iii) reconciliations with internal and external evidence are performed on a timely basis by the appropriate level of management; (iv) balances can be confirmed with external parties; (v) adequate documentation and an audit trail is retained to support transactions; (vi) transactions are allowable under the agreements governing the project; (vii) errors and omissions are detected and corrected by project personnel in the normal course of their duties, and management is informed of recurring problems or weaknesses; (viii) management does not override the normal procedures and the internal control structure; and (ix) assets are property accounted for, safeguarded and can be physically inspected.

i. Management Letter

105. On conclusion of the audit, the auditor will prepare a management letter, detailing:

(i) any material weaknesses in the accounting and internal control systems that were identified during the audit;
(ii) recommendations to rectify identified weaknesses;
(iii) the status of significant matters raised in previous management letters and any corrective actions taken by the organization;
(iv) practical recommendations on the steps that the organization could take to become materially compliant with the agreed accounting standards, together with a time frame for making these changes; and
(v) any other matters that the auditor considers should be brought to the attention of the organization's management.

j. Statement of Access

106. The auditor will be given access to all records and documents including books of account, legal documents, bank records, invoices and any other information associated with the project and deemed necessary by the auditor.

107. The auditor will be provided with full cooperation by all employees of the Project whose activities involve, or may be reflected in, the annual financial statements.

k. Independence

108. The auditor will be impartial and independent from any aspects of management or financial interest in the entity under audit. In particular, the auditor should be independent of the control of the entity. The auditor should not, during the period covered by the audit, be

employed by, or serve as director for, or have any financial or close business relationship with the entity. The auditor should not have any close personal relationships with any senior participant in the management of the entity. The auditor must disclose any issues or relationships that might compromise their independence.

I. Auditor and Audit Staff Competence

109. ***For Auditing Company:*** The auditor must be authorized to practice in the country and be capable of applying the agreed auditing standards. The detailed requirements on the qualification of auditing company are:

(i) be a legal entity with business license granted by the competent authority;
(ii) be included in the 2013 Certified Public Auditor List acceptable to Viet Nam Association of Certified Public Accountants;
(iii) be qualified in dependable principles and operational practice in accordance with international auditing standards; and
(iv) the auditor should have adequate staff, with appropriate professional qualifications and suitable experience in finance/financial management in ODA funded projects or Government projects/programs, including experience in auditing the accounts of entities comparable in nature, size and complexity to the entity whose audit they are to undertake.

110. **For Auditors.** The general requirements on the qualification of auditor are as follows:

(i) auditors shall hold relevant professional qualifications with in-depth experience in conducting audits of project financial statements. They should be properly granted with certified auditor certificate by the MOF or legal international auditor certificate. For particular proposed consultants as auditors as mentioned below, at least 50% personnel must have certificates of auditor granted by MOF or relevant certificates of international auditors;
(ii) auditors should hold a fair opinion on, and be independent of, control of the submitting entity and the employer by whom they were appointed; and
(iii) all established procedures and methodology are reliable and in conformity with Viet Nam Standards on Auditing.

111. The required qualifications and competence of the key staffs are summarized below:

(i) **Audit Director (1pm x 6 years - intermittent).** A university graduate (preferably with a post – graduate degree) in accounting/finance, preferably to whom holding international auditor certificate, at least 15 years or above experience working in financial, advisory and auditing services with 5 years experience in management of auditing teams. The actual working years in auditing must be 10 years or above since being granted with Viet Nam or international auditor certificate. Should have managed as Audit Manager for more than 3 audit contracts on ODA project's financial statements (preferably with ADB funded projects and/or multi-sector projects or implemented simultaneously at various management levels). Fluent in English.

(ii) **Audit Manager (2pm x 6 years – intermittent).** A university graduate (preferably with a post – graduate degree) in accounting/finance, preferably to whom holding international auditor certificate, at least 10 years or above experience working in

financial, advisory and auditing services with 4 years experience in management of auditing teams. The actual working years in auditing must be 10 years or above since being granted with Viet Nam or international auditor certificate. Should have managed as Audit Manager for more than 3 audit contracts on ODA project's financial statements (preferably with ADB funded projects and/or multi-sector projects or implemented simultaneously at various management levels). Fluent in English.

(iii) **Audit Senior/Team leader (2pm x 6 years - intermittent).** A university graduate (preferably with a post – graduate degree in accounting/financial, preferably to whom holding international auditor certificate, at least 10 years or above experience working in financial, advisory and auditing services. The actual working years in auditing must be 6 years or above since being granted with Viet Nam or international auditor certificate. Should have managed as Audit Senior/Team Leader for 3 audit contracts on ODA project's financial statements (preferably with ADB funded projects and/or multi-sector projects or implemented simultaneously at various management levels). Fluent in English.

(iv) **Auditors (2pm x 2 persons x 6 years).** A university graduate (preferably with a post – graduate degree in accounting/financial, preferably to whom holding international auditor certificate, 5 years experience or above working in financial, advisory and auditing services. The actual working years in auditing must be no less than 3 years. Should have managed as Auditor for 3 audit contracts on ODA project's financial statements (preferably with ADB funded projects and/or multi-sector projects or implemented simultaneously at various management levels). Fluent in English.

(v) In order to meet with the working plan and schedule report delivery as requested, the auditing company should arrange 6-7 groups of each comprises 1 team leader and at least 2 auditor with the appropriate qualification and experience.

m. Tentative Time Frame

(i) Auditor's selection and contract award approved by ADB and MARD: June 2013
(ii) Commencement of assignment: September 2013
(iii) Submission of Auditing report for the FY 2012/2013: not later than 10 June 2014.
(iv) Submission of Auditing report for the 2014 fiscal year: not later than 30 June 2015.
(v) Submission of Auditing report for the 2015 fiscal year: not later than 10 June, 2016.
(vi) Submission of Auditing report for the 2016 fiscal year: not later than 30 June, 2017.
(vii) Submission of Auditing report for the 2017 fiscal year: not later than 10 June, 2018.
(viii) Submission of Auditing report for the 2018 fiscal year: not later than 30 June, 2019.

n. Reporting Relationships

112. The Auditor shall report to Director of the Central Project Management Unit, Agriculture Project Management Board (APMB), Ministry of Agriculture and Rural Development (MARD).

- Address: 2nd xxxxx., Hanoi, Viet Nam
- Telephone: (84) xxxx Fax: (84) xxxx
- Email: xxxx

3. Project Management Consultants

a. Background

i. The Project

113. The Project Loan was approved by the Asian Development Bank and the Socialist Republic of Viet Nam, with a total Project cost of US$84.0 million equivalent. Project implementation period is 6 years, from 2013 to 2018.

114. The overall objective of the Project is to reduce air, water and soil pollution by supporting Climate Smart Agricultural Waste Management Practices (CSAWMP) for treating livestock wastes through the expanded use of biogas and bio-slurry processing technologies. The Project comprises 4 components: (i) expanded use of livestock waste management infrastructure; (ii) credit lines for biogas value chains; (iii) enhanced CSAWMP technology transfer[26]; and (iv) effective project management.

115. The Project is implemented in 10 provinces: Dinh, Lao Cai, Binh Dinh, Ha Tinh, Soc Trang, Son La, Phu Tho, Ben Tre, Tien Giang, and Bac Giang.

116. The Ministry of Agriculture and Rural Development (MARD) is the Project Executing Agency. The Central Project Management Unit (CPMU) was established under the Agricultural Projects Management Board (APMB) to coordinate and manage the whole project. A technical support unit (TSU) was also established within CPMU. 10 Provincial Project Management Units (PPMUs) were established under the Departments of Agriculture and Rural Development (DARD) of provinces participating in the project to manage all project activities at the provincial/city level. financial intermediaries (FIs) have been selected to channel credit for BVCM.

ii. The Project

117. The CPMU will select an eligible consulting firm, which possesses adequate qualifications and experience to perform the required services through a firm or non-governmental organization (NGO) or a consortium. The Consultants' Selection method will be *Quality and Cost based Selection (QCBS*) (ratio 80:20) and shall conform to ADB procedures.

b. Requirements of Qualification and Duties of Consultants

i. General Requirements for the Consulting Firm

(i) eligible to provide consulting services to ADB funded Projects;
(ii) have legal status (public or private), operating under Enterprise Law;
(iii) have business registration or decision to specify appropriate business fields according to the required contents of the consultancy package;
(iv) at least five (5) years working experience in related areas;

[26] Basic information, Problem analysis, and the Design and Monitoring Framework are found in Appendices 1, 2 and 3, respectively.

(v) have performed at least three (3) similar Contracts during the last three (3) years; of which at least one similar contract relating to the agriculture field;
(vi) priority for experience in performing consulting services on safeguard policies for loan project funded by 5 banks including: ADB, WB, AFD, JBIC and KFW; and
(vii) have essential financial capacity.

c. Consultant Team to the Assignment

i. Team Leader (Project Agricultural Management and Finance Specialist, international, 30pm)

118. The team leader (TL) shall have an advanced degree in agricultural finance and management with extensive experience in agricultural business management, financial management, and organization quality and management systems. The specialist shall preferably have some familiarity with commercial agricultural development in Viet Nam. The specialist will:

(i) work with other consultants, the government staff and other stakeholders to provide necessary technical and management support to MARD for effective project implementation;
(ii) develop or update the detailed implementation plan (DIP) for project implementation in consultation with the relevant departments of MARD, including TSU, financial intermediaries, provincial PPMUs and other key stakeholders;
(iii) assist in establishing or updating an appropriate project performance management system (PPMS) in all levels;
(iv) assist in the procurement of equipment, materials and civil works required for the Project, in accordance with the Viet Nam Government's tendering and bidding procedures and which are consistent with ADB's *Procurement Guidelines (2010, as amended from time to time)*;
(v) lead the preparation of consultants' technical working papers and progress reports and assist the central project management unit (CPMU) in preparing quarterly progress reports on the Project to be submitted to ADB;
(vi) assist in updating the development, establishment, and institutionalization of the project's overall investments by leading the consultant team in view of the lessons learned and experiences in Viet Nam and other countries in region and overseas;
(vii) assist in ensuring coordination between central-level agencies, provincial agencies, FIs, relevant research institutes, and stakeholders at the national, provincial, district and commune levels for the overall implementation of various investments established under the Project;
(viii) develop policy and institutional framework for implementation and monitoring of BVCM, CSAWMP, good agricultural practices, standards, certification, and inspection funded by the Project;
(ix) help update guidelines for BVCM, CSAWMP, and other supporting investments funded by the Project;
(x) assist in reviewing and developing standards and codes of conducts for the promotion of various investments funded by the Project;
(xi) assist in developing an effective accreditation and certification system, if required for BVCM, CSAWMP and other investments funded by the Project;

(xii) examine the priority needs for the upgrading of supporting facilities based on the list prepared during project formulation and help prepare detailed technical specifications through consultation with the relevant institutes of MARD, financial intermediaries, partner agencies and other stakeholders;
(xiii) provide or arrange for necessary training on the knowledge and skills for the use of supporting facilities required by the Project;
(xiv) assist in reviewing and developing standards and codes of conducts for the promotion of BVCM, CSAWMP and other investments funded by the project;
(xv) conduct capacity building activities for staff of MARD, DARDs, financial intemediaries, coordinating and managing entity (CME) and project staff.
(xvi) assist CPMU in preparing the quarterly reports, midterm review report, and the Project completion report in accordance with ADB standards

ii. BVCM Development Specialist (Deputy Team Leader, national, 48pm)

119. The BVCM Development Specialist will assist the team leader to coordinate all consultant activities related to the Project investments through the executing agency and implementing agencies. She/he will:

(i) update and develop biogas digester design and guidelines for use by households, livestock farms, government institutions, financial institutions and other stakeholders, review and update the existing “best-practice” and “state-of-the-art” BVCM and CSAWMP in Viet Nam, assess the viability of livestock farms and other enterprises with respect to new biogas investments and estimate the potential improvement of the existing biogas systems and potential promotion of small biogas plants (SBPs) and medium biogas plants (MBPs) and large biogas plants (LBPs); assess how readily various potential technologies can be utilized for large-scale applications in the project areas;
(ii) in consultation with the team leader, update the calculation and estimation of the costs of various technologies of BVCM and CSAWMP;
(iii) update and finalize the detailed work plan and implementation schedule, and assign the work to various team members on biogas related investments;
(iv) review, assess and update national and appropriate international experience with small, medium- and large-scale biogas plants design technologies, and the implications for local authorities (provinces, districts and communes) and other stakeholders (government institutions, financial institutions, NGOs, private, enterprises and households);
(v) carry out a review of basic documents on manure types and local climates and assess technology options available in Viet Nam, and provide recommendations regarding priority technologies, marketing, and management for bio-slurry based CSAWMP development, based on local conditions;
(vi) together with the Government staff and other experts, (a) review the ongoing BVCM and CSAWMP investments and formulate recommendations to improve technical manuals and financial management of the related investments;
(vii) prepare a working paper to assess the viability and sustainability of potential expansion for MBPs and LBPs beyond the lagoon system and also for biogas beyond livestock wastes; analyze strengths, weaknesses, opportunities and threats of such investments; disseminate and assess a potential pilot test for different technical options to be funded by the Project;

(viii) update the capacity strengthening needs relating to BVCM and CSAWMP development;
(ix) update the institutional, management structure, coordination, monitoring and evaluation mechanisms for a nationwide biogas program for both household and medium- to large-scale biogas including recommendation to empower relevant agencies;
(x) strengthen and finalize feasibility studies for selected livestock farms for MBPs and LBPs to be included in the project;
(xi) appraise the biogas-related technical and design soundness of the representative sample livestock farms and other relevant enterprises and develop criteria to assess the technical feasibility for biogas plants proposed by potential investors; and
(xii) recommend technical inputs needed to improve existing biogas programs and provide inputs and assist the team leader and other team members in preparing the detailed proposal for the new proposed investment project for the expansion of biogas development in Viet Nam.

iii. CSAWMP Specialists (international, 4pm and national, 48pm)

120. Their tasks will cover: (i) develop detailed guidelines to organize farmers based research by constructing biogas plants from rice straws; using bio-slurry as organic fertilizers; managing waste treatments in aquaculture; and other CSAWMP; (ii) develop detailed terms of reference (TOR) including budget to establish an information system, e-library, journals and database for for sharing CSAWMP research and training; (iii) develop training modules to train staff of the research institutions for efficient low carbon agricultural waste management technology and practices including organize overseas study tour in order to promote research collaboration; (iv) develop detailed TOR and modules for training programs and teaching textbook and syllabus for farmers about appropriate techniques for CSAWMPs; provide vocational training for farmers; (v) develop detailed TORs and budget to upgrade CSAWMP based map sets for 7 agro-ecological regions to forecast direct impact of climate change (sea level rise, salt sea intrusion, flood, drought) and support for agricultural planning; (vi) develop the detailed guidelines for livestock waste management models for agricultural production and GHG emission reduction; and (vii) facilitate training of trainers for extension staff and farmers in low-carbon agricultural production technologies to promote application of the technologies into agricultural production.

121. **General requirements.** (i) Masters degree for international consultant and at least a bachelors degree in appropriate specialities on CSAWMP and BVCM; (ii) at least five (5) years working experience in related areas; (iii) priority for experience in providing the consulting services on CSAWMP and BVCM for loan and/or grant project funded by ADB, WB, AFD, JBIC, KFW and/or other donor funded projects; (iv) experience in issues related to CSAWMP and BVCM in either international or national development programs; (v) 15 years of working experience including 10 years working for the donors' funded development projects; (vi) thorough understanding of Vietnamese Law and regulations related to CSAWMP and BVCM as well as ADB's policies is an advantage; (vii) good command of spoken and written English; and (viii) good skills on computer (Word, Excel, Internet Explorer and Power Point).

122. The TORs of these consultants will focus on helping CPMU and PPMUs to implement activities, mainly for component 3 of the Project. They will assist the Government staff, other consultants and service providers to prioritize the direction of the program of green house gas reduction in agricultural production which was approved in the decision 3119/QĐ-BNN-KHCN,

dated on 26 December 2011 of MARD's Minister in Greenhouse gas reduction in agriculture and rural by 2020. Their detailed TORs are specified as follows:

123. **Sub-component 3.1: Preparing a research strategy to direct project research activities on CSAWMP.** The activities include the following:

(i) Guide the CPMU, PPMU, other consultants, facilitators and other service providers to develop and implement packages to develop CSAWMP for different eco-agricultural regions, including research to use about 50 million ton of rice straw residue annually for making bio energy and organic fertilizers, biochar technology; and integrated management of aquaculture environment and waste treatment in aquaculture. The prioritized activities will be implemented following current MARD's regulations about research projects such as: (i) the research demand of each local will be investigated in the first year of project implementation; (ii) select research sub-projects in the second year of the project; (iii) implementation time of the sub-projects will be relied on the fact of the work but not over 3 years; (iv) the criteria for project liquidation is the dimension and application levels of the farmers and enterprises who has used the project research results. Project financial mechanism will be following the regulation of Circular 93/2006/TTLT/BTC-BKHCN. Expected results are about 21 research sub-projects of low carbon agricultural waste management in up to 7 agro-eco regions in Viet Nam will be implemented in order to bring up the applied results into production. These production technologies will be replicated by farmers and enterprises for efficient economic, social and environment. Also these successful results will be selected and introduced to the next project of government and private companies.

(ii) Establish an information system, (e-libary) research and training institutions connecting with center library in Viet Nam Academy of Agriculture Sciences (VAAS) to promote storage, exploitation and sharing of domestic and overseas science and technology information on low-carbon agricultural production technologies, climate change mitigation; to provide database for research and training institutions to effectively utilize the investment resources for scientific technology and extension of the State. Expected results are exploitation and sharing of science and technology information on low-carbon agricultural waste management technologies for selected research and technology transfer institutions of MARD will be enhanced. Increasing 30% research project about low carbon in these institutions will be presented in knowledgable international scientific journals.

(iii) Training for staff in the research institutions for efficient low carbon agricultural waste management technology and practices in the world and organize study tour in order to promote research collaboration for this purpose. Expected results are about 500 research staff are trained on low carbon agricultural waste management technologies.

(iv) Develop training programs and teaching textbook and syllabus for farmers about appropriate techniques for low carbon agricultural waste management practices, provide for training and rural vocational training. Expected results are about 20 training programs for farmers for low carbon agricultural waste management technology will be developed. Training programs will positively contribute to National target program for rural and farmer vocational training.

(v) Construct map sets for 7 agro-ecological regions to forecast high risk agricultural regions in the direct impact of climate change (sea level rise, salt sea intrusion, flood, drought), support for agricultural production planning, response to climate change, cropping interchange in order to increase land use efficiency and GHG emission reduction. Expected results are 7 map sets are constructed to positively contribute to CSAWMP of MARD.

124. **Sub-component 3.2. Constructing Low Carbon Agricultural Models for Agricultural Waste Management.** The activities include the following:

(i) Develop livestock waste management models for agricultural production and GHG emission reduction which was proven in the applied research activities. The models will be implemented with the principle that only support for technical but not for material for both farmers and enterprises. Expected results are about 70 extension models will be developed in 7 agro-ecological regions. These models will be performance pilots for supporting low carbon agricultural waste management technologies and practices.

(ii) Training in low-carbon agricultural production technologies through climate-smart agricultural waste management practices shall be provided for extension staff and farmers, particulary giving priority to agro-eco regions vulnerable to climate change. Expected results are about 7,000 farmers and 700 extension staff will be trained for CSAWMP techniques in order to promote application of low carbon technologies into agricultural production in the trial area where the research was applied.

iv. Design Research Strategy (international, 2pm and national, 4pm)

125. Their tasks will cover: (i) Elaborate a national research strategy for improving associate CSAWMP and BVCM and specific research activities that will be implemented in 10 participating provinces; (ii) Seek Government/ADB approval for CSAWMP and BVCM for research strategy and plan for national and provincial levels; and (iii) work closely with CSAWMP Specialists, CPMU, PPMUs, and facilitators Identify research and supporting facilities (including civil works, materials and equipments) for CSAWMP and BVCM development.

126. **General requirements.** (i) Masters degree for international consultant and at least a bachelors' degree in appropriate specialities on research strategies on CSAWMP and BVCM; (ii) at least five (5) years working experience in related areas; (iii) priority for experience in providing the similar services on CSAWMP and BVCM based researches for loan and/or grant project funded by ADB, WB, AFD, JBIC, KFW and/or other donor funded projects; (iv) experience in issues related to CSAWMP and BVCM in either international or national development programs; (v) 15 years of working experience including 10 years working for the donors' funded development projects; (vi) thorough understanding of Vietnamese Law and regulations related to CSAWMP and BVCM as well as ADB's policies is an advantage; (vii) good command of spoken and written English; and (viii) good skills on computer (Word, Excel, Internet Explorer and Power Point).

127. Some areas of CSAWMP and BVCM in Viet Nam still require research for specific environmental and geographic conditions. The consultants will support research activities in two stages: (i) elaboration of a research strategy to provide coherent direction to project research activities; and (ii) extending research into practice. The consultants will prepare a CSAWMP and BVCM research strategy, which will: (a) define the government's long-term objectives to

manage agricultural wastes; (b) assess current knowledge and practice, along with relevant institutional issues; (c) identify and prioritize research, dissemination and mainstreaming Gender Action Plans that need to be addressed; and (d) outline the activities needed to fill the identified gaps. Based on these priorities, the project will carry out priority research and disseminate the findings to practitioners, and mainstream them into standard practice. Examples of research activities could be: the use of non livestock agricultural wastes for producing bio-energy, biochar and organic compost; and waste treatments in aquaculture.

v. Gender and Ethnic Minority Development Specialist (international, 3pm and national, 30pm)

128. Their tasks will cover: (i) review of social reports on ethnic minorities and gender and community consultation in conformity with related regulations at national and specific in local regulations in the 10 participating provinces; (ii) prepare detailed monitoring schedules as well as safeguard policy reports on ethnic people and gender in accordance with ADB requirements; (iii) conduct community consultation in the Project area; and (iv) provide advice and guidance to CPMU/PPMUs on the strategy and project action plan related to Safeguard and Gender and Development policies.

129. **General requirements.** (i) Masters degree for international consultant and at least a bachelors degree in appropriate specialities on social science; (ii) at least five (5) years working experience in related areas; (iii) priority for experience in providing the consulting services on safeguard policies for loan project funded by ADB, WB, AFD, JBIC, KFW and/or other donor funded projects; (iv) experience in issues related to ethnic minorities, gender and vulnerable groups in either international or national development programs; (v) 15 years of working experience including 10 years working for the donors' funded development projects; (vi) thorough understanding of Vietnamese Law and regulations related to gender and ethnic minority development as well as ADB's policies is an advantage; (vii) good command of spoken and written English; and (viii) good computer skills (Word, Excel, Internet Explorer and Power Point).

130. **Detailed Tasks for Gender Action Plan**

(i) Support gender focal points in CPMU and PPMUs in implementing the Gender Action Plan to promote gender equality and ensure that women participate and benefit equally from the project.
(ii) Ensure the Project benefits to be shared among the community, particularly to vulnerable groups like the poor, women and ethnic minorities.
(iii) Design and deliver capacity building programs to improve understanding on gender issues for the government staff both at provincial and central level, encourage community in general and women in particular to participate in the implementation of the Project.
(iv) Review ADB's and Government's policies on gender equality and vulnerable groups in development and support the CPMU gender focal point to update Gender Action Plan, EMDP, etc as needed prior to implementation. Coordinate with PPMUs and environmental specialists to prepare and conduct consultation meetings with the participation of the community, including meetings on gender (if any), to ensure that safeguard and gender equality policies are appropriately addressed.
(v) Design and gather baseline sex-disaggregated data and gender analytical information as part of the PPMS.

(vi) Support CPMU to conduct social impact assessment and for any other preparatory surveys, feasibility studies or assessments.
(vii) Identify best practices in gender and agriculture/ waste management to develop materials for publication on gender and development and ensure the product output meet quality of ADB/government standard. Ensure targets for participation of female staff and ethnic minority (EM) staff in all project-related capacity development activities.
(viii) Include responsibility for consideration of gender issues and gender analysis in Terms of Reference for other consultants.
(ix) Ensure monitoring and reporting on all gender and sex disaggregated indicators and targets included iin PPMUs report and CPMU regular reports to ADB.

131. **Detailed Tasks for Ethnic Minority Development Plan**

(i) Review ADB's and Government's policies on ethnic minority and vulnerable groups in development and support the CPMU focal point to update EMDP, as needed prior to implementation.
(ii) Coordinate with PPMUs to prepare and conduct consultation meetings with the participation of the community, to ensure that safeguard and gender equality policies are appropriately addressed.
(iii) Design and gather baseline data on ethnic minorities and ethnic minority information as part of the project monitoring, evaluation and reporting system.
(iv) Support CPMU to conduct social impact assessment and for any other preparatory surveys, feasibility studies or assessments related to ethnic minority issues.
(v) Design and deliver training for CPMU, and all PPMUs focal points on ethnic minority and social development.
(vi) Develop materials for publication on ethnic minority and development and ensure the product output meet quality of ADB /government standard.
(vii) Ensure targets for participation of ethnic minority staff in all project-related capacity development activities.
(viii) Ensure monitoring and reporting on all ethnicity disaggregated indicators in ethnic minority data and targets included in PPMUs report and CPMU regular reports to ADB.

vi. Environment Safeguard Specialist (national, 36pm)

132. **Requirements on Qualification**. (i) Bachelor degree or higher qualifications on environmental management or related areas; (ii) experience in project management and safeguard policies and experience in assessment and preparation of environment report, environment supervision in the ODA funded projects, including projects funded by ADB as well as experience as team leader; (iii) thorough understanding on Vietnamese Law and relevant regulations on environmental protection and other provisions and guidelines by ADB; (iv) at least 10 years of working experience including 5 years working for the donors' funded development projects and preferably with work experience in biogas technology; (v) good command of oral and writren English; (vi) good computer skills (Words, Excel, Internet Explorer and Power Point).

133. **Specific Requirements.** The Environment Safeguard Specialist will assist CPMU and PPMUs in ensuring the project's compliance with environmental safeguards of the Government

and the ADB of the Project. He/she will report directly to the Project Director or authorized staff. The specific duties of the environment safeguard specialist are:

(i) Review all project documents, including, but not limited to, Loan Agreement, Report and Recommendation of the President (RRP), Monitoring and Evaluation Framework on Environment; Environmental Assessment Review Framework (EARF), Initial Environmental Examination (IEE), Project Administration Manual (PAM) and other related documents, ADB policies, and Government laws related to environmental management, supervision and protection;
(ii) Carry out a formal screening of all proposed MBPs and LBPs as part of the project for environmental impact, both according to ADB environmental safeguard standards and according to those of the Government, based on the completed screening checklists; in particular prepare a screening checklist based on the relevant ADB Rapid Environmental Assessment Checklists and the environment categorization form for all proposed MBPs and LBPs as part of the Project;
(iii) Assist CPMU and PPMUs in submitting the required documentation to report to ADB the outcome of the screening and categorization process;
(iv) In the case of category C biogas plants, notify ADB of the screening findings and the categorization of the subprojects;
(v) Identify and report to CPMU to remove proposed biogas plants which may have major adverse environmental impact and would be classified as “A Category” for environment under the ADB guidelines;
(vi) Upon ADB’s confirmation on the categorization of the biogas plants, prepare IEE, in both Vietnamese and English, for all medium and large biogas plants, proposed as part of the Project, which are classified as B category. This will include preparing an Environment Management Plan (EMP) with support from PPMUs in accordance with ADB Guidelines to assure these documents to be endorsed in conformity with ADB’s standards. The EMP shall highlight proposed mitigated measures and recommend required monitoring and supervision;
(vii) Coordinate activities of other specialists in the field trips and assist CPMU and PPMUs in organizing meaningful stakeholder consultations on all proposed medium and large biogas plants as required by ADB Safeguard Policy Statement 2009;
(viii) Provide recommendations on technologies to make full use of the biogas and bio-slurry produced by biogas plants;
(ix) Provide training as necessary on safeguard policies and environmental monitoring of biogas plants, according to the EMP, to CPMU and PPMU environmental specialists;
(x) Assist CPMU and PPMUs in the environmental monitoring of biogas plants as required. Monitoring of all medium and large biogas plants is prioritized although sample environmental monitoring of small biogas plants may also be required.
(xi) Prepare cost estimates for the environmental measures to mitigate any adverse impact;
(xii) Ensure disclosure of project information on environment for affected persons and other stakeholders according to ADB Safeguard Policy Statement 2009; and
(xiii) Assist CPMU and PPMU to prepare regular environmental monitoring reports to ADB according to the PAM.

d. Work Outputs

134. The specialists will work together to deliver following reports in addition to delivering outcomes mentioned above for each position. These are the reports specified below for submission to CPMU:

Table 14: Work Outputs

No.	Name of report	Specialist in charge	Number of copies		Submission date
			Vietnamese	English	
	Main report				
1	Inception report (max. 10 pages of main text)	Team leader	10	5	
2	Quarterly Report				
3	Mid-term report (max. 30 pages of main text including the Executive summary)	Team leader	10	5	
4	Final report (max. 35 pages of main text including the Executive summary)	Team leader	10	5	
	Total		**30**	**15**	
1	Sub-project Environmental Report	Environment Specialist	10	5	
2	Ethnic Minority Development Plan (EMDP), Community Consultation Report, Gender and Vulnerable Report	Specialist on Consultation, Ethnic Minority and Gender	10	5	
	Total		**20**	**10**	

e. Facilities to be Provided by the Client

135. The Client (CPMU) will support the Consultants in the following matters:

(i) Documents, data related to the CSAWM project of provinces/cities;

(ii) Facilitate the access to necessary documents, data, maps available in the provinces/cities.

(iii) Assign project staff to collaborate with, and to support the consultants during their implementation of the assignment.

(iv) Other reasonable requirements if requested by the Consultants and possibly responded by the Client.

(v) Consultants shall arrange by themselves the equipment and technical facilities for implementation of the assignment.

f. Budget

136. The positions will be fulltime and part-time during the project period of seven years. Frequent travel (on average, two trips a month are planned) to the provinces where the Project investments are expected.

Table 15: Project Management Consultants and Budget

Positions	Person	Consultants			Estimate Costs ($'000)		
		International	National	Total	International	National	Total
Team Leader (Management/Finance)	1	30	0	30	750	0	750
BVCM Specialist	1		48	48	0	336	336
CSAWMP Specialists	2	4	48	52	100	336	436
Design research strategy	2	2	4	6	50	28	78
Social for Gender Action Plan and EMDP	2	3	30	33	75	210	285
Environment safeguards	2	0	36	36	0	252	252
Subtotal	**10**	**39**	**166**	**205**	**975**	**1162**	**2,137**

Source: Government and ADB Staff Estimates.

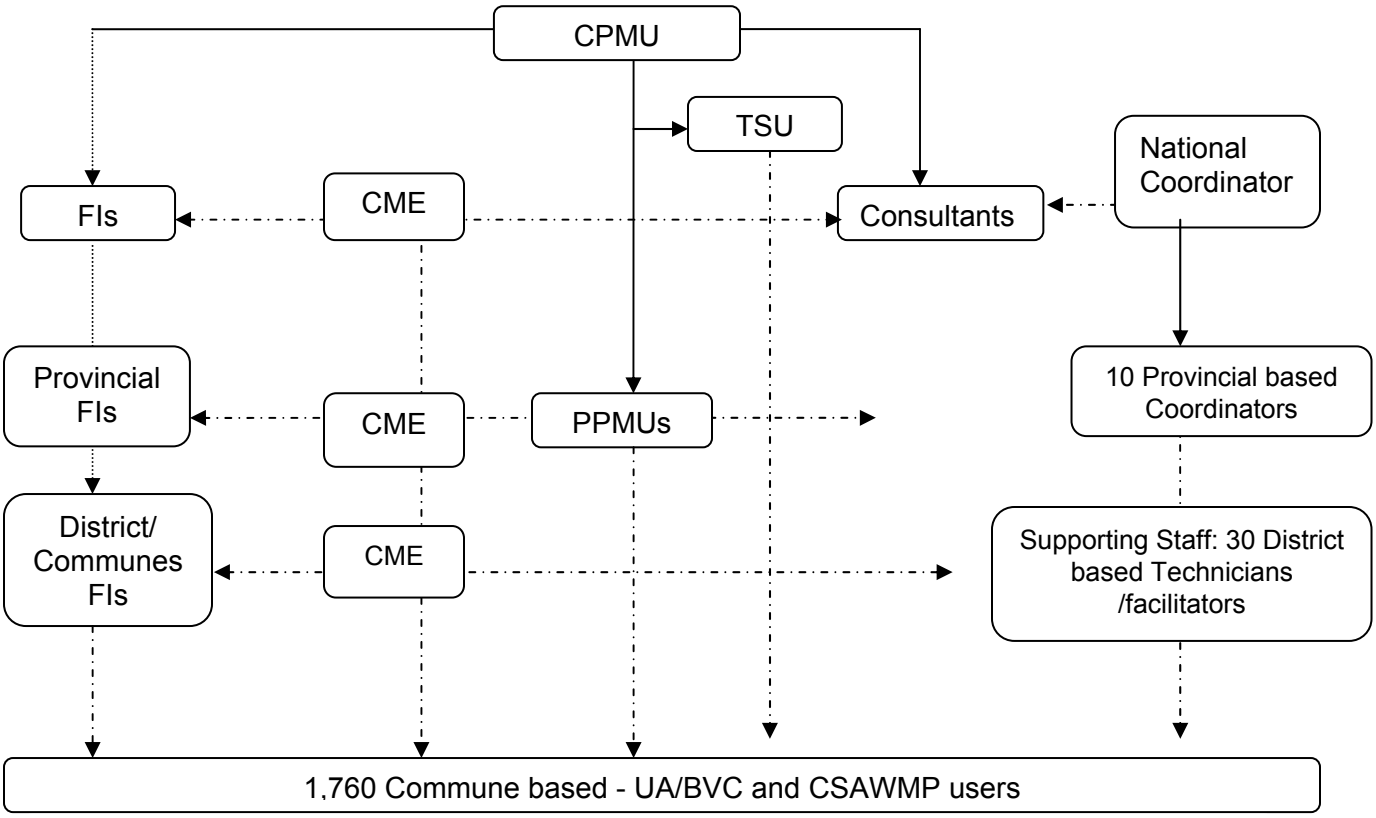
4. LCASP Facilitators

a. Tasks Outline

137. The facilitators will be recruited through one package from entities eligible to bid for such packages, in accordance with the Procurement Plan. The facilitator team will consist of 11 national consultants (one national coordinator who will lead 10 provincial based coordinators, one in each participating province). Each provincial team will be supported by (i) three commune based facilitators and (ii) one supporting administration/financial staff (based in each PPMU office). The National coordinator will work under the supervision of CPMU, to lead the provincial coordinators to implement their terms of reference (TORs).

138. As of December 2010, Viet Nam has 63 provinces, 697 districts and 11,112 communes (about 11 districts and 176 communes per province, about 59 communes per district facilitator). The figures of technicians/supporting staff are indicative since they will be paid based on performance. Chart 1 below presents the role of LCASP facilitators in the overall project structure:

Chart 1: LCASP Facilitators



CSP = central service provider, CPMU = central project management unit, FIs = financial intermediaries, LCASP = low carbon agricultural support project, PPMU = provincial project management unit, PSP = provincial service provider, TSU = technical support unit, UA = user associations.
Source: Government and ADB Staff Estimates.

139. The following are the TORs of 11 consultants and their supporting staff:

b. Detailed TOR for each consultant and Commune Facilitators

140. **National Coordinator:** Under the supervision of CPMU, s/he will: (i) assist the Coordinating and Managing Entity (CME), in close coordination with the database specialist, to consolidate in one database the progress of biogas plants and coordinate with other consultants to interlink the database with potential markets for carbon credits; (ii) coordinate with financial intemediaries to consolidate the biogas plants funded by credit lines and update the consolidated progress of the ICMD distribution in the project areas; (iii) coordinate with PPMUs, research and training agencies to facilitate the implementation of component 3 at commune levels; and (iv) lead the provincial coordinators to organize project activities at provincial to commune levels.

141. **General requirements:** (i) a university graduate in agriculture, economic, management and other relevant fields; (ii) at least five (5) years working experience in related areas; (iii) priority for experience in providing the similar services on CSAWMP and BVCM based investments for loan and/or grant project funded by ADB, WB, AFD, JBIC, KFW and/or other donor funded projects; (iv) 10 years of working experience including 5 years working for the donors' funded development projects; (vi) thorough understanding of Vietnamese Law and regulations related to CSAWMP and BVCM as well as ADB's policies is an advantage; (vii) good command of spoken and written English; and (viii) good computer skills (Word, Excel, Internet Explorer and Power Point)

142. **Provincial Coordinators (One in each province):** Under the supervision of PPMUs, s/he will: (i) assist the Coordinating and Managing Entity (CME), in close coordination with the database specialist, to consolidate in one database the progress of biogas plants and coordinate with other consultants to interlink the database with potential markets for carbon credits; (ii) coordinate with financial intermediaries to consolidate the biogas plants funded by credit lines and update the consolidated progress of the ICMD distribution in the project areas; (iii) coordinate with PPMUs, research and training agencies to facilitate the implementation of component 3 at commune levels; and (iv) lead the provincial coordinators to organize project activities at provincial to commune levels.

143. **General requirements:** (i) a master degree in agriculture, economic, management or other relevant fields; (ii) priority for experience in providing the similar services on CSAWMP and BVCM based investments for loan and/or grant project funded by ADB, WB, AFD, JBIC, KFW and/or other donor funded projects; (iii) 5 years of working experience including 3 years working for the donors' funded development projects; (vi) thorough understanding of Vietnamese Law and regulations related to CSAWMP and BVCM as well as ADB's policies is an advantage; (vii) good command of oral and written English; and (viii) good computer skills (Word, Excel, Internet Explorer and Power Point).

144. National Coordinator, Provincial coordinators and commune facilitators will help the implementation of the three components through the following activities:

145. For component 1, expanded use of livestock waste management infrastructure, the facilitators will:

(i) Assist PPMUs to coordinate closely with the CPMU and the Project Management Consultants, especially the BVCM Specialist to formulate detailed investment activities from provincial to commune level for the component one of the Project;
(ii) Work closely with qualified technicians, contractors and masons to conduct survey and complete the baseline/database for biogas value chain management (BVCM), CSAWMP and other project investments to ensure that the PPMS is well prepared, monitored and reported (for quarterly, yearly, midterm, and completion report); and link these to project related websites;
(iii) Facilitate communication between PPMUs and CPMU to ensure that the CPMU disburse the incentive for carbon market development (ICMD) after the biogas owners fully comply with the technical and environmental requirements under the Project;
(iv) Carbon Market Development. Coordinate with the Transaction and Carbon Market Specialist team and Coordinating Managing Entity (CME) to gather the specific information and data required for various carbon trading; and ensure that the PPMU staff work closely with technicians, masons, contractors and other stakeholders to properly collect and submit the data;
(v) Work closely with PPMU staff to ensure that their district representatives properly monitor the progress of data gathering; maintain the computer, software, and other supporting facilities assigned to them; and work effectively with relevant agencies and other stakeholders to support the viability of the carbon market initiatives.

146. For component 2, credit lines for biogas value chains, the facilitators will:

(i) Ensure that PPMUs properly disclose to the participating financial intermediaries and the potential biogas owners the list of qualified masons for small biogas plants (SBPs); and qualified contractors for medium biogas plants (MBPs) and large biogas plants (LBPs);
(ii) Facilitate meeting between potential biogas owners, financial intermediaries, qualified masons and contractors to be more proactive in establishing biogas value chain facilities; and ensure that the technicians and engineers properly insert the incremental BVCM facilities to update the database;
(iii) Monitor the flow of ICMD from CPMU to beneficiaries' accounts

147. For component 3, enhanced CSAWMP technology transfer, the facilitators will:

(i) Help the CPMU through PPMU staff to properly implement the investment activities funded by the Project up to commune level.
(ii) Assist PPMU to coordinate closely with the Project Management Consultants, especially the CSAWMP specialist, to formulate detailed investment activities from provincial to commune level for the second component of the Project.
(iii) Facilitate PPMU staff to organize biogas owners through associations to effectively use and trade bioslurry for fertilizers in system of rice intensification; fresh water fishery development; tree crops, annual crops and other commodities.
(iv) Facilitate PPMU staff to organize biogas owners through associations to effectively use, trade and/or treat the surplus of gas and electricity to avoid the potential emission of the surplus gas to atmospheres.

148. For component 4, Project Management, the facilitators will:

(i) Assist PPMU to provide necessary data and coordinate with the Project Management Consultants, especially the Design research strategy Specialist in formulating the long- (up to 10 years) and short-term (five year and annual basis) on CSAWMP;
(ii) Assist PPMU to identify and prioritize at least 21 packages of critical CSAWMP knowledge gaps (at least 2 packages per PPMU); and assist the PPMU to carry out the research activities.

c. Budget Estimates

149. The LCASP facilitators will be recruited through firms or nongovernmental organizations (NGOs) under one package through QCBS (80:20). One NGO or firm may serve more than one lot. It is expected that the maximum 10 firms and/or NGOs who will provide these services. The list of facilitators required per province given in Table 16 below is only indicative figures for the budget projection purpose, since the NGO or firm will be paid on performance basis. Each firm or NGO may restructure the persons involved in the services to ensure the targets set in the contract will be fully achieved.

Table 16: LCASP Facilitators – Consultants

Potential Positions	Persons	Person Months	Monthly Remuneration ($'000)	The Overall Project Duration ($'000)
A. Consultants (funded by ADB Loan)				
Central Coordinator - team	1	60	2.0	120
1.Provincial LCASP Coordinator	10	600	0.8	480
Sub-total				**600**
B. Supporting Staff (funded by Government)				
1.CPMU Finance/Administration support	1	60	0.4	24
2.District LCASP Coordinator	30	1800	0.8	1440
3. Finance/Administration support	10	600	0.4	24
Subtotal	**41**	**2460**	**-**	**1,488**
Total				**2.088**

Note: Remuneration including travel, communication, administrative and other expenses
Source: Government and ADB Staff Estimate.

5. Individual Consultants

a. Carbon Market Consultants

150. These terms of reference are for the Carbon Market Consultant under Low Carbon Agricultural Support Project in Viet Nam. The Carbon Market Consultant team is expected to support carbon market operations for the projects under the loan and other on-going efforts for obtaining carbon market benefits of MARD. The support would include one national and one international consultants. The consultants will work as a team to provide inputs and later on the responsibility will be passed on to the coordinating and managing entity (CME) under MARD and its potential partners, the relevant agencies. The consultants are expected to work in regulated as well as voluntary markets in national and international arena.

i. Transaction and Carbon Market Specialist (international, 12pm)

151. Focus of the project is on environmentally sound technology that can take advantage of carbon market. Hence, an environment consultant with experience in technical and commercial market will be desirable. She/he will guide technical consultants and overview technical and commercial issues of the carbon market. She/he should have post-graduation in environment science and must possess technical as well as financial experience in carbon market operations. She/he is expected to give critical inputs to MARD's CME on legal implications with respect to emission reduction purchase agreements with potential buyer and emission reduction/ remuneration distribution within component project activity (CPA). The consultant will review/ prepare necessary documents. He may also participate in legal dispute resolution process if any.

152. Qualifications and experience: International Carbon Market Consultant (Technical) will have basic degree in Engineering/Science and will have master's degree in engineering, economics, management or related fields. He will have about 4 years' experience in carbon market related technical work. Work experience in Viet Nam and South East Asia is desirable.

153. She/he will report to the Director of the Central Project Management Unit (CPMU) and will be responsible for technical aspects of carbon market operations for the project. She/he will work in close coordination with the National Carbon Market Consultant and advise MARD/CME on carbon market related activities. Major responsibilities will include:

(i) Activities required until registration under Clean Development Mechanism (CDM), Voluntary Gold Standard (VGS), International Bilateral Schemes or any other national/international scheme for both small biogas and medium and large biogas plants (SBPs , MBPs and LBPs)

- Preparation
  - Decide appropriate carbon market scheme / tool for the projects under the loan
  - Follow initial process such as prior consideration of CDM / Opening of Gold Standard (GS) account and other activities, in close consultation with the CME
  - Agreement on parties participating in the Voluntary Gold Standard Program of Activity (VGS-PoA)
  - Study of the programs, Quality Control (QC) systems and forms used

- Development of a local stakeholder consultation report: The consultant will guide and assist the MARD/CME in execution of local stakeholder consultation according to requirement of the carbon market scheme selected for the project and prepare documents.
- Development of Project Design Document, Generic CPA, Specific CPAs and other carbon reports where applicable and work on all the reports necessary for completion including requirement for additionality, baseline, monitoring and associated forms
- Help MARD / CME in Designated Operational Entity (DOE) related activities including
  - Selection of DOE
  - DOE on site visit assistance

  - Reponses to DOE comments
  - Reponses to GS comments after 4 week GS review period
- Implementation activities
  - Monitoring system
  - Database set-up, form storage
  - CME capacity building
  - Inclusion of CPA and database installation
- Follow procedure of inclusion of CPA, record the same and coordinate with CME/ United Nations Framework Convention on Climate Change (UNFCCC)/DOE
- The consultant is also expected to suggest changes / modifications in existing methodologies (of CDM / GS or any other carbon market governing technical body) in consultation with the Carbon Market Program of ADB so as to maximize benefits for the project proponent. The consultant will review project design and its specific elements such as distribution of biogas, its usage for various application and advise on carbon market application.

(ii) Verification of monitoring period of household biogas (CDM PoA and any other chosen approach) and MLS Biogas

- Design of survey and execution of the same
  - Sampling method conform with the requirement of the selected carbon market mechanism
  - The consultant will guide and assist the CME in executing the monitoring plan as per requirements of the relevant carbon market mechanism including training and ensuring calibration of instruments as required
  - Review and analysis of survey data
- Update of non-renewable biomass assessment if applicable or ex post fuel survey measurement or any other requirement specified in the carbon mechanism
- Development of monitoring report
- Assistance to selection of DOE
- DOE field visit assistance
- Replies to DOE comment
- Coordinate with the potential buyers to fulfill their information requirements

(iii) Knowledge transfer and update on developments

- The consultant is required to keep an eye on national and international carbon market activities. It is expected that the market developments, international climate negotiations and national issues are reported to the CME / MARD. There should be at least one update every six months.

(iv) Training

- The consultant will ensure that MARD has received adequate training to carry out the work and has met all the training requirements specified in POA DD or relevant document. Training records should be recorded and stored properly for verification at a later date in the system. The consultant will ensure that all the training material, documents, procedures; records are handed over to MARD for their maintenance at the end of consultancy assignment. The consultant is

expected to assess need for resources to maintain carbon market operations from time to time and advise the MARD on requirements during the phase of project implementation and after project implementation period.

(v) Carbon Asset Management

- The consultant will assist and train CME on the legal and financial aspects related to sale of carbon credits and carbon asset management in consultation with MARD. This includes contacting and screening of potential buyers and due diligence on ERPA (emission reduction purchase agreements). Legal / financial aspects of contracts between CME and CPA owner will also be covered by the consultants.

(vi) Reporting

- The consultant will report on his/her activities to ADB as well to MARD/CME. A status report will be presented to ADB on work done for each 25% of work completed each year and steps to be taken for remaining period will be discussed. The consultant will coordinate closely with CME / MARD and help them in identification of additional consultancy input requirements.

ii. Carbon Market Consultant (national, 28 pm)

154. National Carbon Management Consultant will be responsible for overall management of carbon market operations for LCASP. She/he will work in close coordination with the International Carbon Market Consultant; the Project Management Consultants, the LCASP Facilitators, and other stakeholders. Major responsibilities will include:

(i) Activities required until registration under CDM, Voluntary Gold Standard, International Bilateral Schemes or any other national/international scheme for both household biogas and MLBP

- Preparation
  - Follow initial process such as prior consideration of CDM / Opening of GS account and other activities, in close consultation with the CME
  - Agreement on parties partaking in the VGS-POA
  - Study of the programs, QC systems and forms used
- Development of a local stakeholder consultation report
  - The consultant will guide and assist MARD / CME in execution of local stakeholder consultation according to requirement of the carbon market scheme selected for the project and prepare documents.
- Development of Project Design Document, Generic CPA, Specific CPAs and other carbon reports where applicable and work on all the reports necessary for completion including requirement for additionality, baseline, monitoring and associated forms
- Help MARD / CME in DOE related activities including
  - Selection of DOE
  - DOE on site visit assistance
  - Reponses to DOE comments
  - Reponses to GS comments after 4 week GS review period

- Implementation activities
  - Monitoring system
  - Database set-up, form storage
  - CME capacity building
  - Inclusion of CPA and database installation
- Follow procedure of inclusion of CPA, record the same and coordinate with CME/ UNFCCC / DOE

(ii) Verification of monitoring period of household biogas (CDM POA and any other chosen approach) and MLBP

- Design of survey and execution of the same
  - Sampling method conform with the requirement of the selected carbon market mechanism
  - The consultant will guide and assist the CME in executing the monitoring plan as per requirements of the relevant carbon market mechanism including training and ensuring calibration of instruments as required
  - Review and analysis of survey data
- Update of non-renewable biomass assessment if applicable or ex post fuel survey measurement or any other requirement specified in the carbon mechanism
- Development of monitoring report
- Assistance to selection of DOE
- DOE field visit assistance
- Replies to DOE comment
- Coordinate with the potential buyers to fulfill their information requirements

(iii) Training

- The consultant will ensure that MARD has received adequate training to carry out the work and has met all the training requirements specified in POA DD or relevant document. Training records should be recorded and stored properly for verification at a later date in the system. The consultant will ensure that all the training material, documents, procedures, records are handed over to MARD for their maintenance at the end of consultancy assignment. The consultant is expected to assess need for resources to maintain carbon market operations from time to time and advise the MARD on requirements during the phase of project implementation and after project implementation period.

(iv) Reporting

- The consultant will report on his/her activities to ADB as well to MARD/CME. A status report will be presented to ADB on work done for each 25% of work completed each year and steps to be taken for remaining period will be discussed. The consultant will coordinate closely with CME/MARD and help them in identification of additional consultancy input requirements.

155. Qualifications and experience: National Carbon Market Consultant (Technical) will have basic degree in Engineering / Science and will have master's degree in engineering, economics, management or related fields. He will have about 2 years' experience in carbon market related technical work. Work experience in Viet Nam and South East Asia is desirable.

156. The carbon market consultant (Financial) is expected to give critical inputs to MARD / CME on financial structuring of the deals with the potential buyers. Carbon market consultant (Financial) will work closely with Carbon Market Consultant (Technical).

157. Design philosophy of above arrangement is that initially, registration-related activities will be prominent and hence, an international consultant will be required to put more inputs. Later on the international consultant will be building the capacity of the national consultants thus the international consultant will take on a supervisory role. The national consultant will also make sure that the project is finally handed over to the project proponent. For thisreason, the national consultant inputs were reduced. Thus, MARD / CME is expected to increase its own infrastructure for the project more from revenue generated out of carbon credits. Thus, any shortfall in consultancy assignment can be complimented by CME / PP's own resources.

6. Start-up Consultants

a. Background of the Assignment

158. The CPMU of LCASP requires a start-up team comprised of four national individual consultants to carry out the assignment as: (i) PAM development Specialist; (ii) Procurement Specialist; (iii) Training Implementation Specialist; and Planning and monitoring Specialist. The expected duration and budget of their services are given in Table 17 below:

Table 17: Project Start-up Support Consultants

Positions	Consultants (Persons)	Services (Months)	Remuneration ($'000) Monthly	Remuneration ($'000) All Project
1. PAM development Specialist	1	3	7	21
2. Procurement Specialist	1	14	7	98
3. Training Implementation Specialist	1	8	7	56
4. Database Specialist	1	8	7	56
Sub-Total	**4**		**28**	**231**
Contingencies				**19**
Total				**250**

Source: Government and ADB Staff Estimate.

159. The consultants will be recruited on individual basis for the following assignment scope and terms. They will be recruited to provide start-up support for the Project to help CPMU, TSU, PPMUs, 2 finanial intemediaries to formulate the detailed project implementation plan (DIP) based on the agreed Project Administration Manual (PAM). DIP and PAM will be used as guidelines for implementing all detailed investment activities of the Project.

b. Terms of Reference of Each Start-Up Consultant

i. PAM Development Specialist (national, 3 pm)

160. **Objective of Services.** The specialists will assist CPMU, TSU, PPMU and financial intemediaries to develop the detailed project implementation plan (DIP) on quarterly basis for the overall project implementation that will cover all project components. They will also consolidate the technical guidelines from other service providers and stakeholders. The DIP and

the guidelines should be comprehensive and should be based on the legal documents approved by MARD, and ADB's supporting documents.

161. **Duties and Responsibilities.** The Consultants should:

(i) Thoroughly study the project legal documents including: (a) Project Detailed Outline (PDO) and Feasibility Study (FS) Report of the proposed LCASP approved by the Government; (b) Report and Recommendation of the President (RRP) and its linked and supplementary documents on the proposed loan approved by the ADB's Board of Directors; (c) Loan Agreement and Project Agreement approved by the Government and ADB; and other regulations adopted by Vietnamese Government and ADB, mentioned in the three legal documents above;

(ii) Facilitate consultation meetings and workshops with representatives from relevant MARD Departments, Ministry of Financial (MOF), Ministry of Planning and Investment (MPI), State Bank of Viet Nam (SBV), and the relevant project provinces, FFIs, by the logistic supporting of the CPMU.

(iii) Consult with the relevant MARD's Departments for consultation are mainly Agricultural Projects Management Board (APMB), International Cooperation Department (ICD), Department of Planning (DP), Department of Finance (DOF), Department of Science, Technology and Environment (DSTE), Department of Crop Production (DCP), Department of Livestock Production (DLP), National Agro-Forestry and Fisheries Quality Assurance Department (NAFIQAD), and Department of Plan Protection;

(iv) Consult with representatives of the Department of Renewable Energy under the Ministry of Industry and Trade; the Ministry of Natural Resource and Environment to gather their inputs on investments related to electricity tariff, carbon markets, waste management and other related investments under the proposed project to ensure that their views are well incorporated in DIP;

(v) Incorporate comments and recommendations from various key stakeholders for the DIP preparation to ensure that the Draft DIP shall set forth but will not be limited to the following: (a) the implementation arrangement at the central, provincial, and local levels; (b) guidelines for the preparation and technical review of provincial annual work plans; (c) in respect of BVC and CSAWMP investments, eligibility criteria and review and approval procedures for the preparation of the detailed investment by each owner; (d) in respect of credit lines from FIIs, eligibility criteria and review and approval procedures for financial assistances to support carbon market development and sub-loans to support for establishment and operation of safe and effective BVC facilities; (e) detailed guidelines for financial management and procurement consistent with the Project Legal Documents, including procedures and requirements for disbursement of funds, internal control arrangement, record keeping, reporting and auditing of Project records and accounts; (f) guidelines for the implementation of environmental and social safeguard policies.

(vi) Revise and finalize the DIP for approval by ADB and MARD.

162. **Outputs.** Main deliverables include the Draft and the approved DIP and supporting guidelines.

163. **Key Qualifications.**

(i) University degree; preferably with a master's degree in Agronomy or Economics, related fields or rural development projects; and experience in international donors' funded projects in areas of agriculture, environment and rural development projects;
(ii) has held senior positions in development work and managerial/ advisory experience of at least 15 years preferably in an International or Multinational Bank.
(iii) have a good knowledge on Vietnamese rural areas including project areas and have good working relationships with key government officials, and representatives of key aid agencies and private sector, and be familiar with overseas development assistance (ODA)-funded projects in Viet Nam;
(iv) Extensive knowledge about ODA projects, experience in ODA project management and implementation with at least 10 years of experience. Having experience in PAM and DIP preparation is required;
(v) In depth knowledge on Government's and Donor's procedures and regulations; and
(vi) Good command of oral and written English.

164. **Assignment Duration.** The project consultancy will be required for a 2 and 4 months input, respectively for the international and national consultants, which is expected to start in January 2013.

165. **Duty Station, Reporting Arrangements, and Timeframe.** The consultant will be based mainly in Hanoi with possibility of travel to project areas. He/she will report directly to and under supervision of the CPMU Director of LCASP.

166. **Facilities to be provided by the Project.** The project will support the Consultants by providing office support and facilities, supervision and advice, documents and materials and by facilitating access to relevant information and materials. The translation services and workshops organization cost will be included into the contract.

ii. Procurement Specialist (national, 14pm)

167. **Objective of Consultancy**. The specialist shall assist and advice the CPMU, TSU, and PPMUs in all procurement activities under the project, including procurement of Goods and Civil works, Recruitment of Consultant. The specialist shall help ensuring that all procurement activities are complied with the ADB's Guidelines and GOV's Guidelines.

168. **Duties and Responsibilities.** The Consultant should (i) compile a specific guideline on project procument; (ii) provide relevant trainings for related staffs; (iii) monitor the procurement activities and provide timely reports and recomemendations; and (iv) do other tasks required by the CPMU Director.

169. **Other specific tasks for Procurement of Goods and civil works.**
(i) Prepare the General Procurement Plan for the whole project, guide CPMU, TSU and PPMUs to prepare their procurement plan.
(ii) Guide and assist CPMU, TSU and PPMUs to prepare bidding invitation for goods and civil works.
(iii) Provide technical assistance to CPMU, TSU and PPMUs in the procurement implementation including main activities such as advertisement, bidding invitation

issuance, bid receipt, bid opening, bid evaluation and preparation of bid evaluation report.

(iv) Provide technical assistance to CPMU, TSU and PPMUs in the contract preparation, contract negotiations, goods acceptance, goods and works checking and taking over, payment and contract liquidation.

170. **Recruitment of consultant**

(i) Prepare the general plan of consultant recruitment, provide assistance to PPMU in the preparation of this plan; Guide and assist CPMU, TSU and PPMUs to prepare Terms of Reference (ToR) for consulting services; Provide technical assistance for CPMU, TSU and PPMUs to prepare the short list of consultants; Provide technical assistance to CPMU, TSU and PPMUs in the preparation of request for proposal (RFP) for consulting services; Provide technical assistance to CPMU, TSU and PPMUs in the consultant selection including main activities such as RFP issuance, proposal receiving, technical and financial proposal evaluation and bid evaluation report preparation;

(ii) Provide technical assistance to CPMU, TSU and PPMUs in the contract preparation, contract negotiation and contract signing;

(iii) Provide advice to CPMU, TSU and PPMUs in monitoring the implementation of consulting services contracts.

171. **Major outputs required**.

(i) Provide technical assistance to CPMU, TSU and PPMUs in procurement so that CPMU and PPMUs can implement the procurement in compliance with required regulations and procedures and in an effective, economic, transparent and explicit manner.

(ii) Assist and coordinate with CPMU, TSU and PPMUs and related consultants in the team to manage and monitor the consulting service contracts, the payment and control the quality of consulting services, goods and civil works.

172. **Key qualifications.**

(i) Have minimum B.A. degree on agriculture, technology or economics or other related fields; Have intensive working experience in development projects; Have a minimum of 10 year- experience in procument of goods, civil works and consultant selection in projects funded by ADB or WB; In depth knowledge on Government's and Donor's procedures and regulations; Good command of spoken and written English.

173. **Assignment duration**. The project consultancy will be required for fourteen-month input (22 working-day/month) on part-time basis with an estimated duration of 16 months, which will expected to starting soon after the Project effectiveness.

174. **Duty Station and Reporting Arrangements and time frame**. The consultant will be based mainly in Hanoi with possibility of travel to project areas. She/he will report directly to and under supervision of the CPMU Director.

175. **Facilities to be provided by the Project**. The project will support the Consultant by providing office support and facilities, supervision and advice, documents and materials and by

facilitating access to relevant information and materials. The translation services and workshops organization cost will be comprised into the contract.

Table 18: Expected inputs

No	Item	Unit	Quantity
I	**Remuneration**	Person-day	308
II	**Reimbursables**		
1	National flight (return ticket)	Flight	7
2	Travel by car	day	140
3	Perdiem	day	140
4	Training course (5 days, 105 participants)	Training course	2
5	Communication	month	14
6	Report, bidding documents preparation and production (includes translation)	page	3000

iii. Training Implementation Specialist (national, 8 pm)

176. **Duties and Responsibilities under the Assignment.** The Consultant has the following responsibilities and tasks:

(i) Guide, monitor, supervise, and conduct training courses to CPMU, TSU, and PPMUs in implementation arrangements of all project activities to be consistent with the Project Implementation manual (PIM);

(ii) In collaboration with the other international and national Consultants on Reviewing of the overall Project Planning, review and appraise the appropriateness, and feasibility of draft plans for various trainings and the suggested medias used for training purposes proposed by each project province;

(iii) Assist the CPMU in establishing implementation arrangements, and managing activities to support project provinces in project implementation", focusing on the selection of research subjects on breeding; testing of new varieties of vegetable, fruit, and tea; and research subjects on design of Pilot Models for Preliminary processing, Packing and Conservation of biogas value chain management and climate smart agricultural waste management practices; and

(iv) Other project implementation tasks related to training requested by the CPMU.

177. **Outputs.** The following outputs are expected from the Consultant:

(i) To participate in preparing recommendation reports on Outlines of Planning of training and various dissemination program proposed by project provinces;

(ii) To participate in preparing recommendation reports on reviewing of Planning of training and dissemination programs for the project provinces/cities;

(iii) Reports on Appraisal of outlines and description of research subjects on various BVCM and CSAWMP interventions;

(iv) Reports on Appraisal of outlines and description of research subjects on design of Pilot Models for Preliminary processing, Packing and Conservation related to BVCM and CSAWMP investment activities; and

(v) Other relevant reports requested by the CPMU.

178. **Key Qualifications.** The expert should have:

(i) at least a Bachelors Degree in Agronomy or similar field, Master's Degree or higher is preferred;

(ii) at least 10 year-experience on project management/monitoring and evaluation;

(iii) extensive experience in Agricultural Science and Technology management ;

(iv) at least C level of English; and
(v) suitable knowledge in using the computer.

179. **Assignment Duration.** The consultancy engagement is for an 8 person-month input (176 person-days [PD]: 96 PD home office in Hanoi, 80 PD fieldwork to project provinces/cities) rendered intermittently over an estimated duration of 12 months. The tentative schedule for consultant mobilization is set for 14 July 2013.

180. **Duty Station, Reporting Arrangements, and Timeframe.** The consultant will be based mainly in Hanoi, at the CPMU Office, and conduct field visits to project provinces/cities implementing the Planning of training on BVCM and CSAWMP investment activities. He/she will report directly to the Director of CPMU; and will work under the supervision of the Technical Vice Director of CPMU, and in close coordination with the Department of Science, Technology (DOST), the Department of Crop Production (DCP), the Department of Livestock (DLP), the Department of Renewable Energy under the Ministry of Industry and Trade, the National Agro-Forestry and Fisheries Quality Assurance Department (NAFIQAD), the National Agricultural and Fisheries Extension Center (NAFEC), the Ministry of Natural Resource and Environment, Financial Intermediaries and the PPMUs.

181. **Facilities to be provided by the Project** The CPMU will support the Consultant in having access to the following:

(i) Documents, data related to the Project, and others if available;
(ii) Documents, Data available in other agencies;
(iii) Assistance of project staff for the implementation of this assignment; and
(iv) Other requirements within the ability of the CPMU to provide.

iv. Database Specialist (National, 8pm)

182. **Consultant Qualification Requirements.** The consultant should have a degree in information technology (IT), informatics or relevant fields relating to website design and development, data and database system management software development and application: (ii) at least 5 working years in the field of website design and development, data and database system management software development and application; (iii) good skills and team work, good skills in analyzing, report making and presentation (in Vietnamese and English).

183. **Scope and Responsibilities** The consultant will report to the CPMU Director and work closely with the Coordinating and Managing Entity (CME), the coordinator for carbon market development, PPMUs, facilitators and other consultants. S/he will update the current progress of biogas program in 10 participating provinces using one database system (that has been currently used by the Department of Livestock Production (DLP) of MARD, funded by the Netherlands Government).

184. **Detailed Tasks.** The Consultant has the following responsibilities and tasks:

(i) Work closely with other projects (including from the ongoing ADB Loan 2513-VIE) funded by various donors and private sectors to update the detailed records of biogas plants, including from other agricultural wastes beyond the livestock's in 10 participating provinces;
(ii) Work with biogas plant technicians to update the database of the biogas plant owners by incorporating names of wife and husbands; double check and ensure all constructed biogas plant have been registered in one existing

database; inform the CPMU and CME for the potential double counting; or the reluctance of certain parties to include their program in one database;

(iii) The consultants should also update in the database forms, for all projects, both the idea number of the husband and the wife so the Project can secure there is no double counting. It recently came to our attention that a household tried to claim a unit with both programs by using two different ID numbers of both husband and wife. We need to make sure that when this happens the database gives a signal;

(iv) Assist CME to coordinate with other biogas plant projects to produce monthly data for financial intermediaries, CPMU and PPMUs the progress of constructed biogas plants including the ones who have received the incentives for carbon market development (both for technical and environmental compliance);

(v) Determine the long-term costs that will be paid to sustain the database; assesses the willingness of other donors[27] to participate in long-term operation and maintenance of the system; assist the CPMU to formulate a memorandum of agreement (MoA) between CME, the Netherlands Government and other donors related to the common uses of one database;

(vi) Ensure that the manager of each project can adapt each others' data, so this needs to be protected. For the technicians it should not matter which program they are active for, as one technician can work with several programs. The consultant should ensure that the technicians can always have the same screen and only has to fill in or 'link' a box that says the specific participating projects;

(vii) Prepare project website and establish a link between the database and the Project website and/or other relevant websites. The websites will disseminate the database and also provide information on biogas technology in which information on biogas technology and news about Biogas Development Component are regularly updated. Priority is given to the website that has established the Vietnam Biogas Association (VBA) since the VBA provides neutral information on all biogas technology for small medium and large scale and may exist during and after the Project completion. The consultant may support the VBA to establish or update the website for VBA, in close coordination with CME. This will be an effort for a good cooperation and ensure the viability of the website;

(viii) The consultant may propose the potential update of the current biogas database, if s/he find the weaknesses of the system. The recommendations shall focus on improving the system to ensure database management will also cover other donor funded household biogas programs, including the SNV and the World Bank's program. It will also cover the database for new projects, and other new projects funded by other donors.

185. **Duty Station, Reporting Arrangements, and Timeframe.** The consultant will be based mainly in Hanoi, at the CPMU Office, and conduct field visits to project provinces/cities implementing the Planning of training on BVCM and CSAWMP investment activities. He/she will report directly to the Director of CPMU; and will work closely with financial intermediaries, the PPMUs, other consultants, facilitators and technicians.

[27] The Netherlands Government through its biogas development program managed by SNV, is willing of course, if the database includes all their units, to co-finance future costs related to the database also after the Project is finalized

186. **Facilities to be provided by the Project** The CPMU will support the Consultant in having access to the following:

(i) Documents, data related to the Project, and others if available;
(ii) Documents, Data available in other agencies;
(iii) Assistance of project staff for the implementation of this assignment; and
(iv) Other requirements within the ability of the CPMU to provide.

7. Project Evaluation Specialist

a. Impact Assessment Specialist (international, 2 pm and national, 4 pm)

187. Consultancy Objectives

(i) Provide estimates of the returns to investment in the activities conducted under the three Components of the Project over the period 2013-2019;
(ii) Provide an estimate of the overall return to investment in the Project; and
(iii) Project Completion Report and relevant project database.

188. Scope of services

(i) Review project documents, reports and data and establish the availability and suitability of input and output data required to estimate returns to investment for activities conducted in each Project Component;
(ii) Develop a suitable approach to evaluating the return to investment in the Project activities that satisfies the consultancy objective and can be achieved with the resources available for the consultancy tasks. The approach would necessarily involve evaluations of random samples of BVCM and CSAWMP research sub-projects and other contracts from Components 1 and 2 respectively, assessment of the impact of training and other capacity building activities in all three components and assessment of the impact of investment in facilities and equipment for research institutes and training and other dissemination programs for beneficiaries;
(iii) Implement the agreed evaluation approach in each of the three Components and estimate a return to investment for each Component, noting key assumptions and risks and indicating the sensitivity of the results to changes in the underlying assumptions;
(iv) Advise and assist the national consultant appointed to evaluate the utilization of equipment and facilities procured under the Project to estimate the return to investment in equipment and facilities for participating research institutes and schools;
(v) Advise and assist the Team Leader and Deputy Leader of the Consultants on estimating the financial return to investment;
(vi) Determine an overall Return to Investment for the Project; and
(vii) Where possible, identify the potential environmental and social impacts associated with changes introduced through investments in agricultural research, extension and vocational training under the Project.

189. Required deliverables

(i) A preliminary report detailing the proposed approach to the assessment for each Project Component, detailed instructions on specific data and information to be collected on each activity, research project or contract for research project leaders, CPMU and PPMUs and a detailed implementation schedule for each Component; and
(ii) A final report detailing the return to investment in activities for each Component of the Project and for the Project as whole. The report should present a justification for the approach taken and indicate the reliability of the results, noting key assumptions and possible risks to achievement of the estimated returns.

190. Qualifications. This consultancy requires an evaluation specialist with

(i) Post-graduate qualifications in agricultural economics or other applied economics field;
(ii) Extensive experience in project evaluation using methods such as Benefit-Cost Analysis or similar to estimate returns to investment; and
(iii) Experience in agriculture in Viet Nam and knowledge of agricultural research and extension processes in Viet Nam

191. Conditions

(i) The consultant will be responsible to the Project Director for consultancy scope of services as detailed in the Terms of Reference.
(ii) The working period of the international and national consultant is 2 and 5 months respectively. The working location of the consultant is in Ha Noi and in the project provinces as required.
(iii) The consultants will be supported by national and international consultants working on the Project and by research project leaders and staff of the Project Management Units in the Research Institutes, provinces and schools as well as staff of the Central Project Management Unit.

b. National Project Evaluation Specialist (4pm)

192. **Consultancy objectives.** The consultant will provide support to the CPMU and IPMUs in monitoring and evaluation of equipment and developing additional plans to improve equipment system, increase using efficiency as planned. The objective of this consultancy service is to produce the project completion report (PCR) based on ADB and Government Guidelines, M&E reports and measures of project outputs, outcomes and impacts.

193. **Scope of services.**

(i) Support CPMU, financial intermediaries and PPMUs in monitoring and evaluating investments in equipment according to technical criteria, configuration and status of using the equipment.
(ii) Evaluate the utilization of equipment and facilities procured under the project for participating research institutes and schools.
(iii) Support the International Impact Assessment to estimate possible net income generated by equipment procured under the project.

(iv) Identify any shortcomings in operation of procured equipment and provide solutions to overcome them including research/training requirement within project' surplus budget.
(v) Coordinate with various stakeholders to develop list of additional equipment to improve equipment system, enhance utilization effectiveness of the equipment for research and training.
(vi) Provide lessons learned, and suggest directions and recommendations for future investments for institutes and schools, where required. The consultant will use the approved Project Design and Monitoring Framework (DMF) and the ADB standards as a guide to prepare the PCR.
(vii) The consultant will prepare the PCR, drawing on estimates of project outputs, outcomes and impacts in accordance with ADB and Government of Viet Nam guidelines and requirements. The consultant will identify lessons learnt, and suggest directions and recommendations for the second phase of the project where appropriate

194. Deliverables

(i) Report on effectiveness of all investment activities under the Project, including lessons learned, and suggest directions and recommendations for the second phase of the project where appropriate.
(ii) Develop the additional list of equipment to complete the system, enhance the utilization effectiveness of the various investments, research and training.

195. **Qualifications.** A university degree is a must and at least 20 years experience in working at research field and lab are required. Experiences with ODA projects in Vietnam are preferable. The consultant must have at least fifteen years of experience in carrying out similar services for ODA projects. The consultant must have at least Masters Degree or higher in relevant disciplines such as Agricultural Science, Economics, Social Science, Public Management.

196. Conditions

(i) The consultants will be responsible to the Project Director for consultancy scope of services as detailed in the Terms of Reference.
(ii) The working period of the consultant is 4 months. The working location of the consultant is in Ha Noi and in the project provinces as required.

VII. SAFEGUARDS

A. Involuntary Resettlement

197. The safeguard categorization is C for involuntary resettlement. No action is required since the project requires no land acquisition and has no involuntary resettlement impacts. BVC management infrastructure will be constructed on land belonging to the BVC owners. The project selection criteria will exclude activities that entail land acquisition and/or involuntary resettlement. MARD and the implementing agencies will monitor and ensure that land to be used for the construction and operation of BVCs are within that owned by the BVC owners/beneficiaries.

B. Indigenous People (IP) – Ethnic Minorities (EM)

198. The safeguard categorization is B for indigenous people therefore an Indigenous Peoples Plan (ethnic minority development plan, EMDP, in local term) was prepared. The IPP/EMDP objective is to design and implement the project in a way that fosters full respect for indigenous people/ethnic minority identity, dignity, human rights, livelihood system, and cultural uniqueness as defined by the indigenous people/ethnic minority themselves so that they:

(i) receive culturally appropriate social and economic benefits,
(ii) do not suffer adverse impacts as a result of the Project, and
(iii) can participate actively in the various investments funded by the Project.

199. Measures were taken in designing the Project to encourage participation and contribution of the indigenous people/ethnic minority based on the recognition of their unique social and cultural characteristics that may require customized approaches and interventions. This includes:

(i) the screening of CSAWMP investments to include indigenous people/ethnic minority as the project beneficiaries;
(ii) targeted 5% of SBP for indigenous people/ethnic minority focused in three sample provinces:
(iii) Indigenous people/ethnic minority involvement in the construction, management, capacity development/skills training, as maintenance operators and masons of biogas and other CSAWMP investments;
(iv) additional human resources support to ensure that indigenous people/ethnic minority received adequate technical support and advise when needed

200. The relevant agencies will encourage indigenous people/ethnic minority participation as members for equal access and control in various aspects of biogas development. The IPP/EMDP was prepared to address the twin issues of risk mitigation and benefit enhancement. It is based on the findings of the social assessment and results of consultations with key stakeholders in three sample provinces of Bac Giang, Soc Trang, and Son La Province undertaken during the project's fact-finding mission. It is in line with Government strategies for indigenous people/ethnic minority as well as ADB SPS (2009) requirement 3. Adequate human and financial resources have been allocated to facilitate the implementation of IPP/EMDP. The IPP/EMDP is attached as RRP LD13.

201. A well-defined grievance redress and resolution mechanism will be established to address indigenous people/ethnic minority's grievances and complaints regarding IPP/EMDP implementation in a timely and satisfactory manner. A complaint or a case to the Court of Law may be made separately or independently from the Project level Grievance Redress mechanism filing process.

202. The CPMU, representative of MARD is responsible for recruiting a safeguard specialist who is knowledgeable and experienced with ethnic minority issues and familiar with the requirements of the ADB on indigenous people/ethnic minority to support and monitor the process of IPP/EMDP implementation. CPMU participates in updating the IPP/EMDP if needed in collaboration with the People's Committees at various levels. MARD, as the project owner through its CPMU, takes responsibility to ensure the entire Project is implemented according to both government and ADB requirements. This includes the responsibility to ensure the IPP/EMDP are implemented in compliance with the commitments set out in it. CPMU will oversee the project implementation of the IPP/EMDP and coordinate with province and the ADB on issues related to the IPP/EMDP. Consultants will be hired by CPMU to: (i) support the updating and implementation of the IPP/EMDP; (ii) conduct independent monitoring of the IPP/EMDP and Gender Action Plan implementation. The indigenous people/ethnic minority specialist consultant should ensure a continuous focus on engagement of indigenous people/ethnic minority during the project detailed planning, review and implementation in each province

C. Environmental Impact

203. The safeguard categorization for environment is B. The extent and nature of environmental impacts are influenced by the fact that the biogas plant and other CSAP investments will be subject to a screening process that will exclude those that may carry significant negative impacts. As such, no biogas plant and other CSAP investments with expected significant environmental adverse impacts (category A according to ADB screening procedures) will be selected.

204. The potential environmental impacts will be addressed by the Project as follows:

(i) careful design of CSAP investments to ensure that increased capacities are accommodated,
(ii) development of management plans for the re-use and/or proper disposal of agri-waste,
(iii) careful design for biogas plants and other CSAP assets,
(iv) provision for collection and disposal of solid waste from rural areas,
(v) studies appropriate mitigation measures for any perceived negative impact,
(vi) inclusion of contract requirements for contractors to quality control for and carry out all practicable steps to mitigate construction impacts,
(vii) increased attention to ensure adequate maintenance of biogas plants and other CSAP assets, and
(viii) safety awareness programs are conducted in each of CSAP investment.

205. Management of the preparation and implementation of each BP and other CSAP investment will be the responsibility of each asset investor. Relevant agencies will be empowered from national to commune level. They will operate in close coordination with the PPMU. Technical support for all aspects of project management and implementation will be provided by the safeguard consultants hired by the CPMU.

206. An initial environmental examination (IEE) has been prepared (RRP LD11) for the project, which outlines the potential adverse environmental impacts and mitigation measures. An environmental management plan has been included in the IEE. During the project implementation, IEE will be prepared as necessary within a Category B[28] classification in accordance with the approved environmental assessment and review framework (EARF) and the approved IEE prepared during the design phase. The EARF is in RRP LD12.

207. The PPC, through the PPMU will have responsibility for ensuring that all mitigation measures are implemented. The IEE of the first proposed MBP and the IEE of the first proposed LBP will be submitted to ADB for review and approval prior to construction. If the quality is acceptable and consistent with ADB's Safeguard Policy Statement 2009 then the subsequent IEEs can be approved by the Project Director in the CPMU. In provinces where MBPs and LBPs will be installed, an environment specialist from the relevant Provincial Department of Natural Resources and Environment (DONRE) will be seconded to the PPMU for environmental management and monitoring tasks.

208. The approved IEE is adequate and there is no need for further detailed study or Environmental Impact Assessment (EIA). No additional study or follow-up EIA is needed under the ADB system, without prejudice to other requirements that the government may enforce under Viet Nam's policy, legal and administrative framework governing EIA.[29]

[28] Subprojects classified as Category C will require due diligence to confirm the lack of any likely environmental impact.

[29] The Law on Environmental Protection (LEP, 2005); Decree 80/2006/ND-CP dated 09 August 2006 by the Government of Vietnam (GOV) on "detailed regulations and guidance for implementation of some clauses of the LEP"; Decree 81/2006/ND-CP dated 09 August 2006 by the GoV; Decree 21/2008/ND-CP dated 28th February 2008 by the GoV; Circular 05/2008/TT-BTNMT dated 28th February 2008 by Ministry of Natural Resources and Environment (MONRE) on "Guidelines on Strategic; Environmental Assessment (SEA), EIA and Commitment in Environmental Protection (CEP); Law on Forest Protection and Development, 2004; Law on Biodiversity, 2008; Law on Water Resources, 1998; and (ix) Law on Biodiversity, 2008.

VIII. GENDER AND SOCIAL DIMENSIONS

209. The Project is classified as "Effective Gender Mainstreaming" (EGM). Gender Action Plan has been prepared based on the gender analysis to promote gender inclusive design of the Project and to ensure involvement of women in BP and CSAP activities. The Gender Action Plan will ensure that women have full and equitable access to Project resources, information and benefits. The plan also provides measures to ensure that equal opportunity and wages are given for women in the construction and O/M of BP. A gender specialist, both international and national, will be included in the LIC team. Gender related activities will be integrated into work plans and adequate resources/budgets will be allocated for Gender Action Plan implementation. Gender Action Plan includes the following target and design features:

Project Outputs	Gender Design features/activities
Expanded livestock waste management infrastructure	• At least 20% of those who are trained in biogas management and technical issues are women. • At least 50% of trainees on biogas use will be women. • 20% of trainees on SBP construction, and 20% of those trained on biogas management and technical issues will be women. • At least 20% of members of participating associations (farmers, biogas, etc.) and 20% of their steering committee members are women. • Women account for at least 50% of those who are trained on farm management and waste management on farms. • At least 30% of trained employees in MBPs and LBPs are women.
Credit lines for biogas value chains	• At least 50% of credit recipients will be registered under husband-wife joint accounts or on behalf of women. • Official registration of all the purchased biogas units and plants under the project will be assisted. At least 50% of such will be under husband-wife joint accounts or on behalf of women.
Enhanced CSAWMP technology transfer	• Gender sensitive research strategy prepared. • Training materials of CSAWMP technology and methodology of dissemination are women friendly (avoiding gender stereotypes and using appropriate illustrations), and at least 50% of dissemination events and consultation will involve women-only groups (e.g. event will be carried out through commune women union's meetings. • 30% of research project topics relate to gender issues/dimensions of biogas plants such as improved cooking stove, improved household water heating system, women friendly post harvest processing tools/equipment that use biogas fuel. • Select and train at least 40% women as champions of smart-agriculture in research and dissemination of CSAWMP technology. • Ensure legal (e.g., employment contract) and remuneration support for champions. • 30% of personnel in participating institutions trained in O&M of research equipment are women.

Project Outputs	Gender Design features/activities
Effective project management	• **Project management support:** CPMU and each PPMU will have a focal point/person for gender and ethnic minority issues. • **Gender sensitivity workshops** at provincial, district, and commune levels will be carried out for all project staff, contractors, agricultural extension and veterinary staff and participating association steering committee as part of the project orientation. • **Develop and update sex-disaggregated and ethnic minority** data as part of project M&E and reporting system. • **30% of CPMU and PPMU staff are women**

ADB = Asian Development Bank, APMB = Agriculture Project Management Board, CPMU = central project management unit, CSAWMP = climate smart agriculture waste management practices, DARD = Department of Agriculture and Rural Development, GAP = Gender Action Plan, LBP = large biogas plant, MBP = medium-sized biogas plant, M&E = monitoring and evaluation, O&M = operation and maintenance, PPC = Provincial People's Committee, PPMU = provincial project management unit, SBP = small biogas plant.

IX. PERFORMANCE MONITORING, EVALUATION, REPORTING AND COMMUNICATION

A. Project Design and Monitoring Framework

210. The Project detailed design and monitoring framework is shown below.

Design Summary	Performance Targets and Indicators with Baselines[a]	Data Sources and Reporting Mechanisms	Assumptions and Risks
Impact Less agriculture-related pollution	By 2024 (from baselines in 2013) in selected participating communities: (i) Livestock waste effluents in water resources is reduced by at least 50%. (ii) GHG emissions are reduced by about 0.2 tons of CO_2 equivalent annually per cubic meter capacity of biogas plants.	MARD data MONRE data National statistics	**Risk** Limited sustainable long-term financing for waste management infrastructure
Outcome Greater uptake of CSAWMP	By 2018 (from baselines in 2013) in the project areas: (i) At least 70% bio-slurry is converted to organic fertilizers. (ii) At least 80% energy produced by BVCs is utilized.[b] (iii) Daily workload of women and children is reduced by 1.8–2 hours, on average.[c]	PPMS Biogas users' survey	**Assumption** The government does not subsidize inorganic fertilizers
Outputs 1. Expanded use of livestock waste management infrastructure	From baselines in 2013: (i) 36,000 SBPs, 40 MBPs, and 10 LBPs and associated value chain infrastructure constructed and operating by 2018. At least 5% of total SBPs will be constructed for ethnic minorities in 3 selected provinces. (ii) 36,000 SBP operators, 500 masons, 160 technicians, 10 engineers and 10 contractors trained and registered in biogas associations by 2018. At least 50% of trainees on biogas use will be women; 20% of trainees on SBP construction, and 20% of those trained on biogas management and technical issues will be women.	PPMS	**Assumption** Livestock waste generation is stable and accessible **Risk** Catastrophic climatic events exceed waste management infrastructure design thresholds Catastrophic animal disease outbreak adversely affects viability of livestock waste management infrastructure

Design Summary	Performance Targets and Indicators with Baselines[a]	Data Sources and Reporting Mechanisms	Assumptions and Risks
	(iii) Biogas plant database managed effectively by 2014, including registration in both husband's and wife's names.		
2. Credit lines for biogas value chains	(i) 50% of credit lines will be under joint accounts and/or on behalf of women by 2018. (ii) BVC infrastructure financing products are mainstreamed in two financial intermediaries by 2018. (iii) ICMD funds are fully channeled into 36,050 accounts of beneficiaries by 2017	PPMS	**Assumption** Close coordination between financial intermediaries, CPMU and PPMUs in managing the subprojects
3. Enhanced CSAWMP technology transfer	(i) Well-established CSAWMP packages are disseminated in 10 participating provinces by 2016.[d] (ii) One long-term, community-based CSAWMP technology transfer and research strategy is elaborated by 2014, and includes communication, dissemination, and mainstreaming plans. (iii) Critical CSAWMP knowledge gaps are identified and at least 21 research, dissemination, and mainstreaming packages carried out according to a priority list, by 2018. 30% of research projects will include gender issues by 2016.	PPMS	**Assumption** The government supports research strategy and plans for climate-smart agriculture practices. **Risk** Low enforcement of existing policy hampers CSAWMP effectiveness.
4. Effective project management	(i) A CPMU and 10 PPMUs established and operational with adequately skilled staff and facilities in MARD by first quarter of 2013. At least 30% of staff are women and a gender focal point will be appointed by 2014. (ii) PPMS with sex-disaggregated and ethnicity data collected and reported operating effectively in 10 provinces by 2015. (iii) Carbon market coordinator and 36,000 biogas owners are organized through associations by 2014.	PPMS	**Assumption** The government will equip the project with skilled central and provincial personnel.

Activities with Milestones	Inputs
1. Expanded use of livestock waste management infrastructure	**ADB: $74.0 million**
1.1 Train and certify technicians, contractors and masons through relevant agencies for construction of BVC management facilities by 2013	Credit lines for BVC management construction ($35.70 million)
1.2 Standardize and disseminate design package for BVC management by 2013[e]	ICMD ($8.31 million)
1.3 Develop training modules for CSAWMP stakeholders by 2014	
1.4 Register program of activities for SBPs by 2013 and for MBP and LBPs by 2014 for the relevant carbon market requirements	BVC management and CSAWMP civil works ($5.30 million)
1.5 Monitor use of biogas plants with adequate environmental facilities by 2018	
1.6 Strengthen relevant agencies to hand over the monitoring of the constructed biogas plants by 2018	Equipment ($1.00 million)
1.7 Monitor annual attributable CO_2 reduction and issuance of carbon revenue from the certified emission reduction by 2018	Vehicles ($0.40 million)
1.8 Provide capacity building to relevant agencies to continuously manage biogas development by 2018	Training and workshops ($3.00 million)
2. Credit lines for biogas value chains	Consulting services ($2.94 million)
2.1 Encourage the selected two financial intermediaries to provide credit lines by 2018	Research and development ($6.18 million)
2.2 Encourage other financial intermediaries to finance BVC management infrastructure by 2016	
2.3 Coordinate training program between CPMUs, PPMUs and financial intermediaries by 2017	Organizing CSAWMP transfer ($3.43 million)
2.4 Monitor the disbursement of incentive for carbon market development through financial intermediaries by 2018	Incremental operating costs ($2.32 million)
3. Enhanced CSAWMP technology transfer	Contingencies/unallocated ($3.01 million)
3.1 Organize 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 by 2018	Interest during implementation ($2.41 million)
3.2 Establish an information system, e-library, journals, and database for sharing CSAWMP research and training by 2018	**Government: $3.7 million**
3.3 Train staff in efficient, CSAWMP, including organizing overseas study tours by 2018	Training, workshops ($0.40 million)
3.4 Develop training programs, textbooks, and syllabus for training farmers on appropriate techniques for CSAWMP; provide vocational training for farmers by 2015	Research and development ($1.11 million)
3.5 Upgrade CSAWMP-based map sets for 7 agro-ecological regions to forecast the direct impact of climate change (sea level rise, salt sea intrusion, flood, drought) and provide support for agricultural planning by 2014	Organizing CSAWMP technology transfer ($1.00 million)
3.6 Develop livestock waste management models for agricultural production and greenhouse gas emission reductions by 2016	Incremental operating costs ($0.10 million)
3.7 Train extension staff and farmers in low carbon agricultural production technologies to promote application of the technologies in agricultural production by 2018	Staff salaries and allowances ($1.09 million)

Activities with Milestones	Inputs
4. Effective project management	
4.1 Establish CPMU and PPMUs to be operational by 2013	**Financial intermediaries: $6.3 million**
4.2 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 2013	Credit lines for BVC management infrastructure construction ($6.3 million)
4.3 Explore all potential carbon markets by 2014	
4.4 Undertake baseline surveys in all project provinces with collection and analysis of sex- and ethnicity-disaggregated data by 2014	
4.5 Conduct a gender awareness raising workshop for PMUs by 2016	
4.6 Organize biogas owners and CSAWMP participants through relevant agencies	
4.7 Prepare progress reports and submit to ADB on a regular basis by 2018	

ADB = Asian Development Bank, BVC = biogas value chain, CO_2 = carbon dioxide, CPMU = central project management unit, CSAWMP = climate-smart agricultural waste management practices, GHG = greenhouse gas, ICMD = incentive for carbon market development, LBP = large biogas plant, MARD = Ministry of Agriculture and Rural Development, MBP = medium-sized biogas plant, MONRE = Ministry of Natural Resources and Environment, PPMS = project performance management system, PPMU = provincial project management unit, SBP = small biogas plant.

[a] The baseline for performance indicators will be established during project inception phase soon after loan effectiveness in 2013.

[b] Annual energy substitution from gas stove of each SBP (for a 10 square meter [m^3] size) is estimated to average 40.5 kilograms (kg) of liquid petroleum gas; 9,734 kg of coal, or 1,175 kg of wood. The biogas is estimated to be converted to electricity at an annual rate of 1.4 to 1.7 kilowatt-hours per m^3 of biogas depending on the efficiency of the generators.

[c] Workload includes collecting firewood, cooking, and taking care of livestock.

[d] At least 50% of participants for dissemination packages are women by involving community-based women's associations and other community groups.

[e] Including viable technical and financial biogas plant models; to communes, private sector, financial intermediary frontline staff, private sector banks, and other development partners active in the subsector.

Source: Asian Development Bank and Government of Viet Nam estimates.

B. Monitoring

1. Project performance monitoring[30]

211. Project progress and performance will be monitored through a comprehensive Project progress and performance monitoring system (PPMS). Report on Gender Action Plan implementation status will be part of the PPMS. The PPMS will record the project's technical performance, evaluate delivery of project facilities, assess achievement of project objectives and measure the project's social, economic, financial and institutional impacts. Detailed PPMS parameters and procedures will be developed during the initial months of project implementation and will be incorporated with the Management Information System (MIS) that is under refinement within the CPMU for the other investments under implementation. Three different kinds of monitoring will be carried out including: (i) implementation progress monitoring, (ii) safeguard monitoring, and (iii) benefit monitoring and evaluation.

212. Implementation progress monitoring will be one of the main tasks of the CPMU. This will be undertaken by a monitoring unit established in the CPMU and will be based on the overall project implementation schedule. The unit will monitor the progress of activities in each province

[30] ADB's project performance reporting system is available at: http://www.adb.org/Documents/Slideshows/PPMS/default.asp?p=evaltool.

based on monthly progress reports from the PPMUs. The CPMU will submit to ADB a bi-annual monitoring reports on Gender Action Plan, IPP/EMDP and IEE/EMP implementation. Withdrawals, disbursement and reimbursement of project accounts will also be monitored by the same unit. Project benefit monitoring activities will entail periodic monitoring of the benefits and impacts of a representative number of selected BPs and other investments funded by the Project. This will be undertaken independently by a university, institute or similar agency with experience in the identification and quantification of economic development benefits.

213. The monitoring and evaluation of EMDP will include the following: (i) ensure that the EMs have been effectively engaged in the project activities; (ii) monitor whether the time lines are being met; (iii) assess if the EM development support programs are sufficient; (iv) identify problems or potential problems; and (v) identify methods of responding immediately to mitigate.

214. Core labor standards and national labor laws will be monitored.

215. A baseline survey, covering both target and control groups, and periodic surveys will be carried out by collecting data disaggregated by income group, sex, and other characteristics as appropriate. CPMU will maintain a Project-specific web-page, in English and Vietnamese, on its official web-site, for wider dissemination of procurement and distribution related information, and to provide a feedback mechanism.

2. Compliance monitoring

216. A number of assurances have been given by the Government to ensure the smooth implementation of the Project. Those are subject to Loan covenants and are summarized below. The ADB will monitor compliance with those covenants throughout the Project effectiveness and implementation via regular review missions, quarterly progress reports submitted by the CPMU, and review of project accounts and procurement procedures.

3. Project Specific Assurances

3. a. Implementation Arrangements

217. The government shall ensure that the project is implemented in accordance with the detailed arrangements set forth in the PAM. Any subsequent change to the PAM shall become effective only after approval of such change by the Government and ADB. In the event of any discrepancy between the PAM and the Loan Agreement, the provisions of the Loan Agreement shall prevail.

3. b. Environment

218. The government shall ensure that the project facilities are constructed and operated in compliance with the Government's applicable environmental laws and regulations and ADB's *Safeguard Policy Statement* (2009), and that no investment with significant adverse environmental impacts are financed under the project. In particular, the government shall ensure that investments are carried out in accordance with environmental assessment procedures provided in the environmental assessment and review framework as agreed between the Government and ADB.

3. c. Resettlement

219. The project criteria will exclude potential project with land acquisition or involuntary resettlement. The Project will be built upon the land belonging to the owner of biogas plant and therefore no anticipated issues/negative impact on communities as a result of involuntary resettlement. The project executing agency/implementing agency will monitor this situation.

3. d. Indigenous Peoples and Vulnerable Groups

220. The Government shall ensure that the Project investments do not adversely affect ethnic minorities, households headed by women, disabled, elderly or other similarly vulnerable groups, and that rights and needs of ethnic minorities are fully addressed in accordance with ADB's relevant policies. In particular, the Project shall be carried out in accordance with the IPP/EMDP as agreed between the Government and ADB.

3. e. Gender and Development

221. MARD, through a designated project coordinator in the Agriculture Projects Management Board (APMB), will ensure that the Gender Action Plan agreed between the Government and ADB is fully implemented. The PPC of each project province, through the DARD and its assigned PPMU, under the guidance of CPMU will be responsible for planning, implementing and monitoring the Gender Action Plan. CPMU and each PPMUs will have a focal point/person on gender and ethnic minority. The international and national consultants will help conduct gender awareness training for project units, establish sex-disaggregated indicators for project performance monitoring and evaluation, and coordinate with other specialists during Gender Action Plan preparation and implementation. The CPMU and PPMUs will provide information about progress of Gender Action Plan implementation in quarterly progress reports submitted to ADB and the Government. The PPMUs will submit gender updates to the PMU prior to CPMU's preparation of these reports. Budget for implementation of the Gender Action Plan has been provided in the project costs.

3. f. Governance and Anticorruption

222. The government shall comply with, and shall cause MARD, the TSU, each implementing agency and each financial intermediary to comply with ADB's Anticorruption Policy (1998, as amended to date). The government: (i) acknowledges that ADB reserves the right to investigate directly, or through its agents, any alleged corrupt, fraudulent, collusive or coercive practice relating to the Project; and (ii) agrees to cooperate with, and to cause MARD, the TSU, each implementing agency and each financial intermediary to cooperate fully with any such investigation and extend all necessary assistance, including providing access to all relevant books and records, as may be necessary for satisfactory completion of such investigation and shall allow, and cause MARD, the TSU, each implementing agency and each financial intermediary to allow, ADB to investigate any violation or potential violation of these undertakings.

223. The government shall: (i) ensure that MARD and each implementing agency conduct periodic inspections on the contractors' activities related to fund withdrawals and settlements; and (ii) ensure and cause MARD and each implementing agency to ensure that all contracts financed by ADB in connection with the Project include provisions specifying the right of ADB to audit and examine the records and accounts of the contractors, suppliers, consultants, and other service providers as they relate to the project.

224. If the government or ADB is or becomes aware or has a reasonable suspicion that any member of MARD, TSU, any implementing agency or financial intermediary has engaged in corrupt or fraudulent practices (as defined in ADB's Anticorruption Policy (1998 as amended to date)) under or in connection with the Project or the Loan, the Government shall take such timely and appropriate action satisfactory to ADB to investigate and/or remedy the situation, including in the case of corrupt or fraudulent practices of an financial intermediary, demanding immediate repayment or otherwise recovering any portion of the relevant Subsidiary Loan, with such repayment or recovery to be promptly paid to ADB in prepayment of the Loan. If the Government does not undertake investigative and/or remedial action to the satisfaction of ADB, ADB may declare the relevant financial intermediary ineligible, either indefinitely or for a stated period, to be considered as a provider of financial intermediary loans or any other financial instruments for future ADB projects.

225. In addition to these requirements, to deter corruption and increase transparency, the Government shall create a Project website within 2 months of loan effectiveness, accessible by the general public, to disclose various information concerning the Project including general information about the Project, public procurements related to the Project, Project progress and contact details in English and Vietnamese languages. The website shall also provide a link to ADB's Integrity Unit (http://www.adb.org/Integrity/complaint.asp) for reporting to ADB any grievances or allegations of corrupt practices arising out of the Project and Project activities. For each contract, the website shall include information on, among others, the list of participating bidders, name of the winning bidder, basic details on bidding procedures adopted, amount of contract awarded, and the list of goods/services, including consulting services, procured. The Government shall cause MARD to permit any bidder to request an explanation as to why a bid was unsuccessful and either MARD shall respond within 20 working days. The website will be updated within 2 weeks after: (i) each award of contract, (ii) each submission of the semi-annual Safeguards Monitoring Report to ADB. In addition to the web-based disclosure, stakeholders, which include civil society and non-governmental organizations, shall be provided by the Government with detailed information on procurement on public notice boards in their respective areas.

3.g. Community Awareness and Beneficiary Participation

226. The key features of C&P plan are a series of consultation workshops, field days and meetings with various stakeholders (central government agencies, BP owners and users, CSAP potential farmers, ethnic minority groups, civil society organizations) involved in policy and guideline formulation and enforcement, biogas plant construction, O&M to LCSAP models development and dissemination.

227. MARD shall ensure that Project provinces promote active community awareness and stakeholder participation in the Project design, implementation and performance monitoring through:

(i) disseminating the nature of the proposed project works in open public forums,
(ii) establishing a mechanism for public consultation, and
(iii) financing the operations of the Commune Supervision Board during project physical implementation activities.

228. The Commune Supervision Board shall include representation from the relevant women's union at the commune level. Bidding documents financed under the Project shall

include provisions to ensure contractors' preferential hiring of local labor and to comply with the Government's Labor Code and labor regulations including guaranteeing equal opportunities for female workers to work with the principle of equal pay for work of equal value.

229. Following Project preparation and during the Project implementation, a series of consultation workshops, field days and meetings will be conducted with various stakeholders (central government agencies, biogas plant owners and users, CSAP potential farmers, indigenous people/ethnic minority groups, civil society organizations). They will be involved in the policy and guideline formulation and enforcement, biogas plant construction, O&M to LCSAP models development and dissemination.

3.h. Monitoring of Project Benefit

230. Within 12 months of the effective date, MARD, through CPMU, shall execute a contract with suitably qualified institutions such as social science institutes, universities, consulting firms, NGOs or other institutions acceptable to ADB, for Project benefit monitoring and the monitoring of the Project implementation (the monitoring team). Such contract shall be submitted to ADB, and regular reports from the contracted institution shall be included in the quarterly reports to be submitted to ADB. The monitoring team will be a part of the loan implementation consultant team.

C. Evaluation

231. ADB will conduct regular (at least twice per year) reviews throughout project implementation to assess implementation performance and achievement of project impact, outcome and outputs, examine financial progress, and identify issues and constraints affecting the Project and work out time-bound action plans for their resolution.

232. Apart from regular reviews, ADB and the Government will undertake a comprehensive review within 18 months of loan effectiveness when the BPs and other supporting CSAWMP infrastructure will be commencing construction. A Midterm Review will also be undertaken within 36 months of loan effectiveness. These reviews will include a comprehensive evaluation of project implementation arrangements, detailed evaluation of the scope and implementation process and progress of subprojects, feedback from the project performance monitoring system (PPMS), performance of consultants, capacity building progress, and possible reallocation of loan proceeds. During this more significant review, the impact from the pro-poor initiatives linked to biogas plants and other infrastructure development will be assessed as will the allocation by local administrations for the maintenance of the BPs and other supporting investments developed under the Project. Remedial action will be instituted as required.

233. Within 6 months of physical completion of the Project the ADB will conduct a project completion mission to carry out a preliminary assessment of the success of the Project to achieve its physical, and socio-economic developmental objectives, as well as to review compliance with ADB requirements and loan covenants.

D. Reporting[31]

234. The CPMU will prepare and submit to MARD and ADB within 30 days of the end of each calendar quarter, consolidated quarterly progress reports in a format consistent with ADB's project performance reporting system. These progress reports are designed to allow ADB staff to readily capture key information to record in ADB's Project Performance Report (PPR) System.

235. In addition to these quarterly progress reports, the CPMU will prepare consolidated annual reports, which will include (a) progress achieved by output as measured through the indicator's performance targets, (b) key implementation issues and solutions; (c) an updated procurement plan; and (d) an updated implementation plan for the next 12 months. To ensure projects continue to be both viable and sustainable, project accounts and the executing agency annual financial statements, together with the associated auditor's report, should be adequately reviewed.

236. Within 6 months of physical completion of the Project, the CPMU will submit to ADB a completion report that describes the physical achievements of the Project, actual costs incurred in relation to cost estimates, the results of project activities, a preliminary assessment of achieved benefits, and other relevant project implementation matters requested by ADB. [32]

237. To ensure projects continue to be both viable and sustainable, project accounts and the executing agency audited financial statements (AFSs), together with the associated auditor's report, should be adequately reviewed.

E. Stakeholder Communication Strategy

1. Communication Consultation

238. The Project has been designed to improve the well-being of poor people, especially the vulnerable and excluded groups, through a series of investments in biogas plants and other CSAWMP assets. During the project implementation, the process of consultation will continue throughout the feasibility study and detailed design phase of each biogas plant and other CSAP investments to afford community groups the opportunity to voice their views on how the Project is to be designed, implemented and operated to benefit them. This will be accomplished through a series of community consultation meetings at commune and district level. Community consultations with ethnic minority groups shall be tailored to the needs of ethnic minorities and conducted in a culturally- appropriate manner.

239. The community consultation meetings will be carried out by the PPMUs in collaboration with financial intermediaries, the design and safeguard consultants. It will include the participation of representatives from the District People's Committee, the Commune People's Committee, and mass organizations such as the Women's Unions, the Farmers' Union and the Youth Union. The communities will be briefed on all aspects of the Project including the detailed investments and the safeguard issues of environment, social, management and financial aspects of the Project. Women will be particularly encouraged to actively participate in the

[31] Reporting will be in accordance with Decision 803 issued in 30 July 2007 as agreed between the Government and ODA donors including ADB.

[32] Project completion report format available at: http://www.adb.org/Consulting/consultants-toolkits/PCR-Public-Sector-Landscape.rar.

consultation meetings and voice their opinions and views about the subproject design and implementation arrangements.

240. The community will also be informed of the O&M arrangements for the biogas plants and other CSAP value chain investment and their expected participation in kind or otherwise in this aspect of the work. They will be encouraged to provide ideas and feedback to the design team and raise their concerns regarding potential negative impacts of the biogas plants and other supporting value chain infrastructure on the environment and the welfare of the community.

241. The feedback obtained from these community consultation meetings will be incorporated as necessary in the detailed design of biogas plants and the supporting investments. The process of consultation is expected to build ownership of the biogas plants and other investments by the owners as well as the community and hence foster better sustainability of the investment.

2. Community Participation

242. During planning process, it is anticipated that the community will be mobilized in a number of different ways during the design, implementation and operation of different CSAP investments. Since most of the CSAP assets involved biogas plant construction and other supporting value chain infrastructure, there is a scope for the community to participate in the selection of the site and alignment for instance. Most of the assets are privately owned by households or enterprises. The potential benefits of the investments to the overall communities will be assessed during consultation meetings.

243. During the construction phase of biogas plants and their value chain infrastructure, a significant opportunity for active participation, and for many poor households to benefit from the Project, is in providing wage labor. This will be encouraged through various training for technicians and the bidding documents which will request the contractors to investigate this option whenever possible, especially for MBPs and LBPs. It will also be possible for communities to participate effectively in the supervision of the construction works. The Project will ensure that women and men will be paid equal remuneration for the work of equal value. Child labor will not be allowed; and the measures included in the gender action plan prepared for the Project will be undertaken, and the resources needed for their implementation will be made available, in a timely manner.

244. The community will also be required to participate in the operation and maintenance (O&M) of the completed biogas plants and other value chain infrastructure whenever possible, such as through promotion of the use of bioslurry for organic fertilizers; connection of gas and electricity produced by biogas plants to the neighborhood or public grids; provision of labor or in some cases cost and revenue sharing for common uses of the assets.

3. Community Awareness

245. Experience has demonstrated the importance of community participation in achieving sustainable development including appropriate and well-designed biogas plants and other value chain infrastructure for CSAWMP that are linked to public interest. To ensure adequate participation of the community, it must first be well-informed and there must be adequate opportunities for everyone to participate if they wish.

246. Information about the Project and the BP investments and each CSAP asset in particular, including the objectives, potential environmental impact, implementation arrangements, and issues of concerns for ethnic minorities, gender, social, financial, management and technical issues will provided to beneficiaries. The PPMUs will design a community awareness program for each province and will make this information available to the participating communes in Vietnamese language, and the language(s) of the communities whenever appropriate.

247. Awareness programs will take advantage of existing social development systems such as commune /village meetings and announcements on commune speaker systems, but may also include different and more innovative approaches. The community will be fully informed of issues such as their right to participate in the Project investments and to be compensated for any loss of property including productive land and/or assets; as well as gender equity and other relevant policies. Separate meetings and discussions will be arranged with the people who will potentially participate in the project.

X. ANTICORRUPTION POLICY

248. ADB's *Anticorruption Policy* (1998, as amended to date) was explained to and discussed with MARD and APMB. Consistent with its commitment to good governance, accountability, and transparency, ADB reserves the right to investigate, directly or through its agents, any alleged corrupt, fraudulent, collusive, or coercive practices relating to the project.[33]

249. To support these efforts, relevant provisions of ADB's *Anticorruption Policy* are included in the loan agreement and project agreement and the bidding documents for the project. In particular, all contracts financed by ADB in connection with the Project shall include provisions specifying the right of ADB to audit and examine the records and accounts of MARD, APMB, CPMU, PPMUs, TSU, all contractors, suppliers, consultants, and other service providers as they relate to the Project. Individuals/ entities on ADB's anticorruption debarment list are ineligible to participate in ADB-financed activity and may not be awarded any contracts under the project.[34] The project design and implementation arrangements provide for mitigation of corruption risks. Risks associated with project management, including procurement and disbursement, will be mitigated by (i) engaging a national consultant to advise and assist in the procurement of goods and services, and the engagement of other consultants; and (iii) periodic inspection by the CPMU of the contractor's and other service provider activities relating to fund withdrawals and settlements. References on ADB's Anticorruption Policy can be accessed through the following link: http://www.adb.org/Integrity/.

XI. ACCOUNTABILITY MECHANISM

250. People who are, or may in the future be, adversely affected by the Project may address complaints to ADB, or request the review of ADB's compliance under the Accountability Mechanism.[35] People who are, or may in the future be, adversely affected by the Project may address complaints to ADB, or request the review of ADB's compliance under the Accountability Mechanism.[36] The Accountability Mechanism provides an independent forum and process whereby people adversely affected by ADB-assisted projects can voice, and seek a resolution of their problems, as well as report alleged violations of ADB's operational policies and procedures. Before submitting a complaint to the Accountability Mechanism, affected people should make a good faith effort to solve their problems by working with the concerned ADB operations department. Only after doing that, and if they are still dissatisfied, should they approach the Accountability Mechanism.[37]

XII. RECORD OF PAM CHANGES

251. All revisions/updates during the course of implementation will be retained in this Section to provide a chronological history of changes to implemented arrangements recorded in the PAM.

[33] Available at: http://www.adb.org/Documents/Policies/Anticorruption-Integrity/Policies-Strategies.pdf.
[34] ADB's Integrity Office web site is available at: http://www.adb.org/integrity/unit.asp.
[35] For further information see: http://compliance.adb.org/.
[36] For further information see: http://compliance.adb.org/.
[37] For further information see: http://www.adb.org/Accountability-Mechanism/default.asp.

GUIDELINES FOR BIOGAS VALUE CHAINS

I. Guidelines for Biogas Value Chains

A. Introduction

1. The development of biogas value chain (BVC) infrastructure is aimed to reduce livestock waste hazard in agricultural areas, thereby reducing the negative impact exerted on the physical environment (i.e., water, soil, and air) and associated pollution affecting the quality and safety of water and agricultural products. Aside from improving the environment, it will also have positive consequential impacts on public health due to reduced contamination of agricultural products through waste digestion; improved household savings and livelihoods through lternative clean energy for cooking and lighting and biogas slurry for crop production enhancement. The following are the guidelines for the technical, environmental financial, economic and incentive for carbon market development (ICMD) for the BVC infrastructure and eligibility criteria for borrower farmers and households.

B. Technical Guidelines for Eligible Subprojects

2. Each biogas plant including its value chain infrastructure is defined as a subproject. The project will construct about 36,000 small BPs (SBPs), 40 medium biogas plants (MBPs) and 10 large biogas plants (LBPs) in the following provinces: Bac Giang, Ben Tre, Binh Dinh, Ha Tinh, Lao Cai, Nam Dinh, Phu Tho, Soc Trang, Son La, and Tien Giang.

3. Detailed technical aspects of SBPs, MBPs and LBPs are given in Parts II and III of this Appendix. An overview of selected biogas technologies is given in Part IV. The project will train incremental biogas plant operators, masons, technicians, engineers, contractors, and biogas associations to ensure that the project will comply with the following measures:

(i) efficient use of biogas and electricity produced by biogas plants;
(ii) efficient management of bioslurry including issues concerning (a) length of storage of slurry for use as fertilizer, (b) transport and spreading of slurry, (c) detailed laboratory analysis and assessment of the components in raw manure and digested manure such as pathogenic bacteria and chemicals/pesticides, and standard methods for determination developed, (d) demonstration of improved fertilizer value on crops, compared to livestock raw solid and liquid manure as well as chemical fertilizer, (e) assessment of alternative uses of bioslurry such as production of worms for fodder for fish or chicken, etc.
(iii) provide ideas for the improvement of quality of each type of biogas plant and their interfaces; the digester process such as better control of input manure and amount of water as well as effective temperature control (stability, insulation, mixing, etc;
(iv) determine of the ideal size of each biogas plant to be constructed;
(v) assess the technical, environmental impacts, and financial and economic viability of each biogas plant design options;
(vi) monitor the biogas plant construction and recommend its technical, environmental, financial and economic compliance;
(vii) list the constructed biogas plant in the database system;
(viii) the biogas plants have been constructed by certified masons/contractors; and
(ix) each of the other technical requirements and considerations for SBPs, MBPs and LBPs as described in Parts II, III and IV (as applicable).

4. According to size of livestock in households and farms, biogas plants (BPs) are divided into three categories[1]: (i) SBPs up to 50m^3, (ii) MBPs from 51 to 1,000m^3 and (iii) LBPs with more than 1,000m^3 digester volumes.

5. BVC infrastructure includes (i) well-constructed biogas plants; and (ii) an environmental package that includes installation of foot baths to reduce transmission of disease organisms into farm areas, improved livestock drainage sewers, installed storage tanks to hold the bio-slurry before applying it to the fields as organic fertilizer, and facilities to fully utilize the potential surplus of gas and electricity.

C. Environmental Guidelines for Eligible Subprojects

6. The Project will comply with the requirements set out in the Initial Environmental Examination [IEE, RRP Linked Document (LD) 11] and the Environmental Assessment and Review Framework (EARF, RRP LD 12) including compliance with the following environmental protection measures:

(i) prior to the start of construction of any MBPs or LBPs, ADB's screening procedure (as described in the IEE) shall be conducted, in addition to any other review and appraisal procedures described in the IEE or EARF.
(ii) compliance with each of the recommendations and risk mitigation measures set out in Part V (Anticipated Environmental Impacts and Mitigation Measures);
(iii) compliance with each of the mitigation measures set out in Part VI (Environmental Management Plan); and
(iv) compliance with each of the environmental selection criteria set out in Part VII (Environmental Selection Criteria).

D. Financial and Economic Viability Requirements for Eligible Subprojects

7. The Project will comply with the financial and economic viability requirements and recommendations set out in the Detailed Economic and Financial Analysis [RRP Supplementary Document (SD) 18] including compliance with the requirements and recommendations set out in Part VIII (Financial and Economic Viability Criteria).

E. Eligible Beneficiaries

1. Eligible Beneficiaries for SBPs

8. The following are the criteria for households to be eligible for SBP construction:

(i) each SBP needs supply from at least 8 -10 pigs (or at least three heads of cattle) and human waste from the household toilet, the minimum livestock waste production in farm household units is 20 kg/day;
(ii) the size of each SBP is from minimum 10m^3 up to 50m^3, with maximum price per cubic meter of $50 equivalent, potential increase of which is subject to ADB approval;

[1] At Government's definition.

(iii) clustered households with limited livestock may collaborate to construct a SBP; clear arrangements how the households will finance and utilize the common facilities should be determined prior to its construction;
(iv) farm area is adequate to accommodate the construction of the SBP at the farm site;
(v) farm household willing to invest in biogas construction should send their representatives (the farm owner or a member of the farm household, prioritized women) to fully commit to attend training courses on biogas, cooperate with project biogas masons and technician(s) during the construction period, and comply with the technical requirements for operation and maintenance; technicians will independently certify qualified trained household members as certified masons;
(vi) priority in providing support will be for poor households or those located in remote areas;
(vii) willingness to construct an environmental package that includes installation of foot baths to reduce transmission of disease organisms into farm areas, improved livestock drainage sewers, installed storage tanks to hold the bio-slurry before applying it to the fields as organic fertilizer, and facilities to fully utilize the potential surplus of gas and electricity;
(viii) the household is not registered in the database for the ones who have constructed the SBP funded by other financiers;
(ix) the SBPs will be eligible to tap the credit lines and incentive for carbon market development (ICMD) if they are constructed by certified masons or households who have been trained in the technical and environmental requirements of SBPs funded by the credit lines under the project;[2] and
(x) the masons and trained households should register their biogas plant construction plan with the certified technicians since they will independently certify the compliance of the constructed biogas plants to the standardized technical and environmental requirements; and
(xi) at least 50% of eligible beneficiaries will be registered under husband-wife joint accounts or on behalf of women (in order to comply with the Gender Action Plan).

2. Eligible Beneficiaries for MBPs and LBPs

9. The following are the criteria for households to be eligible for MBP construction:

(i) at least each MBP need supply from 50 adult pigs equivalent, or 20 head of adult cattle equivalent, or 5,000 adult chickens equivalent;
(ii) the minimum size for MBP funded by the credit lines under the Project is 500m.[3] The constructed MBPs should be viable to produce gas and electricity;
(iii) the minimum livestock waste production in each farm for MBP is 100 kg/day;
(iv) LBP needs supply from at least 200 adult pigs equivalent, or 80 head of adult cattle equivalent, or 20,000 adult chickens equivalent;

[2] Training of trainers (TOTs) for financial intermediaries' credit officers on technical and environmental requirements of SBPs funded under the Project are to be conducted. The trained credit officers will guide the borrowers on the technical and environmental requirements of SBPs. Financial intermediaries will advise PPMU on the demand for training in the project areas, and will distribute the manual on technical and environmental requirements of SBPs to each of the sub-borrowers. In case the SBPs are constructed by the households, financial intermediaries will disburse based on the construction progress only and make sure that the SBPs funded under the Project comply with the required technical and environmental criteria, otherwise the sub-loans can be terminated.

[3] The minimum size for MBPs which are eligible to be funded by the credit lines under the Project only given the limited sources of the Project.

(v) the minimum size for LBP funded by the credit lines under the Project is 2,000m[34], the constructed LBPs should be viable to produce gas and electricity;
(vi) the minimum livestock waste production in each farm for LBP is 400 kg/day;
(vii) clustered households may collaborate to construct an MBP or LBP; clear arrangements on how the households will finance and utilize the common facility should be determined prior to its construction;
(viii) farm area is adequate to accommodate the MBP or LBP, and construction at the farm site, and is technically and environmentally acceptable;
(ix) the households or enterprises that are willing to invest in biogas construction should send their representative(s) to fully attend training courses on biogas, cooperate with Project biogas masons and technician(s) during the construction period, and comply with the technical requirements for operation and maintenance;
(x) willingness to construct an environmental package that includes installation of foot baths to reduce transmission of disease organisms into farm areas, improved livestock drainage sewers, installed storage tanks to hold the bio-slurry before applying it to the fields as organic fertilizer, and facilities to fully utilize the potential surplus of gas and electricity;
(xi) the households or enterprises have not been registered in the database for the ones who have constructed the SBP funded by other financiers; and
(xii) the MBP or LBP will be eligible to tap the credit lines and incentive for carbon market development (ICMD) if the biogas plant is constructed by certified contractors; and it is financially and economically viable.

F. Credit Lines for Biogas Plants

1. Credit line Requirements for SBPs

10. The Project will provide credit lines to eligible beneficiaries through selected financial intermediaries. The following are the requirements for credit line for SBPs:

(i) the potential owners comply with eligibility criteria set in para. 8 above;
(ii) applicants commit to employ certified masons to construct the BVC facilities or attend trainings conducted by the credit officers in close coordination with the certified technicians on the technical and environmental requirements of SBPs and comply with the prescribed criteria for construction;
(iii) loan amount from ADB fund is maximum 85% of the total subloan of each subborrower;
(iv) financial intermediary's contribution should be at least 15% of the total subloan of each subborrower;
(v) applicant's contribution are in kinds including lands, labors and local materials and other supports that will not be quantified as cash;
(vi) maximum loan amount per SBP will be $2,500 equivalent, with average loan size for the SBP being $1,000 equivalent per unit;
(vii) loan term is up to 60 months;
(viii) principal repayment in equal installments or as agreed with financial intermediaries; full or partial repayment of principal in advance is accepted;
(ix) interest rate should be in line with prevailing market rate, payable monthly, quarterly or as agreed with financial intermediaries on a declining balance basis. In

[4] The minimum size for LBPs which are eligible to be funded by credit lines under the Project only given the limited sources of the Project.

determining the interest rate, guarantee and collateral arrangements, financial intermediaries shall ensure that eligible beneficiaries have access to affordable financial sources for construction of SBPs;

(x) collateral according to financial intermediaries policies as amended (if necessary) to incorporate sub-paragraphs (xi) to (xiii) below;

(xi) financial intermediaries will consider using one collateral for several credits under one or more households. For example, households having existing credits will also be eligible to use the same collateral like the red book (land certificates) to get additional loan for biogas plant construction as long as the collateral value complies with financial intermediaries policy;

(xii) the one who has borrowed for SBP construction will also use the same collateral to borrow for other purposes, as long as the comparison between the value of the collateral and the total loan per household is acceptable to the financial intermediary's policy;

(xiii) eligible collateral shall not be confined solely to the red book (land certificates) and financial intermediaries must also consider flexible guarantee and/or collateral arrangements including (but not limited to) individual farmers getting together to borrow as a group under cooperative structure, guarantee from collaterals owned by other households, and have a joint guarantee in lieu of collaterals;

(xiv) eligible beneficiaries shall make certain covenants set out in the subloan agreement including but not limited to those set out in Section A3 of Part VII of this Appendix (Environmental Selection Criteria).

2. Credit Line Requirements for MBPs and LBPs

11. The following are the requirements for credit line for MBPs and LBPs:

(i) the potential owners comply with eligibility criteria set in para. 9 above;

(ii) the livestock farms have been located in the concentrated safe livestock zones;

(iii) loan amount from ADB fund should be maximum 85% of the total subloan for each MBP and LBP;

(iv) finanicial intermediary's contribution should be at least 15% of total subloan of each MBP or LBP;

(v) applicant's contribution can be in kind and cash including lands, local material, labor and other potential contribution;

(vi) maximum loan amount per MBP will be $85,000 equivalent, and for each LBP a is $187,000 equivalent per unit;

(vii) loan term up to 10 years;

(viii) principal repayment in equal installments or as agreed with financial intermediaries; full or partial repayment of principal in advance accepted;

(ix) interest rate should be in line with prevailing market rate, payable monthly, quarterly or as agreed with financial intermediaries on a declining balance basis;

(x) collateral according to financial intermediary policies; and

(xi) applicants should be committed to follow the Project's biogas development component's construction procedures and quality standards, verified by the contract and ultimately verified by the Certificate of Acceptance issued by Biogas Component upon completion; and

(xii) Eligible beneficiaries shall make certain covenants set out in the subloan agreement including but not limited to those set out in Sections B3 and C3 (as applicable) of Part VII of this Appendix (Environmental Selection Criteria).

3. Free-Limit Requirements

12. As stated in the Project Agreement, each financial intermediary shall submit for prior review and clearance by ADB, each Subloan proposal financing the construction of an LBP for which the principal amount of the Subloan borrowed by an eligible beneficiary exceeds $187,000. The free limit equivalent to the SOE ceiling is $187,000, the maximum loan size for the construction of a LBP.

G. Procurement Plan of SBPs, MBPs and LBPs

13. Table 1 presents a list of the existing trained masons and technicians for the constructed SBPs in the 10 participating provinces. The details of masons, technicians and the owners of constructed SBPs will be available in the central and provincial project management units (CPMU and PPMUs) and participating financial intermediaries and such list shall be promptly updated by the CPMU and PPMUs from time to time to include new masons and technicians trained under the Project.

Table 1: Trained Technicians and Masons in Project Areas

No.	Province	Since	Since	Constructed SBPs		Trained Technicians		Certified Masons	
		SNV	L2513	SNV	L2513	SNV	L2513	SNV	L2513
1	Bac Giang	2007	2009	5,003	2,576	13	10	21	19
2	Ben Tre	2008	2009	1,475	1,763	9	9	24	17
3	Binh Dinh	2004		6,713		15		25	
4	Ha Tinh	2010		741		12		24	
5	Lao Cai	2009		205		11		24	
6	Nam Dinh	2007		1,772		15		16	
7	Soc Trang	2011		16		20		41	
8	Son La	2006	2009	859	330	13	13	15	15
9	Phu Tho	2006	2009	2,575	2,660	22	40	32	60
10	Tien Giang	2003	2009	5,259	1,253	13	25	42	17
	Total		-	**24,618**	**8,582**	**143**	**97**	**264**	**128**

Source: SNV and the Government. 2012.

14. Experience shows that one mason can construct on average 25 SBPs per annum. The existing certified masons and technicians, just from the Netherlands Government's funded project (through SNV), will be able to construct the targeted incremental 36,000 SBPs within six years. By including additional trained technicians and certified masons from the ongoing Loan For MBPs and LBPs, there are at least 22 main companies and institutions related to MBP and LBP development in Viet Nam that can be assigned commercial practices by end-users to construct MBP and LBP on turn-key based. The list and experience of the companies are given in Table 2.

Table 2: Companies Experienced in MLBP Construction in Viet Nam

No.	Name	Since	Experience/Remarks
1	Biogas Technology Center - Hanoi	2007	KT3 up to 32,000m^3, stove, filter, lamps, water heater
2	Nghia Hung – Dac Lak	2008	KT1, 2, composite, generators
3	CCRD-VACVINA	2002	Constant gas production
4	Centre of Renewable Energy Hai Phong and Thai Binh		Plug flow vertical cylinder shaped tank
5	Da Nang Research and Devt of New Energy	2000	250m^3
6	Thanh Hoa Centre of Environment & Techno		Hybrid techno bio-digester and use slurry as bio-fertilizer
7	Science &Training – Danang University		Biogas to generate electricity
8	Hung Vuong Biogas Techno	2007	Gas stove, biogas water heater
9	Quang Huy Company		Composite digesters
10	Nguyen Khang Energy in Binh Duong, Dong Nai, Toan Xuan, Da Nang	2009	Cover lagoon more than 190,000m^3, biogas from cassava
11	Phu Hoang Gia		Anaerobic lagoon up to 3,600m^3
12	RCEE	2009	Electric generator for biogas
13	VECC	2007	Waste water treatment & biogas
14	NUCE	2009	Composite digesters
15	Thanh Loc Composite		Composite, biogas stove, lamp, etc
16	Minh Tuan Biogas Ltd		Up to 1,000m^3 BPs
17	D&D Viet Nam Ltd	2006	Lagoon more than 5,000m^3
18	INEST – Ha Noi Technology University		Waste water, emission treatment and reuse of industrial wastes
19	Asia Biogas Viet Nam	2006	Cover lagoon, hybrid reactors, etc.
20	Rhodia Nuoc Biogas		Biogas capture and fuel switch project
21	Thai Biogas – permanent office in Ho Chi Minh	2003	Its biogas project won the first price from ASEAN renewable energy
22	SURE – Viet Nam – Ho Chi Minh		Installed power generating on biogas

Source: Ministry of Agriculture and Rural Development. 2012. Hanoi.

15. Detailed profiles of these companies will be available in the participating financial intermediaries. Applicants are free to employ the preferred contractors to construct the BVC infrastructure. The project will regularly update the profile of qualified contractors and masons.

H. Incentive for Carbon Market Development (ICMD)

16. Biogas plant investments will be required to meet the technical and environmental compliance criteria set out in Sections B and C above. The compliance will be issued by certified technicians acknowledged by the project. The following are the procedures for the ICMD.

1. ICMD for Biogas Plant Technical Compliance

17. The following are the ICMD procedures for biogas plant technical compliance:

(i) applicants will check PPMU or participating financial intermediaries to ensure their names are not registered in the database of constructed biogas plants; and never received any similar incentives from other projects or financiers;

(ii) applicants will complete the form to indicate the mason who will s/he choose to construct the biogas plants and including the timetable to construct the BVC infrastructure;
(iii) certified masons will coordinate with the certified technicians to monitor the construction of BVC infrastructure;
(iv) technician will independently certify the technical compliance of constructed biogas plants including compliance with Section B above (Technical Guidelines for Eligible Subprojects);
(v) PPMUs will consolidate the constructed biogas plants that have complied with technical specification including the account number of each owner;
(vi) husband and wife should be registered as the owners; the accounts can be in the name of the wife or a joint account;
(vii) widows, divorced or single owners should be clearly identified; the bank account can be represented by a family member (preferably women);
(viii) CPMU through participating financial intermediaries will flow the ICMD for biogas plant technical compliance directly to the bank account of each owner;
(ix) applicants should sign the agreement that the Coordinating and Managing Entity (CME) or its representatives (potentially biogas associations) is authorized to trade the certified emission of carbon reduction (CER) in the carbon markets and the revenues from the trading will be fully owned by the CME; and
(x) the amount of the ICMD for BP technical compliance will be VND1.2 million for each SBP; and
(xi) Households will receive through their accounts in financial intermediaries the ICMD for technical compliance after the certified technicians issue the technical compliance certification and registered the BPs in one database system approved by the Project.

2. ICMD for Biogas Plant Environmental Compliance:

18. In addition to the ICMD for technical compliance, the Project will also offer an ICDM for BP environmental compliance. The environmental compliance should cover well installed foot baths to reduce transmission of disease organisms into farm areas, improved livestock drainage sewers, installed storage tanks to hold the bio-slurry before applying it to the fields as organic fertilizer, and installed facilities to fully utilize the potential surplus of gas and electricity.

19. The following are the ICMD procedures for biogas plant environmental compliance:

(i) revenues from the CER trading will be fully owned by the CME; the applicants should have been registered in database to indicate that the constructed BPs have fulfilled the technical compliance;
(ii) for environmental compliance, the applicants can apply as individual or as a group. Applicants will complete the form to indicate the environmental packages that they will establish including the estimated cost, the certified masons, and the timetable to construct the environmental packages;
(iii) certified masons will coordinate with the certified technicians to monitor the construction of the environmental facilities;
(iv) technician will certify the environmental compliance of constructed biogas plants to PPMUs including compliance with Section C above (Environmental Guidelines for Eligible Subprojects);
(v) PPMUs will consolidate the constructed biogas plants that have complied with environmental specification including the account number of each owner; group can be presented by one of the owners;

(vi) husband and wife should be registered as the owners; the accounts can be in the name of the wife or a joint account;
(vii) widows, divorced or single owners should be clearly identified; the bank account can be represented by a family member (preferably women);
(viii) group can authorize the project to transfer the ICMD for environmental compliance to a member account, preferable through women;
(ix) CPMU through participating financial intermediaries will flow the ICMD for biogas plant technical compliance directly to the bank account of each owner representative;
(x) applicants should sign the agreement that the Coordinating and Managing Entity (CME) or its representatives (potentially biogas associations) is authorized to trade the certified emission of carbon reduction (CER) in the carbon markets and the revenues from the trading will be fully owned by the CME;
(xi) the amount of the ICMD for BP environmental compliance will be VND 1.8 million for each SBP the amount of the ICMD for both technical and environmental compliance will be VND 10 million for each MBP (with minimum size of 500m^3, and minimum number of livestock as discussed eligible beneficiaries); and VND 20 million for each LBP (with minimum size of 2,000m^3, and minimum number of livestock as discussed eligible beneficiaries);
(xii) households will receive through their accounts in financial intermediaries the ICMD for environmental compliance after the certified technicians issue the environmental compliance certification and registered the biogas plants in one database system.

I. Subsidiary Loan Agreement

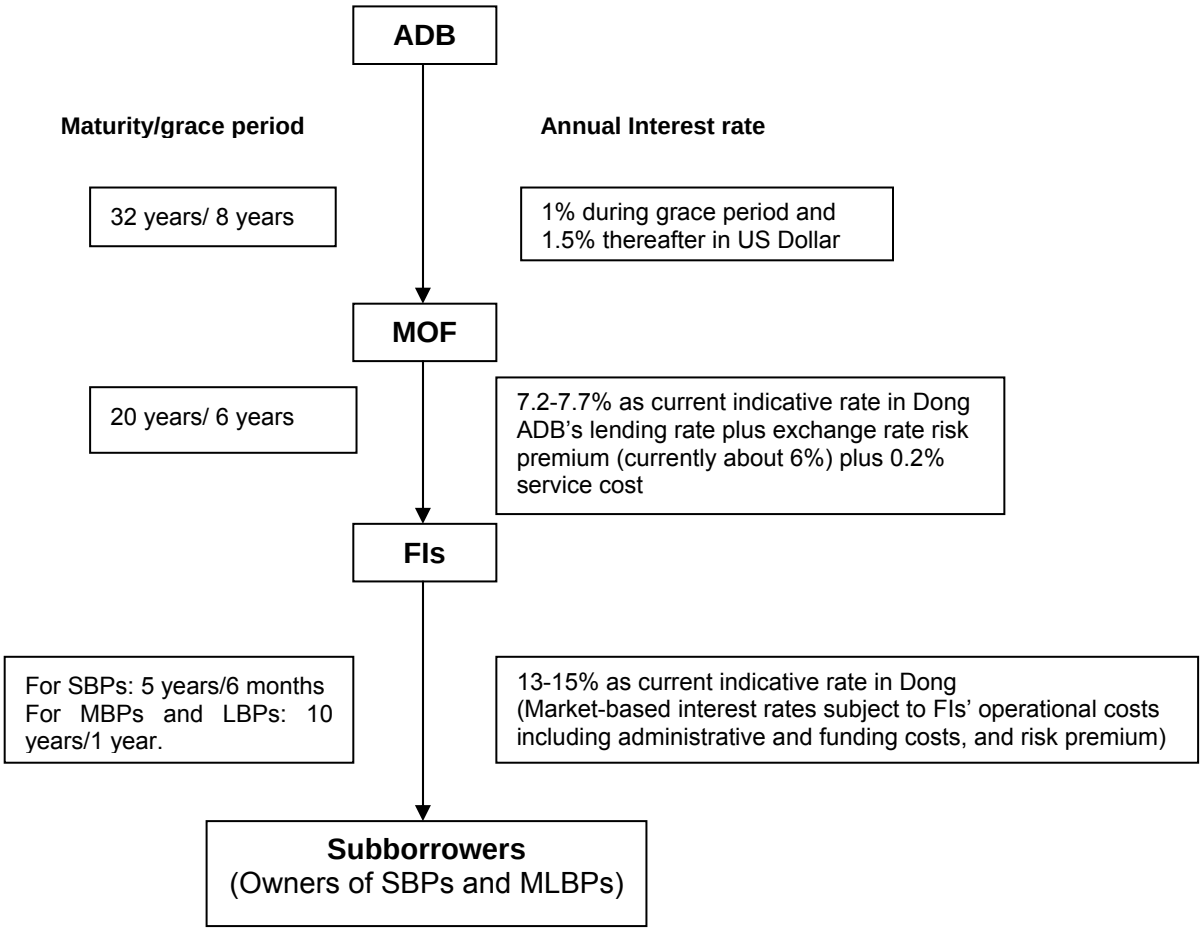
1. Terms and Conditions

20. The implementing policy and procedures of the Government's relending sourced from foreign loans is defined by Decree No.78/2010/ND-CP entitled "*Onlending of the Government's Foreign Loan*". As in the decree, the Ministry of Finance (MOF) shall select financial and credit institutions to be relending agencies according to the following criteria:

(i) having experience in lending investment programs and projects in the domains eligible for on-lending;
(ii) operating in a geographical area suitable to the area of the investment program or project to be on-lent;
(iii) observing regulations on the management and recovery of on-lent loans, on-lending charges and reporting;
(iv) being accepted by the foreign lender to be on-lending agency (if such is required under the foreign loan agreement);
(v) with regard to the relending of overseas development assistance (ODA) loans, priority shall be given to the Government's policy banks. With regard to on-lending of commercial and concessional loans, other commercial banks and financial and credit institutions shall be selected, with priority given to those co-financing the on-lent loan-funded projects; and
(vi) on-lending agencies are entitled to on-lending charges specified in the Decree.

2. Flow of Funds and Lending Terms

21. Chart 1 presents the flow of funds and lending terms in various levels:



ADB= Asian Development Bank, FI = financial Intermediary, MOF = Ministry of Finance, LBP = large biogas plant, MBP = medium biogas plant, SBP = small biogas plant.
Source: Asian Development Bank.

22. The Subsidiary Loan Agreement will be prepared for each financial intermediary and signed between (MOF) and the authorized person of each financial intermediary. As stated in the Loan Agreement, the Government agrees to relend the financial intermediaries, a part of the loan proceeds to carry out the credit component under the Project as regulated in the Subsidiary Loan Agreement and upon the following terms and conditions:

(i) MOF agrees to relend to financial intermediaries a part of the proceeds of the loan financed by ADB of an amount in Vietnamese Dong (VND) equivalent to and not exceeding xxxxx Special Drawing Rights (xxxx SDR) to carry out credit lines funded by the Project;

(ii) the currency of relending of Subsidiary loan and the currency of repayment is Vietnamese Dong (VND). Effective date is the date that ADB disburses from the Loan Account to each withdrawal application regarding the account for this loan opened by financial intermediaries, as regulated in the Loan Agreement. Each amount of the Subsidiary Loan shall be recorded on the Subsidiary Loan Account

in VND based on the VND-equivalent amount converted from the various currencies. The exchange rate to be applied shall be the servicing bank's buying rate on the effective date;

(iii) the total amount of the subsidiary loan shall not exceed SDR xxxx during project implementation. Each financial intermediary has access to the Subsidiary loan on the basis of the principle of who provides the eligible withdrawal application first, should be served first;

(iv) relending interest rate: the relending interest rate imposed on Subsidiary loan charged by MOF to FIs shall be at the relending interest rate in VND complied with Decree 78/2010/ND-CP of 14 July 2010 on "Onlending of the Government's foreign loans". The relending service charge of 0.20% per annum is added to relending interest rate; and

(v) maturity of the relending loan shall be twenty (20) years, including six (6) years of the grace period.

3. Schedule for Payment and Interest Charge

23. The following are the schedule for payment of the principal amount and interest charge of the subsidiary loan:

(i) Financial intermediaries shall repay MOF the principal amount in Vietnamese dong in 28 equal semi-annual installments on 15 August and 15 February each year, starting from 15 February [2019] and closing on 15 August [2025];

(ii) on every 15 February and 15 August annually, starting from 15 February 2019, financial intermediaries shall pay MOF the interest charge for the principal withdrawn and the principal balance based on specific period with the interest rate;

(iii) interest charge and delayed interest charge shall be calculated on the practical period of the use of the loan and on the basis of a year consisting of 360 days;

(iv) if the date of 15 February/15 August falls on the day off, financial intermediaries shall be payable to MOF on the following working day;

(v) the principal amount and interest charge mentioned herein shall be calculated by financial intermediaries, as the interest charge, principal and delayed interest charge (if any), and paid into MOF's Sinking Fund account; or to any other account announced from time to time by MOF 10 days before the due date;

(vi) in case of overdue settlement of the principal and interest charge, financial intermediaries must pay a penalty at the rate of 150% of the onlending interest rate, applicable to the number of overdue days. The overdue date starts from the first working day following the due date;

(vii) in respect to any payment of the principal and interest charge before the due date, each financial intermediary has to make a prior notice in written form to MOF before 30 days;

(viii) Financial intermediaries shall bear full credit risks for onlending to subprojects from this Subsidiary Loan; and

(ix) Procedure of disbursement of this subsidiary loan shall be complied with the provisions specified in ADB's Disbursement Handbook.

4. Financial Intermediaries' Commitment

24. Financial intermediaries shall agree with the following commitments:

(i) coordinate closely with the Departments of Agriculture and Rural Development (DARD) in each participating province to ensure that the works that are to be financed from the subsidiary loan are in compliance with environmental and technical criteria which have been developed and agreed between the Ministry of Agriculture and Rural Development (MARD) and ADB;

(ii) provide funds as subloans to subborrowers to construct biogas plants and their environmental packages. The subloan does not include the in kind contribution of the subborrowers. Out of each subloan (100%), which maximum of 85% is financed from Subsidiary loan (ADB source), and minimum of 15% from FIs' owned sources. The remaining costs of BPs and their environmental packages (mostly in kind) shall be contributed by eligible households/enterprises by providing locally available materials and/or equivalent labor value;

(iii) the subloan interest rate and its onlending duration is determined by financial intermediaries on the basis of market interest rates and demand and ensure that eligible households/livestock enterprises have access to affordable financial sources for construction of biogas plants and their environmental packages;

(iv) use the subsidiary loan to on-lend to eligible households if the planned biogas plants will be constructed by certified masons and contractors or households who have been trained in the technical and environmental requirements of SBPs funded by the credit lines under the Project. These will ensure that the biogas plant infrastructure will comply with the technical, social, environmental, economic and financial standards specified in the Project Administration Manual (PAM);

(v) ensure that household and enterprises beneficiaries in the project provinces, including those who have received financial and technical assistance under biogas program funded by other development partners, are eligible for applying for Subloans under the Project, if these households or enterprises have demand for such loans;

(vi) ensure that the subsidiary loan proceeds shall be utilized to cover only the following project provinces: Bac Giang, Ben Tre, Binh Dinh, Ha Tinh, Lao Cai, Nam Dinh, Phu Tho, Soc Trang, Son La, and Tien Giang.

(vii) perform the loan- related-rights aiming at protecting interest of its own and of the Socialist Republic of Viet Nam and ADB, complying with obligations as regulated in the Subsidiary Loan Agreement herein and achieving the objectives of the Project;

(viii) prepare and submit and/or caused to prepare and submit to MARD and ADB all information and documents in accordance with regulations of the PAM as required by MARD and ADB related to project activities executed by financial intermediaries;

(ix) support MARD and ADB in working with financial intermediaries' staff and auditors required by MARD or ADB for the purpose of supervision and implementation of project activities executed by financial intermediaries;

(x) sign On-lending Agreements with individual eligible household, as regulated in the PAM that financial intermediaries bear full rights to protects benefits of its own, Socialist Republic of Viet Nam and ADB, including rights to request eligible households and enterprises to: (a) Carry out its biogas constructions with due

diligence and efficiency and in accordance with sound technical, economic, financial, managerial, environmental and social standards and practices acceptable to MARD and ADB, including in the provisions of the Safeguard Frameworks and the provisions of the Anticorruption Policy (1998, as amended to date) applicable to recipients of loan proceeds from ADB; (b) Provide promptly as needed, the resources required for the implementation of its biogas constructions; (c) Ensure that goods, works and services financed out of the Sub-loan be procured at a reasonable price in accordance with the provisions of the Operation Manual; (c) Promptly enable financial intermediariess, or jointly with the MARD and ADB, if ADB requests, inspects the biogas constructions, its operation and any relevant records and documents; and (d) Prepare and furnish, in a timely manner, to MARD and ADB all such information as MARD and ADB shall reasonably request relating to biogas constructions;

(xi) fully comply with State Bank of Viet Nam's regulations and financial intermediaries eligible criteria as provided in the PAM during the project implementation (herein called "Eligible Criteria");

(xii) maintain separate accounts for the project; have such accounts and related financial statements audited annually, in accordance with appropriate auditing standards consistently applied, by independent auditors whose qualifications, experience and terms of are acceptable to MARD's CPMU and ADB;

(xiii) fully comply with ADB's Anticorruption Policy (1998, as amended to date) and the provisions contained in the Loan Agreement dealing with Governance and Anticorruption including but not limited to: (a) cooperating with and extending all necessary assistance (including access to information) to ADB in respect of any investigation by ADB into alleged corrupt, fraudulent, collusive or coercive practices relating to the Project; (b) if either the Government or ADB becomes aware or has a reasonable suspicion that a representative of any financial intermediary has engaged in corrupt or fraudulent practices in connection with the Project, the financial intermediary shall take such timely and appropriate action satisfactory to ADB including immediately repaying or allowing any other form of recovery of any portion of a Subsidiary Loan. If the financial intermediary fails to take any such actions stipulated by ADB, ADB may declare the financial intermediaryI ineligible, either indefinitely or for a stated period, to be considered as a provider of financial intermediary loans or any other financial instruments for future ADB projects; and fully comply with ADB's policy relating to Enhancing the Asian Development Bank's Role in Combating Money Laundering and the Financing of Terrorism (2003), applicable laws and regulations of the Socialist Republic of Viet Nam on combating money laundering and financing of terrorism and provisions contained in the Loan Agreement dealing with Combating Money Laundering and Financing of Terrorism including implementing appropriate internal control procedures, including customer due diligence procedures, and informing the Government and ADB if there is any potential or actual violation of these provisions.

5. Compensation and Other Terms

25. The following are the compensation and other terms that both FIs have to comply with:

(i) in case of financial intermediary's failure to perform its obligations as stipulated in the Subsidiary Loan Agreement herein, MOF shall, subject to its determination, require financial intermediaries to pay for compensation under regulations of the Law;
(ii) no regulations in the Subsidiary Loan Agreement act to the prejudice or effect of the rights of MOF and its right of compensation under the Law;
(iii) if the fund withdrawals from the Credit Account of Vietnam under the Loan Agreement is suspended or terminated, for whatever reason, the relative subsidiary loan shall be also immediately suspended or terminated at the same time, if this case happens;
(iv) the Subsidiary Loan Agreement comes into effect on the date that it is signed;
(v) the Subsidiary Loan Agreement shall be applied to any of the agencies succeeding the financial intermediaries in any form;
(vi) any amendment or supplement to the terms and conditions of the Subsidiary Loan Agreement, if any, shall first be consulted with ADB in written form. Upon obtaining ADB's endorsement, the amendment or supplement shall be signed by both parties and will be considered as an integral part of this Subsidiary Loan Agreement;
(vii) any arising conflict related to the implementation of the Subsidiary Loan Agreement which fails to be resolved by negotiation between the two parties shall be brought to the Economic Trial - Hanoi People's Court or any successor of this Court;
(viii) upon occurring force majeure risk that causes failure for debt recovery from the eligible households, financial intermediaries must promptly inform MOF, so that it shall be reviewed and resolved in accordance with current regulations under the Law; and
(ix) any notice, request or agreement between the parties relating to this Subsidiary Loan Agreement must be made in written form. Such a relevant notice or request shall be valid to be sent to related parties to the address below. If the address of any party changes, it should be informed in writing notification to the other party.

J. Project Agreement Between ADB and Financial Intermediaries

1. Subloans

26. Except as ADB may otherwise agree, the proceeds of the Loan shall: (i) be used only for onlending Subloans to eligible beneficiaries for eligible subprojects under and in accordance with the Subsidiary Loan Agreement (Onlending Agreements); and (ii) be applied exclusively to the cost of Goods and Works and other items of expenditure required to carry out such eligible subprojects and the financial intermediaries shall ensure that any facilities and services financed out of such proceeds are used exclusively in the carrying out of the project. Each Onlending Agreement shall include provisions to the effect that:

(i) the eligible beneficiary shall carry out and operate the eligible subproject with due diligence and efficiency and in accordance with sound applicable technical, financial, business and development practices, including maintenance of adequate accounts and records;

(ii) the proceeds of the Subloan shall be used only for procurement in member countries of ADB, in accordance with procedures acceptable to ADB, of Goods which are produced in and supplied from, and Works which are supplied from, such countries;
(iii) the Goods and Works procured for an eligible subproject shall be used exclusively in the carrying out of that eligible subproject; and
(iv) ADB and the financial intermediary shall each have the right to inspect such goods and works, the eligible beneficiary, the eligible subproject and any relevant records and documents;
(v) the eligible beneficiary shall take out and maintain with responsible insurers insurance against such risks and in such amounts as shall be consistent with sound business practice, and without any limitation upon the foregoing, such insurance shall cover hazards incident to the acquisition, transportation and delivery of goods to the place of use or installation, and for such insurance any indemnity shall be payable in a currency freely usable to replace or repair such goods;
(vi) ADB and the financial intermediary shall each be entitled to obtain all such information as each shall reasonably request relating to the subloan, the goods, works, the eligible subproject, the eligible beneficiary and other related matters; and
(vii) the financial intermediary shall be entitled to suspend or terminate further access by the eligible beneficiary to the use of the proceeds of the subloan upon failure by the eligible beneficiary to perform its obligations under its Onlending Agreement with the financial intermediary.

2. Eligible Beneficiary

27. The eligible beneficiary shall take out and maintain with responsible insurers insurance against such risks and in such amounts as shall be consistent with sound business practice, and without any limitation upon the foregoing, such insurance shall cover hazards incident to the acquisition, transportation and delivery of goods to the place of use or installation, and for such insurance any indemnity shall be payable in a currency freely usable to replace or repair such Goods:

(i) ADB and the financial intermediary shall each be entitled to obtain all such information as each shall reasonably request relating to the subloan, the goods, works, the eligible subproject, the eligible beneficiary and other related matters;
(ii) the financial intermediary shall be entitled to suspend or terminate further access by the eligible beneficiary to the use of the proceeds of the subloan upon failure by the eligible beneficiary to perform its obligations under its Onlending Agreement with the financial intermediary.
(iii) each financial intermediary shall promptly and effectively exercise its rights in relation to an eligible subproject in accordance with the standards of a prudent lender and in such manner as to protect the interests of the borrower, the relevant financial intermediary and ADB;
(iv) each financial intermediary shall submit for prior review and clearance by ADB: (a) the first Subloan Agreement financing the construction of a SBP, (b) the first Subloan Agreement financing the construction of a MBP (c) the first Subloan Agreement financing the construction of a LBP; and (d) each Subloan proposal financing the construction of a large biogas plant for which the principal amount of the subloan borrowed by an eligible beneficiary is equal to or exceeds $187,000.

(v) for each subloan proposal financing the construction of a SBP, the principal amount of the subloan borrowed by an eligible beneficiary is maximum $2,500 and keep average subloan size for all SBPs to be maximum $1,000;
(vi) for each subloan proposal financing the construction of a MBP, the principal amount of the Subloan borrowed by an eligible beneficiary is maximum $85,000;
(vii) for each subloan proposal financing the construction of a LBP, the principal amount of each subloan borrowed is maximum $187,000;
(viii) in determining the terms and conditions for a subloan, each financial intermediary shall take into consideration, and hence ensure, that eligible beneficiaries have access to affordable financial sources for biogas plant construction and shall ensure that no amendments, waivers, supplements or other modifications are made to the terms and conditions of any subloan which would jeopardize this principle; and
(ix) none of the financial intermediaries shall amend, supplement, waive, defer or otherwise modify the subproject eligibility criteria in any way without the prior consent of ADB.

3. Particular Covenants

28. The financial intermediaries shall carry out the Project with due diligence and efficiency and in conformity with sound applicable technical, financial, business, engineering, environmental and biogas investment practices. In the carrying out of the Project and in the conduct of its business, the financial intermediaries shall perform all the obligations set forth in the Loan Agreement to the extent that they are applicable to the financial intermediaries, and shall perform all obligations set forth in their respective Subsidiary Loan Agreements.

29. The financial intermediaries shall maintain records and accounts adequate to record the progress of the Project and the Eligible Subprojects (including the cost thereof) and to reflect, in accordance with consistently maintained sound accounting principles, the operations and financial conditions of the financial intermediaries.

30. ADB and the financial intermediaries shall cooperate fully to ensure that the purposes of the Loan will be accomplished. The financial intermediariesshall promptly inform ADB of any condition which interferes with, or threatens to interfere with, the progress of the project, the performance of their respective obligations under this Project Agreement or the relevant Subsidiary Loan Agreement, or the accomplishment of the purposes of the Loan.

31. ADB and the financial intermediaries shall from time to time, at the request of either party, exchange views through their representatives with regard to any matters relating to the Project, the financial intermediaries and the Loan. The financial intermediaries shall furnish to ADB all such reports and information as ADB shall reasonably request concerning (i) the Loan and the expenditure of the proceeds thereof; (ii) the Project; (iii) the eligible beneficiaries, the eligible subprojects and the subloans; (iv) the administration, operations and financial conditions of the financial intermediaries; and (v) any other matters relating to the purposes of the Loan.

32. Without limiting the generality of the foregoing, the financial intermediaries shall furnish to ADB quarterly reports on the execution of the Project and on the operation and management of the financial intermediaries. Such reports shall be submitted in such form and in such detail and within such a period as ADB shall reasonably request, and shall indicate, among other things, progress made and problems encountered during the period under review, steps taken

or proposed to be taken to remedy these problems, and proposed program of activities and expected progress during the following quarter.

33. Promptly after physical completion of the Project, but in any event not later than 3 months thereafter or such later date as ADB may agree for this purpose, the financial intermediaries shall prepare and furnish to ADB a report, in such form and in such detail as ADB shall reasonably request, on the utilization of the Loan, the execution of the eligible subprojects, their costs, the performance by the financial intermediaries of their respective obligations under this Project Agreement and the accomplishment of the purposes of the Loan. The financial intermediaries shall:

(i) maintain separate accounts for the Project;
(ii) establish a revolving fund to which interest and principal payments under the project were credited. The revolving fund resources were used for amortizing the ADB loan and for onlending for eligible subprojects;
(iii) carefully select sub-borrowers for their ability to repay their subloans, assessing their fixed assets, studying the financial viability of their proposals, and closely supervising these sub-borrowers to ensure that the percentage of nonperforming loans (NPLs) should be less than 5% of outstanding loans;
(iv) if the NPLs will reach more than 10% of the outstanding loans, sublending from ADB Loan will be suspended;
(v) prepare annual financial statements for the Project in accordance with accounting principles acceptable to ADB;
(vi) have their accounts and financial statements (balance sheet, statement of income and expenses, and related statements) audited annually, in accordance with appropriate auditing standards consistently applied, by independent auditors whose qualifications, experience and terms of reference are acceptable to ADB, in accordance with international standards for auditing or the national equivalent acceptable to ADB;
(vii) as part of each such audit, the auditors shall prepare a report (which includes the auditors' opinion on the use of the Loan proceeds and compliance with the financial covenants of this Project Agreement as well as on the use of the procedures for the imprest account(s) and statement of expenditures) and a management letter (which sets out the deficiencies in the internal control of the Project that were identified in the course of the audit, if any);
(viii) furnish to ADB, no later than 6 months after the close of the fiscal year to which they relate, copies of such audited financial statements, audit report and management letter, all in the English language, and such other information concerning these documents and the audit thereof as ADB shall from time to time reasonably request. ADB may disclose the annual audited financial statements for the Project within 30 days of the date of their receipt by posting them on ADB's website;
(ix) ensure that technical and environmental criteria related to biogas are added to each financial intermediary's standard loan eligibility criteria to ensure the targeted clientele under the Project is reached;
(x) comply with ADB's Anticorruption Policy (1998, as amended to date) and the provisions contained in the Loan Agreement dealing with Governance and Anticorruption.

34. Each financial intermediary shall enable ADB, upon ADB's request, to discuss its financial statements and its financial affairs from time to time with the auditors appointed by the

relevant financial intermediary, and shall authorize and require any representative of such auditors to participate in any such discussions requested by ADB, provided that any such discussion shall be conducted only in the presence of an authorized officer of the financial intermediary unless the financial intermediary shall otherwise agree.

35. The financial intermediaries shall enable ADB's representatives to inspect any eligible beneficiary, any eligible subproject, the goods and works, all other properties and equipment of the financial intermediaries and any relevant records and documents.

36. The financial intermediaries shall, promptly as required, take all action within their respective powers to maintain their corporate existence, to carry on their operations, and to acquire, maintain and renew all rights, properties, powers, privileges and franchises which are necessary in the carrying out of the Project or in the conduct of their business.

37. The financial intermediaries shall at all times conduct their business in accordance with sound applicable administrative, technical, financial, business, environmental and banking practices, and under the supervision of competent and experienced management and personnel.

38. The financial intermediaries shall at all times operate and maintain their business facilities, and from time to time, promptly as needed, make all necessary repairs and renewals thereof, all in accordance with sound administrative, financial, engineering, environmental, banking and maintenance and operational practices.

39. Except as ADB may otherwise agree, the financial intermediaries shall not sell, lease or otherwise dispose of any of their assets which shall be required for the efficient carrying on of their operations or the disposal of which may prejudice their ability to perform satisfactorily any of their respective obligations under this Project Agreement.

40. Except as ADB may otherwise agree, the financial intermediaries shall duly perform all of their respective obligations under the Subsidiary Loan Agreement to which they are party and shall not take, or concur in, any action which would have the effect of assigning, amending, abrogating or waiving any rights or obligations of the parties under that Subsidiary Loan Agreement.

41. The financial intermediaries shall promptly notify ADB of any proposal to amend, suspend or repeal any provision of their constitutional documents, which, if implemented, could adversely affect the carrying out of the Project or the operation of the project facilities. The financial intermediaries shall afford ADB an adequate opportunity to comment on such proposal prior to taking any affirmative action thereon.

4. Effective Date and Termination

42. The execution and delivery of the Project Agreement on behalf of the financial intermediaries has been duly authorized or ratified by all necessary corporate, administrative and governmental action.

43. The financial intermediaries have furnished to ADB an opinion of a counsel acceptable to ADB showing that this Project Agreement has been duly authorized or ratified by, and executed and delivered on behalf of, the financial intermediaries and is legally binding upon the financial intermediaries in accordance with its terms.

44. ADB shall temporarily suspend further disbursements to a participating financial intermediary when the percentage of nonperforming loans (NPLs) of subloans funded by the Project has reached more than 5% of its outstanding lending portfolio of the subprojects.

45. All the provisions of the Project Agreement shall continue in full force and effect notwithstanding any cancellation or suspension under the Loan Agreement.

5. Miscellaneous

46. Any notice or request required or permitted to be given or made under the Project Agreement and any agreement between the parties contemplated by the Project Agreement shall be in writing. Such notice or request shall be deemed to have been duly given or made when it shall be delivered by hand, mail or facsimile to the party to which it is required or permitted to be given or made at its address hereinafter specified, or at such other address as such party shall have designated by notice to the party giving such notice or making such request. Any action required or permitted to be taken, and any documents required or permitted to be executed, under this Project Agreement by or on behalf of the financial intermediaries may be taken or executed by their respective presidents or by such other person or persons as they shall so designate in writing notified to ADB.

47. No delay in exercising, or omission to exercise, any right, power or remedy accruing to either party under this Project Agreement upon any default shall impair any such right, power or remedy or be construed to be a waiver thereof or an acquiescence in such default; nor shall the action of such party in respect of any default, or any acquiescence in any default, affect or impair any right, power or remedy of such party in respect of any other or subsequent default.

II. Technical Aspects of Small Biogas Plants

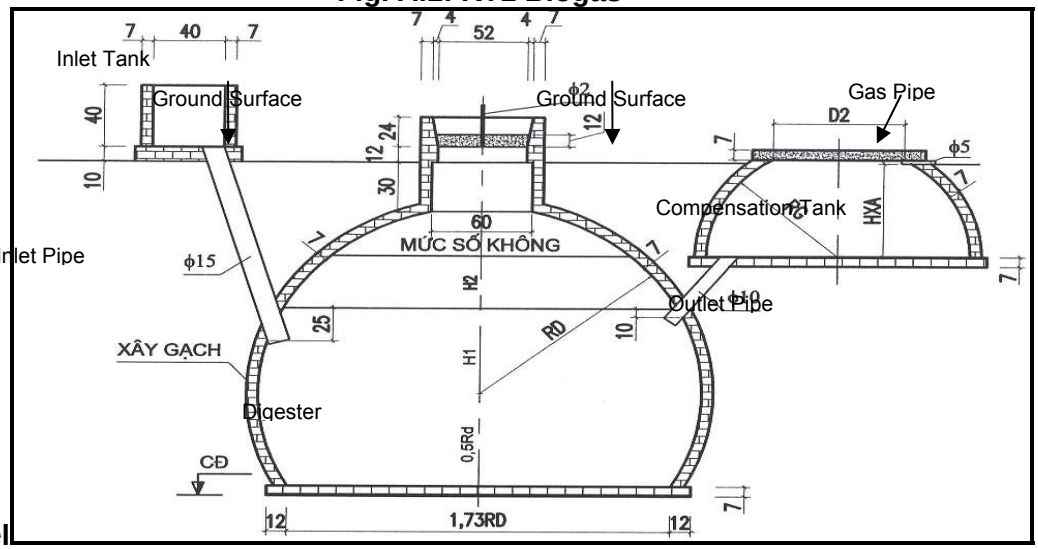
48. The Project aims to promote *fixed-dome* KT1 and KT2 biogas model units, with dimensions ranging 4m^3 to 48.8m^3. The KT1 and KT2 models were developed according to biogas industrial standards *10TCN 492:499-2003* and *10TCN 97:102-2006*, respectively, which were issued by the MARD. The KT1 biogas model is normally recommended to be constructed on steady ground with thin surface which can be dug deeply. In contrast, the KT2 biogas model is more suitable for unsteady ground which has thick surface, plenty of underground water, and cannot be deeply dug.

49. The design of the biogas units is fairly simple with six main components: (i) inlet tank; (ii) inlet pipe; (iii) digester; (iv) outlet pipe; (v) compensation tank; and (vi) gas pipe. These are described in brief below while an illustration of each of these models are presented in Figures A.1 and A.2.

- *Inlet tank* is a container for loading input material;
- *Inlet pipe* is a linking pipe which leads input material to the inlet tank. It is cylindrical in shape and made of cement or solid plastic with a diameter of at least 150mm upwards. A pipe from the household's toilet facilities will be connected to this pipe;
- *Digester* is the key component of the biogas unit in which the digested liquid is contained and allows the fermentation process to take place to produce biogas and digested slurry/manure (effluent);

- *Outlet pipe* is designed and made of the same material as the inlet tank with a diameter equal or smaller than that of the inlet tank;
- *Compensation tank* is semi-circle in shape and its function is to moderate air pressure in the digester. It also receives digested liquid and acts as safety valve for protecting the digester. From this tank, an overflow pipe is connected to a slurry collection tank or lagoon; and
- *Gas pipe* is made of steel or solid plastic and the outlet from the digester links with the gas pipeline going to the consumer installations (i.e., stove, lamps, etc.). On the pipeline, a water pot with a tap is installed to drain condensed water out of the pipeline.

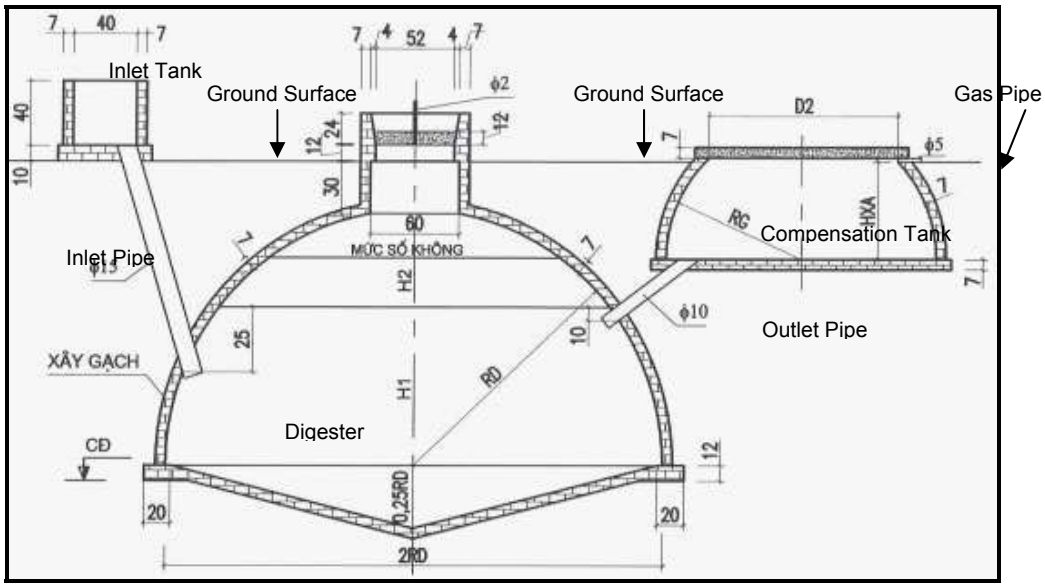
Fig. A.1: KT1 Biogas



Model

50. The KT1 biogas model is an improvement of the original NL-6 biogas model which was developed by the Institute of Energy while the KT2 is an improvement of a model developed by the Can Tho University. Both these models meet industry standards for domestic BPs as approved by MARD. Compared with other biogas models, these possess other advantages such as: (i) simple design; (ii) economy in the materials required for construction; (iii) locally available construction materials and labor; (iv) easily manufactured spare parts; and (v) suitability of the models to the weather conditions prevailing in Viet Nam.

Fig. A.2: KT2 Biogas Model



51. **SBPs for small livestock farms, most of them household** farm based, the predominant technology selections in Viet Nam include: (i) fixed-dome models such as KT1 and KT2 from 4m^3 to 50m^3 as the most popular long-life biogas models which are installed throughout the entire country; (ii) the Ho Chi Minh Agriculture and Forestry University developed polyethylene tubular plastic bag digester from 2m^3 to 10m^3 volume, which is mainly applied in South Viet Nam; (iii) hemispherical shaped fixed-dome systems of the Can Tho University developed as TG-BP with volumes of 4m^3 to 10m^3 for the tropical Mekong delta region in South Viet Nam with high groundwater table; (iv) the VACVINA-HTASC bio-digester (called HTASC - Hybrid Technology with Automatic Scum Control) from 5m^3 to 20m^3, and (v) reinforced polyester glass-fiber composite round shaped BPs from 4.8m^3 to 10m^3. The main economic benefit of small-scale biogas digesters originates from the replacement of fuel wood, coal and agricultural residues for cooking; however, this replacement leads also to significant benefits for human health with long-term economic impacts. Typical with biogas replaced residential cooking fuels are coal with prices at1,000VND/kg, and purchased fuel wood at 500VND/kg.

52. Currently, the domestic biogas market targets livestock farmers who are able to collect a minimum amount of 20kg of fresh animal manure every day as feedstock for the biogas plants, with or without combination with toilet waste. Therefore only households holding at least 6 and more adult pig heads are able to provide the minimum feedstock for an SBP. As cows and buffalos are often only night-stabled, households with 5 cattle heads or more are able to feasibly operate a biogas plant with sufficient feedstock. In zero-grazing units, which are mainly established in the Mekong delta area due to the locally predominant smallholder farms, also the manure produced by 3 cattle[5] could deliver enough feedstock to operate a household biogas plant system with economic benefits.

[5] Based on TA-team's own comparisons during visits in North-Viet Nam, the amount of biogas potential of 1 average cattle (220-250kg life weight) in family farm zero-razing unit, is equivalent to 2 adult pigs (110-125kg each); it is different for medium and large scale farms, there the relation is up 8-10 pigs are equivalent to 1 adult dairy cow

53. The market potential for SBPs in Viet Nam is roughly estimated at 2.53 million household-level farms by 2020 (17% of all rural households) or 4.12 million by 2025 (27%)[6] out of which, according to the Strategy and Master plan for Renewable Energy Development of Viet Nam and MARD sources, about 2 million households[7] have already installed a biogas plant, including at least 1 million of the low-cost polyethylene plastic bag digesters. As the lifetime for the plastic bag digester is 2-4 years only, and it is often counted as biogas for beginners, families upgrade after this first experience to a more durable brick fixed dome biogas plant with 15-20 years lifetime. To tap this market, three different basic types of domestic biogas plant have been developed over time and are dominating the offer: fixed dome in brick, concrete and composite construction material, polyethylene plastic bag digesters, and the so-called hybrid system.

54. The most popular (about 200,000 units in 2011) and since 2002 well-proven type is the fixed-dome plant KT1 and KT2, which were improved developments of the former NL design that was developed in 1984, based on a published German-Indian design. Also other proven models like the TG-BP or EQ model in South Viet Nam, are all based on the same half bowl dome principle, which is followed worldwide by many proven country specific biogas plant designs such as the Sri Lankan UPAWANSA, the Tanzania CAMARTEC, and the Indian and Cambodian DEENBANDHU design. All these are being constructed in situ by skilled and well-trained labor with conventional construction materials like bricks, stones, cement, sand and gravel. The most crucial part of all these constructions is the dome, to be treated inside with a sealant like paint for gas tightness. The gas storage capacity provides om average storage for 50% of the daily nominal biogas production. If well-constructed and managed as per the Viet Namese standards and quality tested, this kind of installations has a continuous operational lifetime from 12 to 20 years, is easy to operate and requires little maintenance. The investment cost of the plants depends on size and location and usually includes all required costs for overhead, profit, and guarantee and after sales service for a period of minimum two years. The replacement of worn-out parts poses a technical and organizational problem; spare parts are not always locally available, and maintenance technicians must be reachable.

55. As documented in a 2007 published biogas plant performance measurement surveys, especially in South Viet Nam the size of the introduced KT fixed dome biogas plant often does not correspond to the number of animals in the farm. When the digester volume is too small sized the feed stock overloads the digestion process, the hydraulic retention time is reduced, insufficiently treated manure flows out, and, if biogas is produced in excess, it is released non-burnt to the atmosphere. This circumstance of the lowered retention time is also possible due to using too much water for cleaning pig stable with water pressure pump. The 3-day measurement of 100 KT biogas plants during a Biogas User Survey in July 2007 showed that in Central and North Viet Nam, biogas plant volumes have the tendency to be slightly too big (little longer retention time as recommended in the standards), so the digestion volume does not fit economically to the size of the family livestock farm. In case toilets are connected it was statistically analyzed that the general tendency is to overload the volume with wastewater, which could create a hygienic challenge for the family and farm workers, when applying the effluent as soil improver or fertilizer without any additional post-treatment of the plants.

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[6] Strategy and Masterplan for Renewable Energy Development of Viet Nam for the period up to the year 2015, with outlook to 2025, version October 2008, Table 5.8: The potential for biogas digesters.

[7] According to TA-team estimation based on GSO's data and MARD, the number reaches already about 2 million existing BPBPs.

56. The KT models have an inlet pipe which protrudes through the wall, therefore a 'free-jet' model flow is formed where the flow reaches the outlet quicker (when the protrusion equals the diameter), as it was measured in different similar models. Therefore the toilet connection at a biogas plant should consider these in the slurry movement to avoid those fresh toilet waste flows directly to the outlet, avoiding these by adding a buffer inside the tank, when a toilet is connected. The investment cost to improve the design with the construction of a simple toilet or connection between toilet and digester is shown in Table A.1.

Table A.1: Investment Cost of improved design of BP

Source	Total labor day (person*day)	Man day cost		Construction material cost (VND)		Total cost	
		VND	USD	VND	USD	VND	USD
Construct a new toilet and connected to the BP							
Based on companies offers	10	1,500,000 - 2,500,000	72.8 - 121.4	2,500,000 – 3,000,000	121.4 - 146	4,500,000 - 5,500,000	218.4 - 267
Only connect the toilet constructed to the BP included PVC pipe and buffer							
Based on companies offers	3	450,000 - 1,000,000	21.8 - 48.5	1,000,000	48.5	1.450,000 - 2,000,000	70.4 - 97.0

57. The introduction of polyethylene tube digesters on small farms in South Viet Nam since 1989 has made a good impact because of the low costs, the simplicity of construction and operation, resulting in a high rate of benefit during its very short lifetime of 3 years. The reported number installed is varying from 800,000 to more than 1 million. Due to the high self-construction-potential, low cost and allover locally available material the number is un-countable. Even it is reported that 40% of this kind of very simple biogas digester plants had problems especially being damaged by sharp objects, playing children or animals. But farmers could correct the problems by themselves, and replacement is easy with locally available polyethylene. The most appropriate material (PVC) is the same as is used for greenhouses as this usually contains an ultraviolet (UV) filter, which helps to prolong the life of the plastic when fully exposed to the sun. Repairs are simple and farmers could teach each other; in addition this kind of digester doesn't need any financial loan strategy due to its low investment costs. It should therefore be part of a biogas dissemination infrastructure as "biogas for beginners", or as "poverty alleviation" strategy for the smallest farm sizes.

58. The VACVINA advanced bio-digester model (named HTASC for Hybrid Technology with Automatic Scum Control) was developed in Viet Nam in 1998. It is an innovative, low-maintenance and easy to build model that is well adapted to the local context. The rectangular flattop system integrates both, pigsty on top with direct effluent inlet and toilet connection while providing a concrete floor on which the animal shelters are built. This system, similar to all brick and concrete fixed dome biogas plants, reduces land requirements to a minimum (available space is a major hurdle for many households). On the other hand, its hybrid nature (plastic bag biogas reservoir) helps keep the cost down, and avoids design leakages of methane emissions in an open compensation chamber. Biogas is collected in a separated plastic bag hanging in the stable or kitchen roof. The gas pressure increases by using a rubber rob wrapped around the gas storage bag, but in fact, the biogas pressure only reaches some centimeters water column. Therefore gas burners used for this digester type are the same as for each plastic bag digester, having only primary air supply, no injector resulting in low efficiency and incomplete combustion with possible carbon monoxide in-house emissions. Its design intends to prevent the accumulation of a hardened scum layer, but studies have been shown that some daily flushing

of several minutes cannot prevent the scum formation.[8] About 11,068 units such are reported to have been built.

59. Since 2006, new construction material like reinforced fiber-glass (in Viet Nam called composite) have been introduced, especially inspired from China, to partly or fully replace conventional construction materials. These materials make industrial pre-fabrication possible, reducing the time for construction and installation at the premises of the biogas household. The models are manufactured and developed by companies in Viet Nam like: Thanh Loc Composite Company Ltd (Thai Binh province) and Quang Huy composite company Ltd (Ha Noi). Material used for composite model is synthetic material of fiberglass, carbon fiber and polyester. The small-scale composite model has four parts: lower bowl for the digestion tank, upper bowl for the gas storage tank and 2 similar pieces for inlet and compensation tank. These four parts are assembled on-site in one block and buried underground. Material quality could be verified by the General Department on Measurement and Quality in document number 09/0349/TN3-CS dated 15/04/2009 on failure durability, bending durability and breaking durability. There is still space for improvements by integrating a buffer to avoid extensive short-cut flows of fresh material from inlet to outlet, reducing the specific biogas production potential from fresh feed stock.

60. The hemispherical shaped fixed dome of Can Tho University was developed 1992 under the name TG-BP (Thailand-German Biogas Program) model. This type of BP is like the CARMATEC type, which was developed in Arusha, Tanzania, in the late 1980s by Tanzanian-German development cooperation. The first hemispherical shaped fixed dome of Can Tho University had been designed with the volume of $10m^3$. This model is implemented in locations in the South of Viet Nam and is the original model for the KT2. The TG-BP model has shown a high success rate in the Mekong delta region, because of its specific safety component within the construction of the hemisphere to prevent cracks: the arch trunk integrated at about 300 degrees from the bottom. This type is considered to be suitable in areas with high groundwater levels, as given in the Mekong delta area. Recently, based on their success, the Can Tho University developed other standard models with smaller sizes of $4m^3$, $6m^3$ and $8m^3$. These models have alternatively (as EQ model) a separate gasbag for biogas storage and to lower the gas pressure in the construction and to avoid a compensation chamber from which a certain percentage of biogas may leak to the air. The Ministry of Agriculture and Rural Development (MARD) certified these models in 2009. Up to now, these models are mainly applied in Can Tho province and in neighboring areas. The digester is made of brick and has a stirring equipment in order to increase the fermentation efficiency. This biogas model (as EQ design) combines the advantages of the spherical-shaped fixed dome and the disadvantages of the biogas fermentation tank with the separate plastic gasbag.

61. It is reported,[9] that only about 50% of household farms use fermented slurry in various ways. This includes use as fertilizer or compost for crops, as feed additives to pigs, feeding to fish, and rising worms and mushrooms. Only about 10% of households post-treat (through composting, drying, or aeration) digested slurry before using it. Most households operate mixed

[8] The slurry is introduced at the top of the digester and the outlet is located near the top of the tank. Since fresh material is lighter than digested material, the probability of fresh slurry not being fully digested and leaving the digester prematurely is high. The inlet is perpendicular to the outlet and almost at the center of the wall. This can cause the slurry to be stagnant in areas in the digester, where it is not being 'pushed' through, and reduce the effective volume of the digester. "Evaluation Study for BP Designs, SNV Cambodia, Consulting Engineers Mekong, September 2005

[9] Bio-slurry utilization in Viet Nam, Le Thi Xuan Thu, Biogas Project Division, The Biogas Program for the Animal Husbandry Sector of Viet Nam, 2007; and,Dong for Dung; *"The economic impact of using bioslurry for tea production on a household level in Thai Nguyen Province, Viet Nam.",*Steven von Eije, University of Groningen, SNV Viet Nam, Biogas Project Division Hanoi, 2007

farms with both livestock and crop production; therefore there is a need for soil improver and fertilizer. After having passed through the compensation tank, bio-slurry can effectively be used as fertilizer for crops, orchards or for feeding fish. Because anaerobic digestion reduces ammonia losses, digested manure can contain more valuable nitrogen for crop production. It can effectively improve the fertility of soil, upgrade the quality of crop, and promote the development of sustainable agriculture. However, in Viet Nam there is no standard and specification for biogas slurry and residue, which may cause dull sale and secondary pollution of these materials. On the other hand, without codes no one can guarantee the quality of the crop to be fertilized with biogas residue and slurry, which may affect the sound development of eco-agriculture. So it is urgently needed to establish codes for quality and implementation of biogas fertilizer.

Table A.2: Summarized Average m^3 Cost Distribution for SBPs (North Viet Nam)

Cost type	VND/m^3 for KT1 (average 7-15m^3)	%	VND/m^3 for Composite (average 7-10m^3)	%
Construction material incl. transport and stove and lamp	708.000	59%	1.020.000	85%
Wages for worker incl. excavation	492.000	41%	180.000	15%
Total	1.200.000	100%	1.200.000	100%
Recommended improvements				
Security (H2S-filter)	410.000	+34%	410.000	+34%
Post-treatment system				
Water saving measures				
Toilet connection				
New total value	1.610.000	100%	1.610.000	100%
Subsidy for additional package, not for the BP	410.000	25.5%	410.000	25.5%
Loan	1.200.000	74.5%	1.200.000	74.5%

62. According to the Biogas User Survey 2006, completed in July 2007, the household KT1 and KT2 BPs have been measured 3 days to determine their potential biogas production and to compare it with the real biogas use, to find out the so-called leakage by unused biogas which may be based on the biogas use pattern, insufficient storage capacity or physical leakages in the digesters system. As it was revealed from the analysis in North/Central Viet Nam, 86% of the produced biogas is used, the rest is leaked to the air. In South Viet Nam 82% of the produced biogas is used, the rest is leaked out. Also the measured specific biogas production amount differs from the technical training manual where for cows and buffalos 15-32 liters of biogas/kg manure is given as potential, which was found only in South Viet Nam in that range, and for pig manure 40-60 liter biogas/kg is recommended, which is only achieved in North and Central Viet Nam (obviously due to the overloading of the digester systems in the South). It is recommended that such evaluations should be completed with a pressure test to find out if there are (a) physical leakages in the construction or piping, or (b) if there is a design leakage (too long storage in the open compensation chamber), or (c) if this is a result of a wrong biogas use pattern. If too much biogas is available and not used in the kitchen, it should be "flared" for climate protection reasons.

63. Independent of the type of biogas plant, in general the biogas piping quality is the overall challenge for the entire gas tightness of the BP system and should be improved. To ensure that biogas is flowing freely out of the biogas digester, the gas outlet pipe end must be always higher than the level of the effluent discharge opening.

Table A.3: Summarized Cost per m^3 Distribution for Small-Scale BPs (Central and South Viet Nam)

Cost type	VND/m^3 for KT2 or TG-BP (average 7-15m^3)	%	VND/m^3 for Composite (average 7-10m^3)	%
Construction material incl. transport and stove and lamp	918.000	54%	1.377.000	81%
Wages for worker incl. excavation	782.000	46%	323.000	19%
Total	1.700.000	100%	1.700.000	100%
Recommended improvements				
Security (H2S-filter)	410.000	+34%	410.000	+34%
Post-treatment system				
Water saving measures				
Toilet connection				
New total value	2.110.000	100%	2.110.000	100%
Subsidy for additional package, not for the BP	410.000	19.5%	410.000	19.5%
Loan	1.700.000	80.5%	1.700.000	80.5%

Note: Due to climatic conditions, which results in shorter hydraulic retention time (smaller construction volumes), for the same number of pigs smaller BP is needed in South and Central Viet Nam.

64. The mainly applied household BP sizes in Viet Nam are 7-15m^3. Average reported unit cost per m^3 is 1.2 million VND in the North and 1.7 million VND in the Central and South Viet Nam.[10] This cost corresponds to an equivalent value of 18.5kg of pig life-weight selling farm gate price in the North, 24.3kg of pig life-weight farm gate price in the Centre, and 29.8 kg of pig life-weight farm gate price in the South (August 2011). Due to climatic conditions, which results in shorter hydraulic retention time (smaller construction volumes), for the same amount of pig smaller biogas plant is needed in South and Central Viet Nam. Observing the distribution of capital costs needed for construction material including transport, and workmanship it shows that the brickwork fixed dome digester systems needs 54-59% of the total investment in construction material and appliances and 41-46% for wages.[11] The composite biogas plants needs 15-19% for wages, rest is for transport and industrial manufacturing. Critical factors in this average analysis are always the soil excavation costs (and to lower extend the construction material transport), for the same digester volume KT1 and KT2 require largest volume of soil excavation, the composite required the least excavation, and the soil conditions a varying from site to site (rocky, sandy, clay) and season to season (ground water table). This cost overview does also not yet include the post-treatment measures necessary, and the toilet connection, to integrate the BPs as a system approach in the agro-livestock-farm cycle, and to improve the biogas use security (by improved gas piping and improved H_2S filter). This additional system

[10] Based on recent TA-Email communication with MARD, August 2011.
[11] Evaluation Study for Household Biogas Plant Model Biogas Project for the Animal Husbandry Sector in Viet Nam 2007-2011,TranHaiAnh, SEDCC, December 2009.

approach element costs are estimated at a lump sum of 4.1 million VND ($200) for each small-scale unit up to 50m^3.

65. It can be summarized that the introduced technology of small-scale fixed dome biogas digesters up to 50m^3 is matured and nearly perfect. Also the installed BTC-developed household biogas cookers are showing a good efficiency and operationally long lifetime. Nevertheless, the offered technology package for an integrated biogas system is still imperfect regarding: (a) the biogas piping, (b) the security and H_2S filter devices, (c) the quality of pressure meters and locally manufactured manometers, (d) the post-treatment and application of bio-slurry. Also water saving measures for stable cleaning and animal welfare are missing. Depending on the substrate used, each kind of SBP may require more or less frequent cleaning and repainting with sealant paint. Experience in the field has shown gas production in the fixed-dome plants decreases over time, typically 10 years after the plant commissioned.[12] Digested slurry and other grit and stones tend to accumulate in "dead zones". No bottom outlet pipe for settled sludge is foreseen. Even the addition of fresh material cannot dislodge the buildup and subsequently the area of the digester is reduced, and fresh slurry is expelled without complete fermentation – the retention time is decreased over time.

III. Technical Aspects of Medium and Large Biogas Plants

66. A concrete footing along the edge of the lagoon holds the cover in place with an airtight seal, or the cover membrane is welded together with the bottom-lining membrane as a big bag. Methane produced in the lagoon collects under the cover. A suction pipe extracts the gas for use. Covered lagoon digesters require large lagoon volumes and a warmer climate. Covered lagoons have low capital cost for the digester volume itself, but these systems are not suitable for locations in cooler climates or locations where a high water table exists. The digester volume itself presents with $10-30/m^3 only half of the investment for the entire biogas system, improved systems, still without GENSETs, but including construction costs, covered anaerobic lagoon, gas collecting equipment (pipeline, flare, flow-meter, gas blower etc.), studies, design, supervision, testing and auxiliary expenses reaches $70/m^3 as in the case of a 13,000m^3 digestion volume unstirred covered lagoon example in Son Hai. Regarding biogas systems used on USA dairy farms with a covered lagoons design, it is found that they operate at approximately ground temperature in the psychrophilic range, and have the lowest biogas production rate. In Germany covered lagoons are usually heated and fully stirred to increase the biogas production rate.

67. In Viet Nam, the membrane for covering the lagoon to store the biogas is made of 2-mm HDPE, which is imported from Thailand or Taiwan. Service life expectancy of these membranes is maximum 10 years, with UV resistant additive at least 20 years. The bottom of the lagoon is sealed by compacted clay soil or covered by 1-mm geo-membrane HDPE, or in some cases made of concrete. The investment cost for this kind of technology depends on the depth (at least 3m) and the bottom sealing. Construction, operation and maintenance of the system are simple. The disadvantage of such lagoon, from the point of view of farmers, is that it occupies a large surface area. Another disadvantage is, as was reported in field visits, that usually after 5-6 years of operation sediments blocks 30-40% of the treatment volume, and would require a cleaning of the lagoon. Often the lagoons are constructed as big bags (plastic cover welded together with the bottom liner) and cleaning of sediments never happens, resulting in decreased treatment efficiency over operational time. Also heavy rainfall results in significant water accumulation on the lagoon cover, which pushed the lagoon cover down into the slurry surface

[12] Evaluation Study for Biogas Plant Designs, SNV Cambodia, Consulting Engineers Mekong, September 2005.

such that the biogas is forced to migrate un-burnt through the overpressure valve and the biogas storage capacity will be reduced.

68. Evaluation reports on MBPs including lagoons for pig slurry treatment in Viet Nam from December 2009[13] revealed that none of the plants was accomplishing environmental effluent standards. The analysis results showed that the concentration of pollutants is significantly reduced after treatment. However, compared with the limits set in the Vietnamese standard the effluent target values are far from being achieved. It was also found that, due to the uncontrolled discharge of incomplete treated pig excrement wastewater into the soil, the concentration of nitrogen and phosphorus in the soil increased. The biogas/feedstock ratio performance and therefore the treatment efficiency are low; introducing appropriate stirring technology to increase biodegradability of the feedstock and to avoid sludge settlements could optimize the lagoon design. In North Viet Nam or in mountain areas with seasonally cooler climates, waste digestion, odor control and gas production will be less consistent with covered anaerobic lagoons, and the than low quality gas may need to be flared off much of these period for odor control and greenhouse gas emission reduction. The covered lagoon digester is argued as the simplest digester system but the evaluation reports turnoffs to this system is that it is the one with the least specific energy output and has the most potential for complications but also for improvements.

69. Plug-flow digesters are suitable for ruminant animal manure that has a solids concentration of 11% to 14%. A typical design for a plug-flow system includes a manure collection system, a mixing pit and the digester itself. In the mixing pit, the addition of water adjusts the proportion of solids in the manure slurry to the optimal consistency. When the system is directly connected to the stable discharge system, no mixing pit is designed, only an inlet chamber. The digester is a long, rectangular container or tubular tank, in Viet Nam usually built below ground, with an airtight, concrete, brickwork or expandable cover or arch. In the KT31 model the arch is manufactured by fiberglass bowls, carbon fiber associated by polyester with filler. Typically at least a 5:1 ratio, 5 or more times as long as the width forms the channel. The theory is that new feedstock material added to the tank at one end pushes older material to the opposite end. But only the coarse solids in ruminant manure form a viscous material as they are digested, limiting solids separation in the digester tank. As a result, the material flows through the tank in a "plug". For optimal digestion, the average retention time (the time a manure "plug" remains in the digester), should be about 30 to 55 days (depending on the operational temperature) for a plug to pass completely through the digester. Pig manure, if highly diluted with stable cleansing water, tends to separate in a settle-able sludge layer, a liquid layer and a scum. Therefore a plug flow" will not be formed when the digester has no agitation transport and scraping system. Anaerobic digestion of the manure slurry releases biogas as the material flows through the digester. Waste heat from the engine-generator (if as combined heat and power (CHP) system designed) can be used to heat the digester in a mesophilic range. Then inside the digester, suspended heating pipes allow hot water to circulate. The hot water heats the digester to keep the slurry to a mesophilic range, suitable for methane-producing bacteria. There are systems with vertical plug-flow and horizontal plug-flow. It was observed in field visits that in Viet Nam plug-flow type digesters are also applied for highly diluted piggery wastewater with a solid content as low as 2% to 6% because of direct flushing of pig manure to biogas digesters. If this happens, the plug-flow digestion process will be severely affected. Either adaptation to the designs in the form of pre-treatment (thickening with two stream

[13] Research on medium-sizedfarmscalebiogasplants, Institute for Environmental and Science Technology (INEST), Nguyen Ngoc Lan, Hanoi University of Technology; 2010.

treatment), with internal baffles as ABR (anaerobic baffled reactor) or as UASB (up-flow anaerobic sludge blanket) are necessary to increase the low performance.

70. A completely mixed digester converts organic waste to biogas in a heated (North Viet Nam) or only insulated (South Viet Nam) tank above or below ground. A mechanical, re-circulation pump or gas mixer keeps the solids in suspension. Completely mixed digesters require more operation and maintenance costs than the other two digesters. Completely mixed digesters are suitable for larger manure volumes having solids concentration of 4% to 13%. The reactor is a circular enameled steel or poured concrete container. During the digestion process, the manure slurry is continuously mixed to keep the solids in suspension. Biogas accumulates at the top of the digester; often a flexible, impermeable cover on the digester traps the gas. Pipes beneath the cover carry the biogas from the digester. The biogas can be used as fuel for an engine generator to produce electricity or as boiler fuel to produce steam. Using waste heat from the engine or boiler to warm the animal manure in the digester reduces retention time to less than 40 days, independent of the climate. It is often operated in the mesophilic range, thereby generating biogas at a high rate; basically it consists of a large tank where fresh material is mixed with partially digested material.

71. Substrate mixing is one of the most important factors for an efficiently working, economic successful operated large-scale anaerobic digestion plant. This applies not only to the digester but also to the inlet tanks, blending tanks, separation systems, digesters themselves and post digestion storage. The requirements for each of these stages are different but effective mixing is essential. Mixing in the digester is critical as it fulfills the functions of (a) bringing the feedstock and microbes into the intimate contact they need to successfully digest, (b) avoiding stratification, (c) avoiding excessive build up of heavy deposits at the bottom of the digester, and (d) minimizing the production of crusts and foams on the top of the digesting sludge. The successful completion of these functions results in a maximized gas production and high quality of the digestate. As these are the primary benefits of digestion, it is clear that mixing and/or inflow distributions are the key components of a large-scale digestion plant.

72. It was observed in many sites that before the highly cleansing water diluted stable run-off enters the lagoon or plug-flow plant, scrapping separates solids. Solids are packed as fresh manure and sold as fertilizer for an average of 250-500VND/kg to neighboring vegetable and orchard farmers. Therefore these solids cannot participate in the biogas production, one reason why the biogas production rate per amount of animal was rather low. A solid-liquid separation at an MLBP was never observed, but it may still be feasible to maintain the market with this after-digestion separated product. The perception is that especially medium- and large scale farmers and farm workers thinking that the feedstock, which is entering the treatment systems, will lose its fertilizer value. There is a huge need of agricultural awareness building.

73. Some farms apply secondary treatment measures on the effluents resulting from anaerobic digestion in the BPs. The possibilities are summarized here: (a) controlled fertile-irrigation of agricultural fields after seasonal storage, (b) aerated or shallow aerobic lagoons and ponds, (c) use of constructed wetlands, (d) fish ponds, (e) drying and composting of sludge.

74. Off-grid biogas power generators connected to medium-scale and even small-scale BPs have been implemented rapidly in recent years due to several factors: (a) improved technologies for biogas production, (b) widely available sources and high demand from animal husbandry sector, and (c) subsidy support. However, electricity production from biogas has faced very specific technology barriers: (i) reduced life-time as no desulphurization units are foreseen or, if available, they are not maintained and not designed for the biogas flow of an

engine, (ii) fragmented and artisanal production of spare parts and instruments which means the quality and compatibility of the equipment and (iii) spare parts replacing is lacking as the technology is not standardized. Due to lack of spare parts to replace, many projects cannot operate efficiently at full capacity.90% of existing and evaluated livestock biogas power projects in 2008 had been designed at the household's size and biogas is used for cooking and electricity generation[14]; they are located in the Red River and Mekong River Delta Regions where the households are mostly connected to the grid. However, they still use biogas power projects instead of electricity from the grid for saving money. More recently (September 2011) it is reported by interviewed GENSET selling companies that only in Ha Noi monthly about 60 GENSETs in an average range of 2-3KVA are sold to biogas using families, operated 0.5 to 10 hours per day.

Table A.4: Average Operational Time for Installed Biogas Powered Small GENSETs[15]

Parameter	27 generators (at 6 districts)	
	Quantity	Proportion
Daily operation, 0.5÷0.8 hours/day without trouble	5	18.52%
Daily operation, 4÷10 hours/day without trouble	22	81.48%

75. Security: Methane (CH_4), which makes 50% up to 80% of biogas, forms explosive mixtures in air, the lower explosive limit being 5% methane and the upper limit 15% methane. Biogas mixtures containing more than 50% methane are combustible, while lower percentages may support, or fuel, combustion. Therefore no open flames should be used in the vicinity of a digester, and electrical equipment must be of suitable quality and "explosion proof". Other sources of sparks are any iron or steel tools or other items, power tools, normal electrical switches, mobile phones and static electricity. None of the visited low-cost MLBPs was equipped with a flame arrestor trap incorporated in the supply line with a suitable length of minimum 20m. For GENSET use a separate plastic bag biogas holder is installed under the roof of the stable. No pressure is needed as combustion engines are sucking the biogas out of the plastic bag. The same greenhouse plastic as for the cheap biogas bag digesters is applied, which may lead to fire accidents. During the TA-team field visits in South Viet Nam in November 2010 two such accidents have been reported in the local newspapers.

76. The quality of BP equipment and supporting facilities is directly related to the quality of the whole biogas system, ultimately affecting the operation and profit. In MLBP systems, the digester itself presents only one third of the investment for the entire biogas system including GENSET or CHP. However, at present, many of the commonly used large-scale digester types do not correspond to technical norms, such as the UV-resistance and methane permeability for membrane gas storage facilities, desulphurization equipment, mixing equipment, automation control equipment and on-line monitoring equipment. As all of these lead to uneven qualities and unrealistic low prices in works, due to low quality or incomplete installations, standards and codes for supporting facilities are urgently needed. There are no engineering standards for the

[14] Strategy and Masterplan for Renewable Energy Development of Viet Nam for the period up to the year 2015, with outlook to 2025, version October 2008.

[15] Study on Biogas Generator – Final Report, Bach Khoa Technical Services Company Ltd., 2009.

design of MBP and LBPs; these are also required to promote their market-oriented operation, and to ultimately realize the long-term, stable and efficient operation of these projects.

77. It can be summarized that the medium- and large-scale biogas digester system "covered lagoons" although dominating the market segment - is imperfect regarding: (a) rainwater sensibility of the cover (could be solved by reinforced covers, double membrane system, or rainwater evacuation pumps), (b) the security, flaring and H_2S filter devices, (c) no ex-proofed equipment (i.e. collecting biogas for larger scale GENSETs requires a gas blower to move the gas), (d) the sedimentation challenge (could be solved by stirring or recirculation devices, which then also allows to increase the solid content up to 6% and reduce the hydraulic retention time, or in the design of a concrete bottom which allows regular cleaning by opening the cover fixed in a water ring channel, or in a bottom design integrated empty-able settler in the first part of the digester body (see AGSTAR lagoon model in Brazil and Mexico)), (e) the poorly developed appliances as the installed GENSETs or infrared heater for piglets, and (f) water saving measures for stable cleaning and animal welfare are missing anywhere.

78. Summarized costs (without contingencies) for MLBPs are presented in Table A.5.

Table A.5: Summarized Costs (without contingencies) for Medium Biogas Plants and Large Biogas Plantss

Digestermodel and capacities (based on pig manure)	USD(average)
MBP system, 200m^3 digestion volume, KT31 or IE plug-flow, 10 KVA GENSET* with 4,400h operation/y	45,708
MBP system, 500m^3 volume, CSTR, 50KVA CHP** with 8,000h operation/y	276,991
Medium-scale BP system, 1,000m^3 volume, covered lagoon and CSTR, 40KVA GENSET* with 4,400h operation/y	214,144
MBP system, 1,000m^3 volume, CSTR, 150KVA CHP** with 8,000h operation/y	886,120
LBP system, 2,000m^3 volume, covered lagoon, 60KVA GENSET* with 4,400h operation/y	263,836
LBP system, 2,000m^3 volume, CSTR, 340KVA CHP** with 8,000h operation/y	1,257,500
LBP system, 5,000m^3 volume, CSTR with hydrolysis, 970KVA CHP** with 8,000h operation/y	2,646,596

*GENSET=w/o digester heating, **CHP=combined heat and power production

Table A.6: Example Details of Equipment for Medium Biogas Plant Systems

Description equipment
Reception tank (Collection tank concrete in the ground, with mixer)
Desulphurization installation (H2S removal unit)
Condensate separator (in water cup)
Gas blower ex proofed (Gas-compressor with accessories)
After storage system (200 – 700 m^3 storage lagoon, 1-mm HDPE lining, gastight covered with 2-mm HDPE, with rain re-covering unit, valves, pipes etc.)
Analytic system for operational control (gas, substrate, laboratory)
Feed-in-grid (low tension) (Transformer for middle voltage system with accessories Installation and documentation)
Instrumentation control (complete electrical parts, switchgear, measuring technique (filling level, foam, temperature, flow), visualization, gas-warning and fire reporting instrument, lightning protection equipment with installation and start-up operation)

Table A.7: Example Details of Equipment for LBP Systems

Description equipment
Acceptance truck weighbridge (Modular assembly weighbridge, pit-less type, steel execution, 6mx2,7mx0,30m for max. 25t, Assembly and Operation)
Collection tank (Collection tank concrete in the ground with d=11,34m; h=3,22m and V(tot.)=324m³, Stirrer with ca15kW for waste and Co-enzyme homogenization, Screw pump with 7,5 kW for charging the hydrolyze tank)
Hydrolysis system (hydrolysis tank enameled Steel, for 3 days buffering process with di=14,2m; hi=5,2m and V(tot.)=914m³, Stirrer with cand15 kW for waste homogenization, Screw pump with 7,5 kW for charging the digester tank, Flow meter for reading the amount charging to the digester tank, valves, pipes and small parts, Heating system, Assembly and Operation)
Digester (Digester tank of enameled prefabricated elements, di = 24,7 m, hi = 6,02 m; V (net) = 2500m ³, V (brut) = 2893m ³, Stirrer with 15kW for waste homogenization, Heating system, Isolation, valves, pipes and small parts, Assembly and Operation)
Desulphurization installation (biological h2s removal unit with pump Assembly and Operation)
Gas storage (gas storage membrane installed on the digester top, 700m³ retention volume Pressure over- and upper flow Gas flow meter, Assembly)
Condensate separator (in water cup execution with pump)
Gas blower ex proofed (Gas compressor with accessories)
CHP unit, Gas Module gas in 40ft Container (970 kW el.) - SES- Exhaust heat exchanger system, Exhaust duct, Gas supply system cooling system, delivery, assembly and documentation)
Post-Digester treatment system (Enameled Steel Buffer tank for effluent storage before separation unit with d=7,6m; hi=2,2m and V(tot.)=100m³, Press screw separation unit, Pump, delivery, assembly and documentation)
After storage system (storage lagoon on plastic film with rain covering unit with b=30m; l= 40m; hi=3,5m and V(net)=4200m³, Stirrer with cand4,5kW for waste homogenization, Recirculation pump, valves, pipes, backstop and small parts, Assembly and Operation)
Gas flare incl. CDM Monitoring equipment (Gas flare, Assembly and Operation)
Analytic system (Gas, substrate, laboratory analyze)
Feed-in-grid (low tension) (Transformer and middle voltage system with accessories, Installation and documentation)
E- and Instrumentation control (E- part complete / switchgear, Measuring technique (filling level, foam, temperature, flow) Visualization, Cabling a- installation, Gas warning and fire reporting instrument Lightning protection equipment, Installation and Operation)

IV. Overview of Selected Biogas Technologies

79. Based on the technical assessment and technical due diligence for the proposed project there are five models that are formulated in order to determine the best suitable digester system. A variety of information has been analyzed to come up with solid models of biogas systems as: (1) fixed dome biogas system based on the well-designed and experienced KT or TG-BP models, (2) improved[16] industrial produced composite biogas plant system, (3) channel or tunnel type plug-flow digesters system, (4) improved covered anaerobic lagoon systems

[16] BTC tests in 2011 revealed that the improvement (avoiding short cut flow) of inlet and outlet could increase the biogas production by 20%.

("Thailand type"), (5) completely stirred tank reactor (CSTR) digesters systems. An overview of all recommended systems can be found in the detailed technical assessment.

80. SBPs from 4m^3 to 50m^3 (selection 1 and 2) should be composed of (i) inlet channel from the paved stable (to collect urine and flushed manure) with attached inlet mixing tank (mainly needed for high solid cow manure); (ii) fixed dome biogas digester corpus in concrete, brickwork, composite, build, sealed and controlled under national standards; (iii) compensation chamber for hydraulically pressurized gas storage with about 40-50% capacity of the daily biogas production (compensation chamber volume should be verified in a specific design study compared with the usual biogas use pattern in North, Central and South Viet Nam to avoid design leakage of biogas to the atmosphere, in case of a separate PVC-bag gasholder this compensation chamber is not needed, but then the biogas stove is very inefficient, in these cases in China small electrical pumps are used to increase the gas pressure for stove); (iv) post-treatment system formed by at least 3 rotationally used stabilized compost chambers, where the effluent could be mixed with carbon rich material (as leafs, paper, wood chips, garden waste), or other adequate post-treatment system which fits to the agricultural re-use at on hand, and to the hygiene requirement (toilet connection!) on the other hand; (v) quality gas piping with main gas valve, over pressure valve, H_2S filter, condense water trap, pressure indicator in the kitchen, and good quality biogas cooking stoves (biogas for lighting is seldom applied in Viet Nam); (vi) water saving measures at the stable (shade, optimized air flow ventilation, introduce water saving sprinklers, apply pressure cleaner) to increase the solid content in the biogas plant; (vii) respecting the recommended minimum retention time under the Vietnamese standards will result in a better performance with a higher specific biogas production rate per volume or per feedstock unit.

81. MBP systems from 50m^3 to 1,000m^3 (selection 3,plug-flow design) may be preferred for dairy farms as they may treat higher solid contents. They should be composed of (i) inlet channel from the paved stable (to collect urine and flushed manure) with attached inlet mixing tank (mainly needed for high solid cow or poultry manure); (ii) biogas digester plug-flow channel corpus with at least a 5:1 ratio (5 or more times as long as the width) in concrete, brickwork, may be also composite or reinforced plastic covered, build, sealed and controlled under national standards; (iii) separated or integrated biogas storage capacity; (iv) selected appropriate post-treatment system which fits to the agricultural re-use (may be with liquid-solid separation) on hand, and to the hygiene requirement (toilet connection!) on the other hand; (v) quality gas piping with main gas valve, over- and under-pressure valve, H_2S filter, condense water trap, pressure indicator, adequate flare, monitoring set for biogas quantity; (vi) good quality biogas GENSET for electricity generation, which may operate at least 8,000h/year (the available Chinese GENSETS are designed for 12h continuous operation time per day resulting in 4,400h/year),automatic engine governor system, and/or other appropriate biogas use appliances; (vi) water saving measures at the stables (shade, optimized air flow ventilation, introduce water saving sprinklers (Sprinklers that make a fine mist should not be used because for pigs as they tend to increase the humidity rather than cooling the animals, they are better for dairy cows.), apply pressure cleaner) to increase the solid content in the biogas plant, resulting in a better performance with a higher specific biogas production rate per volume.

82. Large-scale covered lagoon biogas plant systems from 1,000m^3 to 190,000m^3 (selection 4) should be composed by (i) inlet channel from the paved stable (to collect urine and flushed manure); (ii) rectangular or square biogas digester corpus with bottom lining in concrete or brickwork, or geo-membrane lining, covered with reinforced plastic membrane, build, sealed and controlled under national standards, dividing the digester volume in multiple-cells also improves environmental performance; (iii) re-circulation pump from outlet to inlet, or slurry distribution

system to form a up-flow kinetic, or integrated stirring devices (mechanically, hydraulically, kinetically), or integrated settler with bottom cones; (iv) integrated biogas storage cover with rainwater solution: by double membrane, structured arch, rainwater pumps; (v) selected appropriate post-treatment system which fits to the agricultural re-use (may be with liquid-solid separation); (vi) quality gas piping with ex-proofed gas blower, main gas valve, over pressure valve, H2S filter, condense water trap, pressure indicator, adequate flare, monitoring set for biogas quality and quantity; (vii) good quality biogas GENSET for electricity generation, which may operate 4400h/year, automatic engine governor system, and/or other appropriate biogas use appliances; (viii) water saving measures at the stables (shade, optimized air flow ventilation, introduce water saving sprinklers, apply pressure cleaner) to increase the solid content in the BP, resulting in a better performance with a higher specific biogas production rate per volume.

83. Large-scale completely stirred tank reactor (CSTR) BP systems from 1000m^3 (500m^3 could also be possible) to 5,000m^3 (selection 5) should be composed by (i) inlet channel from the paved stable (to collect urine and flushed manure) with collection tank; (ii) mixing tank with stirrer (needed for high solid cow and poultry manure, for adding co-substrates, and for diluting fresh manure with re-circulated effluent or liquid digestate), for not easy digestible substrates this mixing tank could be designed as a pre-hydrolysis tank; (iii) round cylindrical biogas digester corpus in concrete or enameled steel, covered with reinforced plastic membrane, build, sealed and controlled under national standards, the digester volume can be divided in one or two tank units as single- or multiple-step system, but also lagoons can be built up as CSTR digesters body as shown in Thailand, Germany and U.S.A.; (iv) re-circulation pump from final outlet to inlet and used for substrate mixing, and/or integrated stirring devices (mechanically, hydraulically, kinetically); (v) integrated biogas storage cover as double membrane or with wooden support arch structure; (vi) selected appropriate post-treatment system which fits to the agricultural re-use (may be with liquid-solid separation); (vii) quality gas piping with ex-proofed gas blower, main gas valve, over- and under-pressure valve, H_2S filter, condense water trap, pressure indicator, adequate flare, monitoring set for biogas quality, quantity and operational energy consumption; (viii) good quality combined heat and power generation set (CHP) for electricity generation (in North and Centre of Viet Nam a GENSET will not be sufficient, as heat may be needed for the digester itself), which may operate at least 8000h/year, automatic engine governor system. As the system is self-regulating its solid matter content inside the digester by re-circulation of effluent or liquid digestive, no additional measures are necessary at the stable to increase the dry mater in the influent feedstock. Of course, in pig livestock farms is it environmentally better to avoid excessive fresh water use, too. As the CSTR type is not very well known in Viet Nam, more emphasis was given in the attached design study to such reliable fermentation technology, flexible adaptable for all kind of Viet Nam given feed stock. All other recommended biogas systems are well known and expertise is already available in Viet Nam, also to improve the covered lagoon system for pig farms and the plug-flow design for dairy and poultry farms.

V. Anticipated Environmental Impacts and Mitigation Measures

A. Project Application Phase and Screening Process

84. Project application phase. This is the phase where the household or farm owner presents his interest to participate in the program. Participation forms and forms to receive subsidies, grants or loans have to be prepared and filled out. To receive e.g. a bank loan, currently in Viet Nam no environmental requirements have to be fulfilled by the borrower. One sentence pointing out the purpose of the loan/subsidy (e.g. ‘treatment of animal waste’, ‘production of biogas’, ‘use dung/effluents as fertilizer etc.) is usually sufficient to receive

approval for the project. It is supposed that no adverse environmental impacts will result in the application phase. However, it is recommended that the borrower/applicant describes in a more detailed manner the project and the advantages or impacts/risks for the environment when realizing the project.

85. Screening of biogas projects: For all MBPs and LBPs, before the start of any construction of any MBPs or LBPs, ADB's screening procedure will be applied and conducted by the relevant PPMUs using ADB's rapid environmental assessment checklist (IEE, Annex 1). This checklist, together with the environment categorization form (IEE, Annex 3) will be submitted to ADB for endorsement. If the MBP or LBP is confirmed as category B project according to the screening procedure, an IEE (Annex 3) for the outline of the IEE) is required. The IEE of the first proposed MBP and the IEE of the first proposed LBP will be submitted to ADB for review and approval prior to construction. If the quality is acceptable and consistent with ADB's Safeguard Policy Statement 2009 then the subsequent IEEs can be approved by the Project Director in the CPMU. No MBP or LBP with significant environmental adverse impacts (category A) will be selected.

B. Project Preparation Phase/Project Planning Phase

86. The project preparation phase comprises the selection of the appropriate technology and design for the planned biogas plant. In addition, the dimensioning of the plant and the preparation of the design/construction plans and design/construction drawings of the plant have to be carried out. For households, by law no environmental permits have to be presented to the authorities at present. In this phase, an EIA is required for new cattle farms with more than 500 cows or 1,000 pigs and new poultry farms with more than 20,000 poultries. Farms with less than 1,000 pigs only need an EPC (Environmental Protection Commitment). Also, for all extension projects of an existing farm (if exceeding the before mentioned livestock numbers) a new EIA study has to be presented. If the MBP or LBP is confirmed as category B project according to the screening procedure, an IEE (Annex 3) will be submitted to ADB for endorsement before any construction can start.

87. Besides the possible adverse environmental impacts, in the IEE the biogas plant's design should be presented. The necessary mitigation measures should be described and the environmental management and monitoring plans must be presented in detail.

88. The IEE study should refer to the plant's design and technology used. The study has to be prepared by independent consultants or individuals and not by people that are later on involved in the evaluation of the study on authority level. The design of the plant must correspond to the expected volume of dung to be treated and the volume of water used for stable rinsing, to avoid over- or under-dimensioning of the plant. Incorrect dimensioning might result in the fact that the feeding of the plant results in too short or too long retention times of the dung in the digestion process. In the first case this can result in dung that is not completely digested (Retention time is too short). The out-coming bio-slurry therefore smells and still has digestion potential (biodegradable organic compounds) that can be transformed into biogas.

89. It is recommended that an initial theoretical training for the applicant on his/her future biogas plant should be performed. This can be done e.g. by a freelance biogas expert or by experts from other institutions (e.g. universities, environmental authorities like Ministry of Natural Resources and Environment (MONRE)/DONRE or others). It is recommended that environmental mitigation measures be considered in the project's planning phase. The implementation of these measures should be monitored by the relevant PPMU. Monitoring of

impacts should also be performed according to a set schedule tailored to the technology/model of the plants (e.g. repeated check of gas-tightness of the biogas plants and corresponding appliances).

90. It is expected that no direct adverse environmental impacts will result during the project's planning and design phase. However, environmental mitigation measures should already be addressed and taken into consideration in the project planning phase.

91. Mitigation measures include:

- Check of gas-tightness of the plant and all appliances to avoid release of un-burned greenhouse gases to the atmosphere.
- Substrate storage tanks (dung tanks) should be closed to avoid smells and annoyance of the neighbourhood as well as proliferation of flies and other insects.
- Correct design of the plant to avoid over- and under-feeding of the biogas plant (over or under-dimensioning).
- Training of the farmers/households on the technology of the plant to be installed.
- Training how to dilute the dung with water to be feasible for feeding into the biogas plant.
- Flood protection measures must be applied to plants located in regions close to rivers or with expected heavy rainfalls to avoid flooding of the plants and transfer of pollution into the soil, the groundwater and the neighbourhood.
- Risk of explosions can be reduced when all open flames are strictly prohibited in a circle of around 20m around the plants and when the biogas plant is regularly checked for gas-tightness.
- Extinguishers or water emergency pumps must be available at households and farms and at least 2 persons must have been trained how to use an extinguisher correctly. Maintenance intervals of the extinguishers must be adhered to, inclusion of these into monitoring may be necessary.
- Entrance holes e.g. for cleaning the plants must be locked by padlocks to avoid that people, esp. children, can fall into the plant. The key for the padlock should be controlled by the responsible person.

92. The above list of possible mitigation measures must be taken into consideration already during the project's preparation/planning phase. The above presented list is probably not complete but gives an impression of the necessary preliminary measures.

C. Project Implementation Phase

93. The project implementation phase is distinguished into two sub-phases: the preparation of the substrate (dung) for digestion and the project's construction phase. The latter phase is divided into two subsequent phases: the production of construction and installation materials and the construction of the biogas plant itself.

Phase of substrate preparation

94. Activities in this phase are very similar for household and farm biogas plants as well. The main activities during this phase include:

- Construction of substrate (dung) storage tanks or storage beds and bags (households/ farms).

- Pre-treatment (preparation) of the dung.

95. Possible impacts that can result from this phase include:

- Occurrence of smells in case the storage containers are not closed.
- Attraction of flies, insects and rodents.
- Leakages resulting in penetration of pollution into the soil and groundwater (leachate infiltration).
- Initial biodegradation of organic compounds can result in production of greenhouse gases, esp. methane, in the tanks and beds if the dung is stored too long.
- Over-flooding of drying beds in case of strong rains (esp. in the rainy season) which can result in the distribution of organic compounds (pollution) into the households/farms' surroundings, affecting also neighbours living close by.
- Inadequate discharge of the storage tanks' cleaning water.

96. To mitigate these impacts, the storage tanks and beds should be closed to avoid bad smells. They also should be underground-sealed to avoid penetration of leachate into the soil and groundwater. The side walls of the beds should be high enough to resist against flooding. To avoid biodegradation in the tanks, a simple aeration system (air pump with disburser) can be installed – if not too expensive for very small farms. The latter seems not necessary for household storage devices.

Construction phase

97. Production/fabrication of construction and installation material. Most of the existing biogas plants use the KT1, KT2, KT31 and the composite design and technology. HDPE is mainly applied on larger farms and for bigger biogas plants. The impacts that can result from the production of the construction materials should be taken into consideration.

98. Production of construction materials: To construct KT1, KT2 and KT31 designs, bricks and cement is needed. Both are in general bought from the producing factory or from a supplier. These materials are not produced on-site at the household and small farm premises. Therefore, only indirect environmental impacts result during this project construction phase. These indirect impacts are related to the production of bricks and cement in the corresponding factories. The environmental impacts resulting from the production of the materials must be minimized and monitored at the producers' factories.

99. However, the handling of these materials during construction of the biogas plant on-site can result in low to medium impacts onto the environment and human beings. The handling of bricks can injure the workers when being dropped, being cut up or handled without caution. To mitigate these impacts, the workers should use labour protective items like helmets, leather-working gloves and protective shoes (no sandals or slippers). They also should not work in T-shirts.

100. The use and storage of cement can result in dust emissions in case of wind or heavy storms, not only affecting the workers, but also the surrounding neighbourhood like families living nearby, and livestock in pens and stables. Cement, especially its low-diameter particles, can penetrate the lungs. In addition, in contact with water cement reacts and turns into a hard and inert product. If this chemical reaction takes place in human or animal lungs, medium severe damages can be the result.

101. To mitigate these impacts, dust emissions should be reduced as best as possible (e.g. cover of storage sacks with plastic slides, opening of only one sack for usage, avoid working with cement when windy or stormy, use water sprayers to precipitate dust etc.). To protect the workers, respiration masks should be applied. When working with cement, the doors and windows of houses in the surrounding neighborhood should be closed. The same applies for livestock pens/stables.

Production of installation material

102. For the composite technology, so called installation materials are used. This material consists of a mixture of plastic with fibreglass, organic hardeners and glue. The exact composition of the composite material is not known to the environmental team. The resulting impacts are first of all in parts related to the production of composite in the corresponding factories. These impacts are indirect and concentrate mainly on bad (organic) smells and solid waste resulting from useless fibers etc. Direct impacts on-site during installation of the biogas plant using the above mentioned material are dust from cutting/sawing of material, resulting partly in low diameter particles (lung penetrable) as well as strong smells due to the use of glue to join (stick together) the different parts of composite together. Apparently the glue, most probably a mixture of organic solvents and other organic compounds, is medium toxic as it was reported that some workers got headaches when using the glue. The composition of the glue is not known to the environmental team. However, the application of glue lasts only for a few hours, the time necessary to join together the composite parts.

103. The above mentioned impacts (dust, smell, organic solvent evaporation) affect the workers and the nearby surrounding neighborhood. To mitigate these temporary impacts, the workers should use respiration protection when applying glue, and the doors and windows of surrounding houses should be closed. No work should take place in windy and stormy conditions, to prevent spread of dust and smells into the vicinity of the neighborhood and into the wider environment.

Plant construction phase

104. The plant construction phase starts in general with earth works for both, household biogas plants and farm biogas plants. However, for farms earth works are in general more intensive than for household plants. The consultants expect that the impacts resulting from earthworks for household plants are mainly negligible. The pits to be dug are normally not wider than some 4 to 5 m and require a depth of some 3m. Thus, only some 12 to 15m³ of earth must in general be discharged or transported for small and household biogas plants.

105. The environmental impacts resulting from digs for the construction of medium and large sized farm-based biogas plants are, besides others:

- Excavation of large amounts of earth. The earth can either be distributed on the farm itself, or, if not possible, it must be transported to a construction waste dump site. The latter results in transport traffic and corresponding emissions of truck exhaust gases.
- For the excavation of the earth, heavy machines (e.g. excavator machines) are used that also produce exhaust gases during the working hours. The workers and the neighborhood can be affected.
- In addition, fuel leakages and (used) oil leakages from such machines and trucks must be taken into consideration.

- Especially the groundwater is affected by oil leakages in case the groundwater layer is close to the sub-earth.
- Mobilization of adsorbed chemical compounds during earth works can not be excluded, as well as the infiltration of fuel and oil into the groundwater.
- Earth works also result in the destruction of the soil structure, not only at the place where the pit and hole is to be dug, but also around the dig due to compression of the soil through the use of heavy machines.
- Earth works using heavy machines are also linked to high noise levels during the working hours of the machines and the frequency of truck traffic also enhances the noise level. Trucks are used to transport the construction material to the farms, and to transport surplus soil and other material to dump sites.
- Dust emissions during earth works, esp. in the dry season, are normal.
- If the soil structure is unstable and the dig is carried out very close to adjacent buildings, it can not be ruled out that these buildings receive damages (e.g. wall cracks, damage of infrastructure installations like electricity cables, water pipes etc.).
- Workers can be affected due to work accidents. The construction of medium to large size biogas plants lasts for some 2 to 4 weeks and 5 to 10 workers are necessary.

106. To mitigate the above impacts on the environment and human beings the following measures should be applied:

- Transport of surplus earth and other waste only to legally registered dump sites. If the soil is distributed on the farm itself, it should be dumped in a way that plants and houses are not affected.
- Machine working hours and truck traffic should be reduced to a minimum but without causing unnecessary delay of the construction. Sound and noise filters for excavators should be applied.
- The machines and trucks should not be maintained on-site (e.g. no oil change). Oil leakages should immediately be excavated with the affected soil and put in sealed metal barrels. These contaminated barrels must be discharged to a legal disposal site or the contaminated soil must be burned in adequate incinerators.
- Before starting earth works very close to houses and stables, the stability of the underground and the soil structure must be investigated and checked (pole piling).
- If the groundwater layer is high, the pit should be underground-sealed immediately after the final depth of the hole is reached.
- Compression of surrounding soil should be avoided in a manner that trucks and machines are only allowed to drive on pre-selected tracks and areas.
- Work should not be conducted during windy and stormy weather in order not to distribute dust into the wider environment.
- Windows and doors of nearby houses and stables should be closed during working hours.
- The workers should be provided with adequate labour and security clothing and devices (e.g. closed shoes, ear and eye protection, masks and helmets etc.) to be protected as well as possible against accidents.
- A solid and liquid waste management plan should be elaborated and applied for collection of solid waste (besides excavated soil) and liquids (e.g. oil).
- Adequate and environmentally friendly rest rooms and showers should be made available for the workers if they stay over-night at the site.

107. The subsequent phase after earth works is the construction of the biogas plant itself. Again, strong adverse impacts from the construction of household biogas plants are not expected, with the exception of the installation of composite plants (see also above). If the construction of the biogas plant is done using bricks, then no severe adverse environmental impacts resulting from construction activities are expected. Bricks are made of inorganic inert material. The only impact resulting from bricks might be the generation of dust in case the bricks must be cut up/sawed up. In this case, only those workers will be affected who cut bricks. Respiration masks can mitigate inhalation of such dusts. To transport the bricks to the site for the construction of medium and large scale biogas plants, increased truck traffic is expected which will also result in the emission of increased truck (diesel) exhaust gases. The workers as well as the nearby neighborhood, and people living close to the site's access road, will be exposed temporarily to more diesel exhaust gases. To mitigate this impact, the traffic should be reduced to a minimum (traffic plan) and the trucks should drive in higher gears. The same that is mentioned for the bricks is also valid for the transport of cement. Dust emissions of cement can be avoided when construction work is stopped under heavy windy and stormy weather conditions (mitigation measure). If work is continued under windy conditions, the workers should be provided with respiration protection masks and the neighborhood's windows and doors must be kept closed.

108. If the construction of the biogas plant is done using composite, the main impact results from emissions of organic vapors from hardeners and glue. These organic emissions seem to be medium-toxic, however, this still has to be confirmed. The workers as well as the nearby neighborhood will be affected during the time of use of such compounds. Workers can be protected by using respiration masks and the neighborhood must close all doors and windows. It is not clear if livestock also will be affected by organic solvent emissions. If the stables are very close to the construction area, it is supposed that livestock will also be affected. In this case it is the responsibility of the livestock owner to close the doors and windows of the stables (if there are any), or to take livestock out of their stables during use of glue.

109. If the construction of the biogas plant is done using HDPE, it is supposed that no adverse environmental impacts result from this activity. Cutting of HDPE will probably not result in any impact. Welding of smaller parts of HDPE can result in organic incineration and degradation products that smell, as well as vapors. However, this is a very short impact and lasts only until the welding is finished. Only the workers doing the job will be exposed to such smells. The use of respiration masks can mitigate this impact. No other environmental impacts probably arise during construction of HDPE biogas plants.

110. The installation of appliances (pipes, cables, generators, etc.) will probably not result in any adverse environmental impacts.

111. For medium and large scale biogas plants, environmental impacts will also occur from the worker camps in case the workers stay on-site during the entire construction phase. These impacts are mainly linked to solid and liquid waste production (e.g. oil spills, cooking and kitchen waste etc.), noise emissions (e.g. TV, radio, football etc.) and production of sanitary wastewater. It is also possible that hunting of wildlife can occur, with subsequent impacts on the wildlife itself and the flora that will be damaged during hunting. It is therefore necessary to include these impacts in the environmental management plan that has to be elaborated during the project's preparation phase. The contractor who will construct the biogas plant must take responsibility for his workers and their environmentally friendly behavior during the construction time.

112. In the contractor's/constructor's contract it should be fixed that the constructor will take into consideration and apply all necessary environmental mitigation measures to reduce as much as possible environmental impacts on humans, air, soil, ground water and livestock during construction of the plant. This has to be monitored by the farmer/plant owner or by responsible local authorities.

113. Finally, it is communicated that all impacts during the construction phase of the biogas plants are only temporary impacts that will last from a short period of a couple of days up to 4 to 6 weeks for large scale biogas plants.

D. Project Operation Phase

114. Adverse environmental impacts linked to the operation phase of the biogas plant are mainly the:

- Impacts resulting from the storage of dung.
- Impacts resulting from gas production.
- Impacts on human beings due to unexpected accidents.
- Impacts of bio-slurry on the environment if discharged untreated to the environment.

115. The possible impacts resulting from the storage of dung and the possible mitigation measures are already described here above and are again summarized.

116. Possible impacts that can result from the storage of dung are e.g.:

- Occurrence of smells resulting in attraction of flies, insects and rodents.
- Leakages resulting in pollution of the soil and groundwater (leachate infiltration).
- GHG production during longer storage periods and increased ambient temperatures.
- Over-flooding of beds and pollution of households/farms as well as the neighbors.

117. Mitigation measures include:

- Closure of all storage tanks and beds.
- Beds should be underground-sealed to avoid penetration of leachate into the soil and groundwater.
- The beds' side walls must be high enough to resist against flooding.
- To avoid biodegradation in the tanks, a simple aeration system can be installed.

118. To avoid that the dung fed into the digester is neither too thick nor too liquid, the correct mixture of dung and water and/or commercial products supplying micro-organisms (not yet in common use in Viet Nam) should be applied, to guarantee the best possible biodegradation and to yield as much biogas (methane) as possible. The farmers should be trained on this issue by independent biogas experts, universities or other relevant persons. It is therefore recommend that a training component for farmers and households should be included into the project, to make sure that the new investments are sustainable.

119. The environmental impacts that can result from the biogas production unit and periphery units are:

- Gas leakages resulting from the bio-digester.

- Gas leakages resulting from the gas pipes.
- Gas leakages resulting from the appliances and generators.

120. Other impacts that may be considered as side-effects of the biogas production are:

- Burning of surplus gas without any previous use resulting in CO_2 emissions.
- Release of un-burned biogas directly into the atmosphere, resulting in high contribution to GHG emissions.
- Intoxications of people living close to the digester, esp. due to respiration of CO and H_2S gases.
- Explosions caused by methane and – to a lower extent – carbon monoxide.
- Corrosion of pipes, generators and appliances due to continuous contact with hydrogen di-sulphide.

121. To mitigate the above presented impacts, the following measures can be applied:

- The bio-digesters must be checked for gas-tightness. All valves, pipe connections, pumps (if used) and devices that have contact with gas should regularly be checked for gas-tightness. This can easily be done by checking for H_2S smells directly at the devices, pipe connections or valves. In some cases, also bubble-counters/meters can be applied. For large scale bio-digesters the owner should be supplied with or should be forced to buy H_2S- and CH_4-gas detectors. These are very small glass tubes that are filled with an indicator substance that changes colour if coming into contact with methane or H_2S. It is recommended that the gas-tightness of the digester and all devices should be checked and monitored by the biogas plant's owner every three months for large scale and every three to six months for medium scale biogas plants. For small farm and household plants, the check of gas-tightness depends on the expected volume of biogas. However, the monitoring should be in a 1-year rhythm. The frequency of monitoring on gas tightness to be carried out by the Environmental Monitoring Unit (official monitoring).
- Burning of surplus gas should be avoided as much as possible. Other possible usages, e.g. transfer to neighbourhood families (for cooking and lighting), should be checked before burning surplus gas. Already during the project's preparation phase it must be checked if surplus gas will occur or not (estimation/calculation of the expected biogas resulting from a known volume of dung and estimation how much gas can be used internally at the farm). If no generator to produce electricity is used, surplus gas will most probably be produced. An appropriate use of this gas should already be defined during the project's preparation phase.
- Biogas should never be released unburned to the atmosphere as methane contributes 21 times more to greenhouse effects in the atmosphere than carbon di-oxide. The release of unburned biogas must be monitored by the CPMU and PPMUs. In provinces where MBPs and LBPs will be installed, an environment specialist from the relevant Provincial Department of Natural Resources and Environment (DONRE) will be seconded to the PPMU for environmental management and monitoring tasks. In case a polluter is found, he/she must be punished severely, as the release of unburned biogas contradicts the CDM mechanism and makes it un-sustainable.

122. To use up produced biogas, all SBPs, MBPs and LBPs should be equipped with quality pipeline and suitable biogas appliances. Specific requirements for each type of biogas plants are summarized as follows:

- SBPs from 4m^3 to 50m^3 should installed with quality gas piping with main gas valve, over pressure valve, H_2S filter, condense water trap, pressure indicator in the kitchen, and good quality biogas cooking stoves (biogas for lighting is seldom applied in Viet Nam);
- MBPs from 51m^3 to 1,000m^3 should be equipped with quality gas piping with main gas valve, over- and under-pressure valve, H_2S filter, condense water trap, pressure indicator, adequate flare, monitoring set for biogas quantity and good quality biogas GENSET for electricity generation, which may operate at least 8,000h/year (the available Chinese GENSETS are designed for 12h continuous operation time per day resulting in 4,400h/year), automatic engine governor system, and/or other appropriate biogas use appliances;
- Large-scale covered lagoon biogas plant systems from 1,000m^3 to 190,000m^3 should be equipped with quality gas piping with ex-proofed gas blower, main gas valve, over pressure valve, H_2S filter, condense water trap, pressure indicator, adequate flare, monitoring set for biogas quality and quantity and good quality biogas GENSET for electricity generation, which may operate 4,400h/year, automatic engine governor system, and/or other appropriate biogas use appliances;
- Large-scale completely stirred tank reactor (CSTR) biogas plant systems from 1,000m^3 (500m^3 could also be possible) to 5,000m^3 should be equipped with quality gas piping with ex-proofed gas blower, main gas valve, over- and under-pressure valve, H_2S filter, condense water trap, pressure indicator, adequate flare, monitoring set for biogas quality, quantity and operational energy consumption; (viii) good quality combined heat and power generation set (CHP) for electricity generation (in North and Centre of Viet Nam a GENSET will not be sufficient, as heat may be needed for the digester itself), which may operate at least 8,000h/year, automatic engine governor system.

123. In case the biogas produced is not used for any purposes, a flare can be used to burn biogas (methane) in order to get rid of releasing unburned biogas into the atmosphere. However, the flare has to meet certain technical requirements of (i) enclosed flared[17] design and installation; (ii) temperature inside the flare is above 500^{o}C and, (iii) flare's efficiency is at least 50%.

124. Intoxication of people (including livestock) living close to a medium or large scale biogas plant can be avoided if the plants are checked for gas-tightness on a regular basis. The same is valid to avoid explosions. However, cooking and lighting devices must be in proper condition when used, and should also be maintained properly to reduce the risk of explosion.

125. Corrosion of pipes, devices and appliances that come into contact with hydrogen di-sulfide is difficult to avoid. It would be best to use substrate (dung) with low contents of sulfur. However, this is not always possible for livestock farms. The medium content of sulfur in dung should therefore be estimated from trials and experiences presented in publication and international literature. The dilution volume with water should be taken into consideration and then the expected content of H_2S in the gas should be estimated. On that basis, it can be decided (for medium and large scale digesters with high biogas yield) to install a H_2S trap (wash-out using sodium thiosulfate) or a filter to reduce the corresponding corrosion and to enhance the lifetime of the appliances and generators.

126. Other impacts resulting from the operation phase include:

[17] Enclosed flares are defined as devices where the residual gas is burned in a cylindrical or rectilinear enclosure that includes a burning system and a damper where air for the combustion reaction is admitted.

- Damages to human beings caused by accidents, e.g. children, maintenance workers or others falling into the bio-digester.
- Occurrence of smells and odors generated by the dung storage tanks and the bio-digester itself.

127. Mitigation measures for impacts identified in para. 127 include:

- Accidents can be avoided when the entrance holes of a bio-digester are kept closed and locked at all times.
- Use of closed dung storage tanks and drying beds.
- Check of gas-tightness on regular basis.

128. The environmental impacts that can result from the bio-slurry in the system are:

- Leakages of the bio-digester can result in penetration of bio-slurry into the soil, not only contaminating the soil but also the groundwater. This is of course a severe pollution if the groundwater layer is high and the groundwater is used for drinking water purposes. In case the digester is installed close to neighboring houses of other families, these will also be affected.
- A too low hydraulic retention time of the dung in the bio-digester results in smelly bio-slurry (high remaining organic charge) and reduces the possible yield of methane for useful purposes (not all biodegradable compounds are digested by the bacteria).
- All leakages and also short retention times enhance the risk that pathogen micro-organisms are spilled out of the bio-digester, affecting the close environment.

129. Possible mitigation measures for impacts identified in para. 129 include:

- As previously mentioned for gas-tightness, the biogas plant should periodically be checked for leakages.
- As previously mentioned, the necessary hydraulic retention time to bio-degrade the dung and to produce maximum yield of biogas must be determined in the project's preparation phase and be applied in the operation phase. Not too much and not too little water should be used to prepare the dung. The farmers/households should be trained how to determine to correct dilution ratio. The retention time is mostly given through the dimension of the plant.
- For leakages see above.

130. The main environmental impacts that can result from bio-slurry/wastewater mismanagement and inadequate disposal are described below:

- Eutrophication of surface water (decrease of water quality, uncontrolled algae growth, damage to fish and other aquatic life) due to the input of inorganic and organic compounds.
- Contamination of groundwater with water soluble inorganic and organic compounds. The pollution has to be considered as severe in case the groundwater is used for drinking water abstraction.
- Leaching of nitrate, other soluble inorganic and organic compounds and possible pathogens to the groundwater from bio-slurry storage facilities and lagoons or from agricultural fields on which high doses of bio-slurry have been applied.

- Accumulation of nutrients in the soil if high concentrations of bio-slurry are applied.
- Natural areas such as wetlands and mangrove swamps are directly impacted by water pollution, often leading to biodiversity losses.
- Air pollution is mainly the result of ammonia (NH_4), di-hydrogen sulphide (H_2S) as well as emissions of organic compounds (aldehyds, ketones, organic sulphur compounds etc.), resulting from subsequent aerobic and anaerobic degradation of bio-slurry. Strong smells and odors can affect the neighbourhood.

131. In general, bio-digesters do not produce any solid waste in high volume. Solids in the dung are partly discharged with the bio-slurry out of the digester, if small enough. Larger solids will sediment on the bio-digester's bottom. These sedimented solids have to be periodically removed from the bio-digester. They can be composted and then used as fertilizer. The bio-sludge coming out of the bio-digester can either be dried (in Viet Nam in drying fields under open skies) or be used in its wet form for application on agricultural land as soil improvement means or soil fertilizer. The semi-dried or dried sludge can also directly be used for application on agricultural land. However, the sludge can also be pre-dried, composted and then used as fertilizing compost for many applications. It is in general expected that the dried sludge or compost is no longer contaminated with high numbers of harmful pathogens. Nevertheless, some parasites in their persistent forms (worm eggs, resistant spores) can survive the anaerobic treatment process in the bio-digester and the drying/composting process. However, an infection risk is hardly expected. Hazardous or toxic organic compounds (e.g. pharmaceutical products like antibiotics, cytostatica, livestock drugs etc.) are mostly degraded during anaerobic treatment and composting. Heavy metals, if present, are of course not affected by degradation and will remain in the sludge or compost. The picture changes a bit when considering the pre-treated effluents from the bio-digesters. Pathogenic microorganisms, helmiths and worms can more easily survive the anaerobic treatment in the bio-digester than in compost production. The subsequent use of these effluents should therefore be determined by the foreseen application. E.g. for irrigation purposes of fruit and vegetables higher quality standards should be applied than for application of the water on wetlands or cereal crops. Depending on the intended use of the effluents, testing for health risks, or standardized pre-treatments, should be required. For further information on the use and treatment of digestate and bio-slurry, refer to Part VI of this Appendix.

E. Project Decommissioning Phase

132. This phase is dominated by the production of solid waste once the biogas plant has reached the end of its useful lifetime and must be dismantled. Environmental impacts can result from:

- Solid waste resulting from brick waste. The main impact will be dust emissions during dismantling of the plant.
- Solid waste resulting from composite and HDPE biogas plants. The main impact will be the generation of smells and odors when cutting the materials using burners or welders. These smells might be toxic.
- Increased truck traffic during dismantling of the plant and filling of the remaining pit (if not used for a new biogas plant), resulting in increased diesel exhaust gas emissions and dust emissions.

133. Possible mitigation measures to reduce the environmental impacts are:

- Water spraying when dismantling brick-constructed biogas plants, to wash out solid dust particles. Undamaged bricks might be reused. Other solid brick waste can be used in road construction, e.g. as under-layers.
- The workers should use respiration masks and the windows and doors of neighboring houses should be kept closed.
- It is not clear if composite waste and HDPE waste can be reused. This should be checked at a later stage. If this is not possible, the waste must be transported to a legal disposal site.
- Reduction of truck traffic as far as possible. Use of well-defined access roads only and tracks on-site of the farms.

134. The above presented impacts are all temporary and last only for the time of dismantling of the biogas plants. However, the discharge and dumping of composite and HDPE waste is definitely a long-term and therefore a severe environmental impact. It also cannot be excluded that organic compounds will be released into the atmosphere during the many years that degradation of this waste will last.

VI. Environmental Management Plan

135. The purpose of the Environmental Monitoring Plan (EMP) is to ensure that all construction work (project implementation phase), all operation of biogas plants (project operation phase), and all decommissioning of biogas plants (project decommissioning phase) undertaken under the LCASP project, are environmentally sound, comply with Vietnamese environmental legislation and laws, and wherever possible, satisfy the provisions of the Environmental Assessment Report. The primary concern will be to screen all new work proposals for potential environmental impacts, and to influence the design and implementation of these in order to ensure that they are environmentally sound. The EMP is summarized in Table A.8 below.

Table A.8: Environmental Management Plan

Potential Environmental Impact	Mitigation Measures	Schedule	Responsible Entity
Pre-construction phase (substrate preparation)			
Occurrence of smells in case the storage containers are not closed	The storage tanks and beds should be closed to avoid bad smells.	Before biogas plant construction	Farms
Attraction of flies, insects and rodents	The storage tanks and beds should be sealed		
Leakages resulting in penetration of pollution into the soil and groundwater (leachate infiltration)	They also should be underground-sealed to avoid penetration of leachate into the soil and groundwater		
Initial biodegradation of organic compounds can result in production of greenhouse gases, esp. methane, in the tanks and beds if the dung is stored too long.	To avoid biodegradation in the tanks, a simple aeration system (air pump with disburser) can be installed		
Over-flooding of drying beds in case of strong rains (esp. in the rainy season) which can result in the	The side walls of the beds should be high enough to resist against flooding.		

Potential Environmental Impact	Mitigation Measures	Schedule	Responsible Entity
distribution of organic compounds (pollution) into the households/farms' surroundings, affecting also neighbors living close by			
Construction phase			
Excavation of large amounts of earth. The earth can either be distributed on the farm itself, or, if not possible, it must be transported to a construction waste dump site. The latter results in transport traffic and corresponding emissions of truck exhaust gases.	Transport of surplus earth and other waste only to legally registered dump sites. If the soil is distributed on the farm itself, it should be dumped in a way that plants and houses are not affected	During construction of biogas plant at farms	Farms, constructor and PPMUs
For the excavation of the earth, heavy machines (e.g. excavator machines) are used that also produce exhaust gases during the working hours. The workers and the neighborhood can be affected	Machine working hours and truck traffic should be reduced to a minimum but without causing unnecessary delay of the construction. Sound and noise filters for excavators should be applied		
Dust emissions during earth works, esp. in the dry season, are normal	Work should not be conducted during windy and stormy weather in order not to distribute dust into the wider environment		
If the soil structure is unstable and the dig is carried out very close to adjacent buildings, it cannot be ruled out that these buildings receive damages (e.g. wall cracks, damage of infrastructure installations like electricity cables, water pipes, etc.	Before starting earth works very close to houses and stables, the stability of the underground and the soil structure must be investigated and checked (pole piling)		
Workers can be affected due to work accidents. The construction of medium to large size biogas plants lasts for some 2 to 4 weeks and 5 to 10 workers are necessary	The workers should be provided with adequate labour and security clothing and devices (e.g. closed shoes, ear and eye protection, masks and helmets etc.) to be protected as well as possible against accidents		
Project operation phase			
Impacts resulting from the storage of dung - Occurrence of smells resulting in attraction of flies, insects and rodents - Leakages resulting in pollution of	- Closure of all storage tanks and beds - Beds should be underground-sealed to avoid penetration of leachate into the soil and	After biogas plants are constructed and put into operation	

Potential Environmental Impact	Mitigation Measures	Schedule	Responsible Entity
the soil and groundwater (leachate infiltration). - GHG production during longerstorage periods and increased ambient temperatures - Over-flooding of beds and pollution of households/farms as well as the neighbors	groundwater - The beds side walls must be high enough to resist against flooding - To avoid biodegradation in the tanks, a simple aeration system can be installed		
Impacts resulting from gas production - Gas leakages resulting from the bio-digester - Gas leakages resulting from the gas pipes. - Gas leakages resulting from the appliances and generators	The bio-digesters must be checked for gas-tightness. All valves, pipe connections, pumps (if used) and devices that have contact with gas should regularly be checked for gas-tightness. Burning of surplus gas should be avoided as much as possible. Other possible usages, e.g. transfer to neighbourhood families (for cooking and lighting), should be checked before burning surplus gas - Biogas should never be released unburned to the atmosphere, an enclosed flare has to be installed	After biogas plants are put into operation; For small farm and household plants, the check of gas-tightness depends on the expected volume of biogas. However, the monitoring should be in a 1-year rhythm	Farms, PPMUs for all provincial MBPs and LBPs and CPMU for samples
Impacts on human beings due to unexpected accidents	- Intoxications of people (including livestock) living close to a medium or large scale biogas plant can be avoided if the plants are checked for gas-tightness on a regular basis. - The same is valid to avoid explosions. However, cooking and lighting devices must be in proper condition when used, and should also be maintained properly to reduce the risk of explosion.		
Impacts of bio-slurry on the environment if discharged untreated to the environment: - Leakages of the bio-digester can result in penetration of bio-slurry into the soil, not only contaminating the soil but also the groundwater. This is of course a	- The biogas plant should periodically be checked for leakages - Farmers /households should be trained how to determine to correct dilution ratio. The retention time is mostly given		

Potential Environmental Impact	Mitigation Measures	Schedule	Responsible Entity
severe pollution if the groundwater layer is high and the groundwater is used for drinking water purposes. In case the digester is installed close to neighbouring houses of other families, these will also be affected - A too low hydraulic retention time of the dung in the bio-digester results in smelly bio-slurry (high remaining organic charge) and reduces the possible yield of methane for useful purposes (not all biodegradable compounds are digested by the bacteria). - All leakages and also short retention times enhance the risk that pathogen micro- organisms are spilled out of the bio-digester, affecting the close environment - Eutrophication of surface water (decrease of water quality, uncontrolled algae growth, damage to fish and other aquatic life) due to the input of inorganic and organic compounds - Contamination of groundwater with water soluble inorganic and organic compounds. The pollution has to be considered as severe in case the groundwater is used for drinking water abstraction - Leaching of nitrate, other soluble inorganic and organic compounds and possible pathogens to the groundwater from bio-slurry storage facilities and lagoons or from agricultural fields on which high doses of bio-slurry have been applied - Accumulation of nutrients in the soil if high concentrations of bio-slurry are applied - Natural areas such as wetlands and mangrove swamps are directly impacted by water pollution, often leading to biodiversity losses - Air pollution is mainly the result of	through the dimension of the plant. - Sedimented solids have to be periodically removed from the bio-digester. They can be composted and then used as fertilizer. The bio-sludge coming out of the bio-digester can either be dried (in Viet Nam in drying fields under open skies) or be used in its wet form for application on agricultural land as soil improvement means or soil fertilizer. The semi-dried or dried sludge can also directly be used for application on agricultural land. However, the sludge can also be pre-dried, composted and then used as fertilizing compost for many applications. It is in general expected that the dried sludge or compost is no longer contaminated with high numbers of harmful pathogens. Nevertheless, some parasites in their persistent forms (worm eggs, resistant spores) can survive the anaerobic treatment process in the bio-digester and the drying/composting process.		

Potential Environmental Impact	Mitigation Measures	Schedule	Responsible Entity
ammonia (NH_4), di-hydrogen sulphide (H_2S) as well as emissions of organic compounds (aldehyds, ketones, organic sulphur compounds etc.), resulting from subsequent aerobic and anaerobic degradation of bio-slurry. Strong smells and odours can affect the neighborhood			

VII. Environmental Selection Criteria

136. Environmental selection criteria of biogas plants are summarized in the following table (Table A.9).

Category	Criteria	
A. SBP	A1.	Scope of application: Apply to small livestock farms, most of them household farm based, holding at least 6 and more adult pig heads are able to provide the minimum feedstock for a SBP. As cows and buffalos are often only night-stabled, households with 5 cattle heads or more are able to feasibly operate a biogas plant with sufficient feedstock. In zero-grazing units, which are established mainly in the Mekong delta area, also the manure produced by 3 cattle could deliver enough feedstock to operate a SBP.
	A2.	Environmental pollution management: The SBPs deal with the livestock waste pollution. Sector standard for bio-slurry is applied and followed. Specifically, bio-slurry has to be: (i) no longer bad smell, (ii) no presence of mosquito larvae, (iii) COD is reduced by 80% and, (iv) parasite eggs are reduced by 95%; coliform does not exceed 106 MPN/100ml.
	A3.	Household owners can only apply for support to build their biogas plants if they commit to meet the following criteria: (i) inlet channel from the paved stable (to collect urine and flushed manure) with attached inlet mixing tank (mainly needed for highly solid cow manure); (ii) fixed dome biogas digester corpus in concrete, brickwork, composite build, sealed and controlled under national standards; (iii) compensation chamber for hydraulically pressurized gas storage with about 40-50% capacity of daily biogas production (iv) post-treatment system formed by at least 3 rotationally used stabilized compost chambers, where the effluent could be mixed with carbon rich material (as leafs, paper, wood chips, garden waste), or other adequate post-treatment system which fits to the agricultural re-use at on hand, and to the hygiene requirement (toilet connection) on the other hand; (v)

Category	Criteria	
		quality gas piping with main gas valve, over pressure valve, H_2S filter, condense water trap, pressure indicator in the kitchen, and good quality biogas cooking stoves (vi) water saving measures at the stable (shade, optimized air flow ventilation, introduce water saving sprinklers, apply pressure cleaner) to increase the solid content in the biogas plant.
B. MBP	B1.	Scope of application: MBPs are applied for medium livestock farms. Specifically, the plug-flow design may be preferred for dairy farms as they may treat higher solid content while the HDPE lagoon is suitable for the other animal farms.
	B2.	Environmental pollution management: The MBPs deal with livestock waste pollution. In case of no standard for MBPs and LBPs is existing, the sector standard for bio-slurry can be applied and followed. In details, bio-slurry has to be: (i) no bad smell, (ii) absence of mosquito larvae, (iii) COD is reduced by 80%, (iv) parasite eggs are reduced by 95%, and (v) coliform not exceeding 106 MPN/100ml.
	B3.	Farm owners can only apply for support to build their biogas plants if they commit to meet the following criteria: (i) the biogas plant and wastewater treatment facility is at least one km from schools, hospitals and ecologically sensitive areas, (ii) inlet channel from the paved stable (to collect urine and flushed manure) with attached inlet mixing tank (mainly needed for high solid cow or poultry manure); (iii) separated or integrated biogas storage capacity; (iv) selected appropriate post-treatment system which fits to agricultural re-use (may be with liquid-solid separation) on one hand, and to the hygiene requirement (toilet connection) on the other hand; (v) quality gas piping with main gas valve, over- and under-pressure valve, H_2S filter, condense water trap, pressure indicator, adequate flare, monitoring set for biogas quantity; (vi) good quality biogas GENSET for electricity generation, which may operate at least 8,000h/year (the available Chinese GENSETS are designed for 12h continuous operation time per day resulting in 4,400h/year),automatic engine governor system, and/or other appropriate biogas use appliances; (vii) in case produced biogas is not used, a qualified enclosed flare has to be installed to completely burn the produced biogas.
C. LBP	C1.	Scope of application: LBPs are applied for large livestock farms.
	C2.	Environmental pollution management: The MBPs deal with the livestock waste pollution. In case no standard for MBPs and LBPs is existing, the sector standard for bio-slurry can be applied and followed. In detail, bio-slurry has to be: (i) no bad smell, (ii) absence of mosquito

Category	Criteria
	larvae, (iii) COD reduced by 80%, (iv) parasite eggs are reduced by 95%, and (v) coliform not exceeding 106 MPN/100ml.
	C3. Farm owners can only apply for support to build their biogas plants if they commit to meet the following criteria: (i) the biogas plant and wastewater treatment facility is at least 2 km from schools, hospitals and ecologically sensitive areas, (ii) inlet channel from the paved stable (to collect urine and flushed manure); (iii) rectangular or square biogas digester corpus with bottom lining in concrete or brickwork, or geo-membrane lining, covered with reinforced plastic membrane, built, sealed and controlled under national standards, dividing the digester volume in multiple-cells also improves environmental performance (in case HDPE) or mixing tank with stirrer (needed for high solid cow and poultry manure, for adding co-substrates, and for diluting fresh manure with re-circulated effluent or liquid digestate), for not easily digestible substrates this mixing tank could be designed as a pre-hydrolysis tank (in case of CSTR); (iv) selected appropriate post-treatment system which fits to the agricultural re-use (may be with liquid-solid separation); (v) quality gas piping with ex-proofed gas blower, main gas valve, over pressure valve, H_2S filter, condense water trap, pressure indicator, adequate flare, monitoring set for biogas quality and quantity; (vi) good quality biogas GENSET for electricity generation, which may operate 4,400h/year, automatic engine governor system, and/or other appropriate biogas use appliances; (vii) in case of produced biogas is not used, a qualified enclosed flare has to be installed to burnt completely produced biogas.

VIII. Financial and Economic Viability Criteria

137. The financial and economic analysis has been undertaken for small-, medium- and large-scale biogas plants (SBPs, MBPs and LBPs). This analysis focuses on the investments of individual producers with respect to the financial returns to the individuals and the economic returns to society. Attempt was made to aggregate economic benefits of packages of biogas plants (BPs) at project level to incorporate the additional project implementation costs required to ensure overall project success and viability. The analysis was undertaken to confirm the economic viability of the project.

138. The analysis of SBPs focuses on one model, a 10 cubic meter (m^3) capacity KT1 or KT2 -BPs, which is expected to be the most common size and type supported by the project. The analysis would be similar for other types with a similar size and cost as well as for the considerable range of sizes representing the range of investments common in Viet Nam.[18] For other sizes, the returns are likely to be lower for lower-capacity SBPs and higher for higher-

[18] The size of biogas plant is scaled to the feedstock available, which is a function of the number of animals a farmer has.

capacity ones due predominantly to declining construction costs per unit volume as volume increases.

139. The analysis of MBPs and LBPs (MLBPs) covers a range of investments from 100 m^3 capacity to 10,000 m^3 capacity and several different types of biogas plants—including KT31, plug flow, continuous stirred tank reactor (CSTR), covered lagoon, and fully stirred covered lagoon— and retention periods of 30, 40, and 55 days for all plants except CSTR, which only uses a 30-day retention period. The retention periods reflect the different conditions in different areas of Viet Nam—a 30-day retention period is appropriate for the southern provinces, 40-day retention period for the central provinces, and 55-day retention period for the Northern provinces. The range of types and sizes, totaling 51 model biogas plants, covers most of the possibilities expected to be encountered under the project. However, for the purpose of cost estimation for the project a 500-m^3 covered lagoon was selected as the typical MBPs and a 2,000-m^3 covered lagoon as the typical LBPs. Analysis of results for these two models is included in greater detail in this document.

140. The economic analysis was conducted in accordance with ADB's *Guidelines for the Economic Analysis of Projects (1997)*[19] and compared the without- and with-project scenarios, the without-project scenario in this instance is a continuation of the current situation where livestock waste treatment is not practiced. The following assumptions were used for the analysis:

(i) Construction of all biogas plants can be completed within a one-year schedule, although SBPs can be constructed very quickly and benefits obtained during the first year while construction of MLBPs takes longer and benefits only commence in the year after construction, i.e., the second year.
(ii) The project life is 20 years excluding the project construction period, which is reasonable if regular maintenance and replacement of shorter-term equipment are undertaken. The salvage value of MBPs and LBPs is assumed to be 20% of the investment cost at the end of the project life, while for SBPs it is assumed to be zero.
(iii) Payments for carbon emission reductions (CERs) are excluded since it is uncertain that the Project will receive the revenue from a carbon market. No additional payments are made to the beneficiaries, if the Government will receive the revenues.
(iv) Economic benefits and costs are expressed in constant 2012 terms with an exchange rate of VND21,000 = $1.00 for local currency conversions and are valued in US dollars using the international price *numeraire*.
(v) Taxes and duties, interest, incentive payments,[20] and price contingencies are excluded in the estimation of economic costs, while physical contingencies are included.
(vi) Economic costs and benefits for non-tradable inputs and outputs are derived by adjusting their values by the standard conversion factor (SCF) of 0.90, which is consistent with the SCF used in recent ADB projects for Viet Nam,[21] and the

[19] ADB. 1997. *Guidelines for the Economic Analysis of Projects*. Manila.
[20] Incentive payments are treated as a grant/subsidy for the purpose of the economic analysis. The benefits from carbon emission reduction are estimated as the economic benefit.
[21] ADB. 2009. *Report and Recommendation of the President to the Board of Directors for the Proposed Loan to the Socialist Republic of Viet Nam for the Quality and Safety Enhancement of Agricultural Products and Biogas Development Project.* Manila.

economic value of surplus labor is derived by adjusting the labor cost by the opportunity cost of surplus labor (OCSL) of 0.85 multiplied by the SCF.

(vii) The weighted average cost of capital (WACC) is estimated separately for SBP, MBP and LBP investments based on the percentages of funds to come from various sources, and different taxation requirements. For all investments, the funds are assumed to be 85% from a loan and 15% from the financial intermediaries (FIs). The interest on commercial farm loans, for BPs can be written off against tax at a rate of 25%. The resultant WACCs are 4.04% for households and 4.07% for commercial farms (Table A.10).

(viii) The opportunity cost of capital used for the economic analysis was 12%, which represents the economic cost of capital for Viet Nam.

Table A.10: Estimation of Weighted Average Cost of Capital for Categories of BPs

	Small BPs		Medium and Large BPs	
Financial component	**Financial Intermediary Loan**	**Beneficiary Equity**	**Financial Intermediary Loan**	**Beneficiary Equity**
A. Amount ($)	626.26	110.52	-[a]	-[a]
B. Weighting	85.0%	15.0%	85.0%	15.0%
C. Nominal cost	18.00%	22.00%	18.00%	20.00%
D. Income tax rate (preferential tax rate)	0%	0%	25%	0%
E. Tax-adjusted nominal cost [C x (1 - D)]	18.00%	22.00%	13.50%	20.00%
F. Inflation rate	14.00%	14.0%	10.00%	10.0%
G. Real cost [(1+E) / (1+F) - 1]	3.51%	7.02%	3.18%	9.09%
H. Weighted component of WACC	2.98%	1.05%	2.70%	1.36%
Weighted average cost of capital	**4.04%**		**4.07%**	

[a] The financial intermediary loan and beneficiary equity depend on the size of biogas plant, but the ratio is always 85:15

Source: Asian Development Bank estimates.

A. Financial Viability Criteria

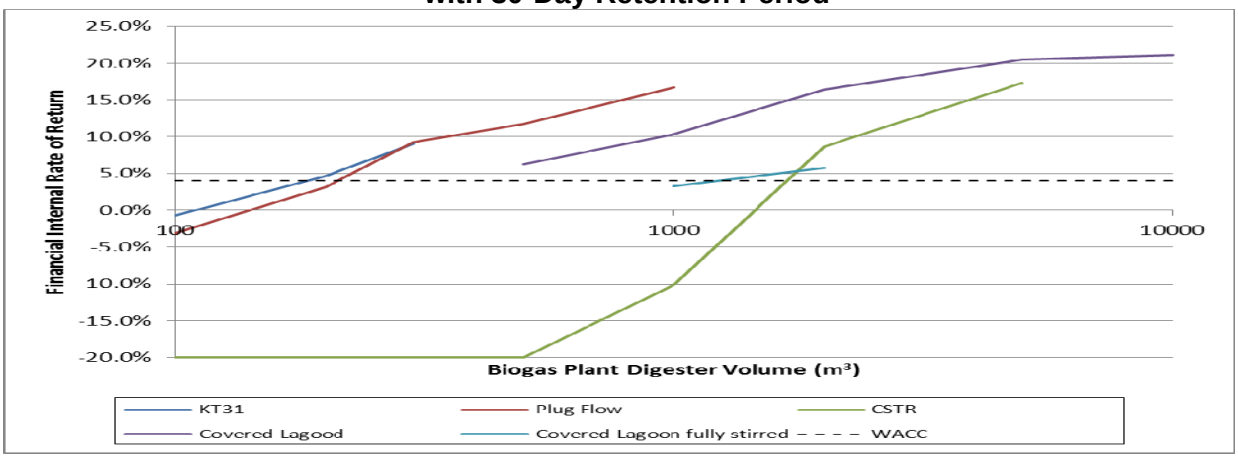
141. An MBP using KT31 technology must be about 200 m^3 capacity to be financially viable with a 30-day retention period, and 300 m^3 with a 40-day retention period, but is not viable with a 55-day retention period. For the plug flow type financial viability is achieved at about 200 m^3, 300 m^3, and 500 m^3, respectively, while for a covered lagoon all sizes are financially viable at 30- and 40-day retention periods and a size of 1,000 m^3 is required for 55-days retention. Fully stirred covered lagoons require 2,000 m^3 capacity for financial viability at 30- and 40-day retention periods and more than 2,000 m^3 for a 55 day retention period. Similarly CSTR requires about 2,000 m^3 capacity for financial viability. The indicative MLBP—500 m^3 and 2,000 m^3 covered lagoons—have FIRRs in excess of the WACC, other than in the case of the MBP with a 55-day retention period where the FIRR is 0.7% indicating that this scale of investment should not be supported in the southern provinces without additional investigations. Examination of the graphs (Figures A.3, A.4 and A.5) indicates the range of biogas plants with an FIRR in excess of the WACC (the dotted line), the condition required for financial viability, and also permits a more accurate estimate of the actual capacity required for a plant to be financially viable.

Table A.11: Estimated Financial Internal Rates of Return of Various Medium Biogas Plants and Large Biogas Plants

Biogas plant type	Retention period (days)	Capacity (m^3)							
		100	200	300	500	1,000	2,000	5,000	10,000
KT31	30	(0.7%)	4.7%	9.0%					
	40	(3.6%)	2.6%	6.9%					
	55	(7.9%)	(0.2%)	2.3%					
Plug Flow	30	(3.1%)	3.2%	9.3%	11.7%	16.7%			
	40	(6.8%)	0.2%	4.9%	7.7%	11.3%			
	55	(11.1%)	(4.3%)	(0.6%)	4.3%	7.1%			
CSTR	30	(20.0%)	(20.0%)	(20.0%)	(20.0%)	(10.1%)	8.6%	17.3%	
Covered Lagoon	30				6.3%	10.3%	16.4%	20.5%	21.1%
	40				4.6%	8.2%	15.3%	20.1%	20.8%
	55				0.7%	6.5%	12.2%	19.5%	20.4%
Covered Lagoon fully stirred	30					3.3%	5.8%		
	40					1.8%	3.8%		
	55					-2.6%	0.0%		

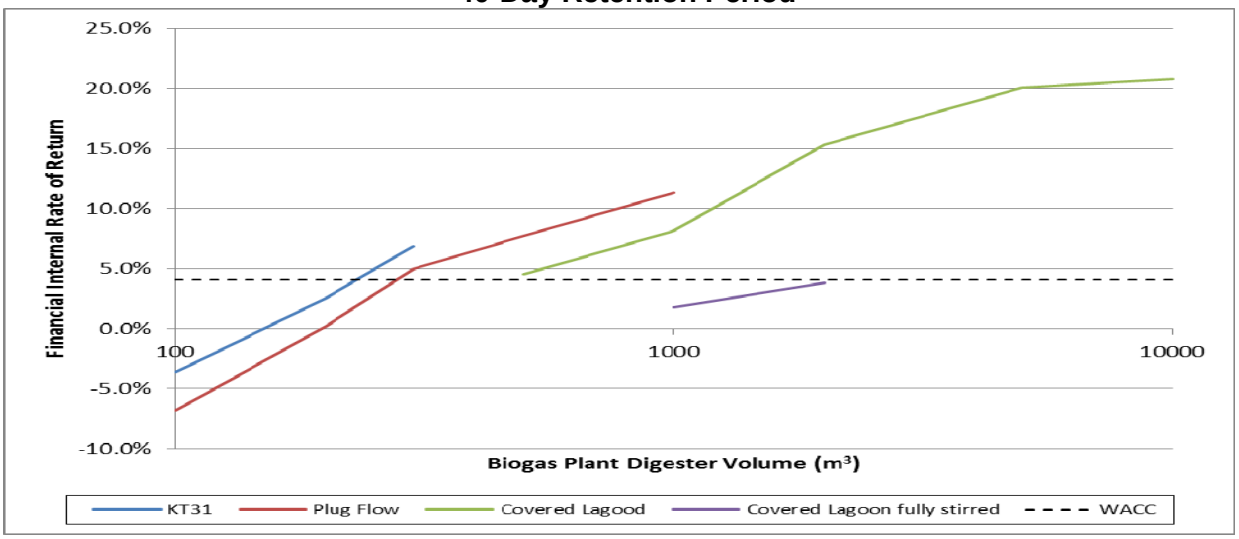
( ) = negative. CSTR = completely stirred tank reactor.
Source: Asian Development Bank estimates.

Figure A.3: Estimated Financial Ineternal Rates of Return for Biogas Plants with 30-Day Retention Period



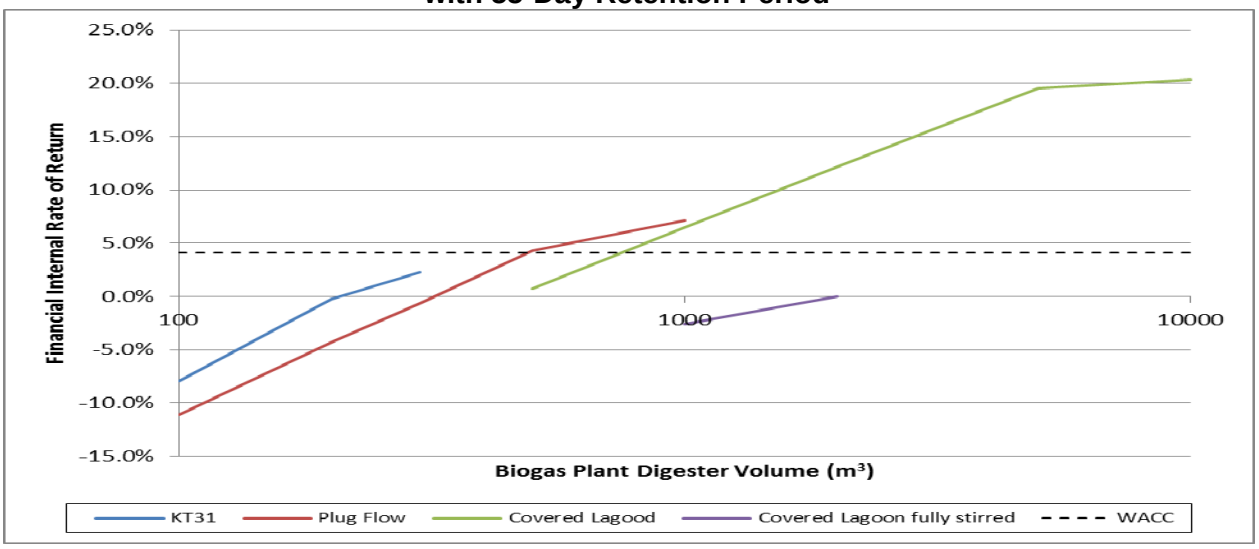
Source: Asian Development Bank estimates.

Figure A.4: Estimated Financial Ineternal Rates of Return for Biogas Plants with 40-Day Retention Period



Source: Asian Development Bank estimates.

Figure A.5: Estimated Financial Ineternal Rates of Return for Biogas Plants with 55-Day Retention Period



Source: Asian Development Bank estimates.

142. FNPVs per m^3 of digester volume are estimated for each MLBP as well as for the different retention periods. The results are summarized in Table A.12 and are presented graphically in Figures A.6, A.7 and A.8 for the 30-, 40-, and 55-day retention periods. The FNPVs are estimated using a discount rate equal to the WACC, and hence provide a confirmation of the conclusions obtained from the FIRR estimates. When interpreting these results it should be noted that the FNPV is required to be greater than zero for the investment to be financially viable. The graphs indicate clearly the capacity at which the FNPV exceeds zero, taking into account the log-scale of the X-axis.

Table A.12: Estimated Financial Net Present Value of Various Medium Biogas Plants and Large Biogas Plantss

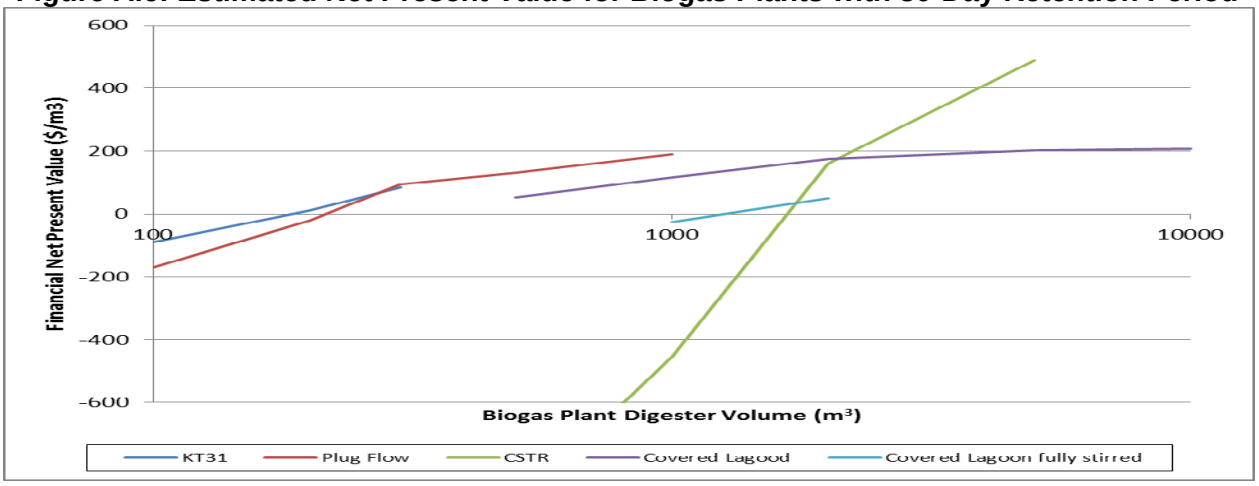
($/m^3 capacity)

Biogas plant type	Retention period (days)	Capacity (m3)							
		100	200	300	500	1,000	2,000	5,000	10,000
KT31	30	(89)	11	84					
	40	(124)	(24)	42					
	55	(160)	(59)	(24)					
Plug Flow	30	(169)	(20)	95	132	190			
	40	(209)	(70)	14	56	100			
	55	(238)	(138)	(73)	3	38			
CSTR	30	(1,514)	(1,393)	(1,332)	(926)	(455)	162	490	
Covered Lagoon	30				52	117	176	203	207
	40				10	70	137	163	168
	55				(74)	36	88	124	128
Covered Lagoon fully stirred	30					(26)	51		
	40					(64)	(7)		
	55					(169)	(88)		

( ) = negative. CSTR = completely stirred tank reactor.

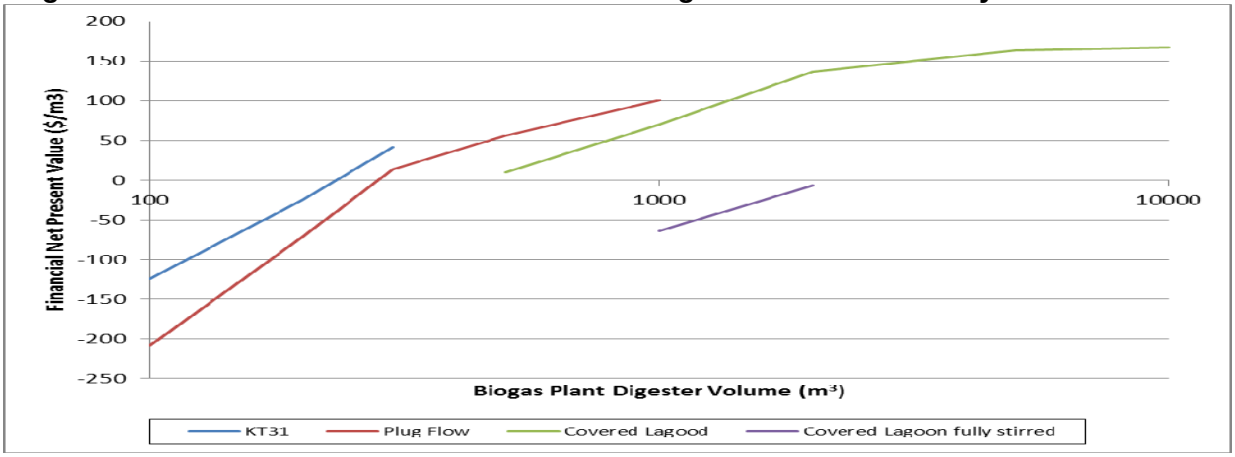
Source: Asian Development Bank estimates.

Figure A.6: Estimated Net Present Value for Biogas Plants with 30-Day Retention Period



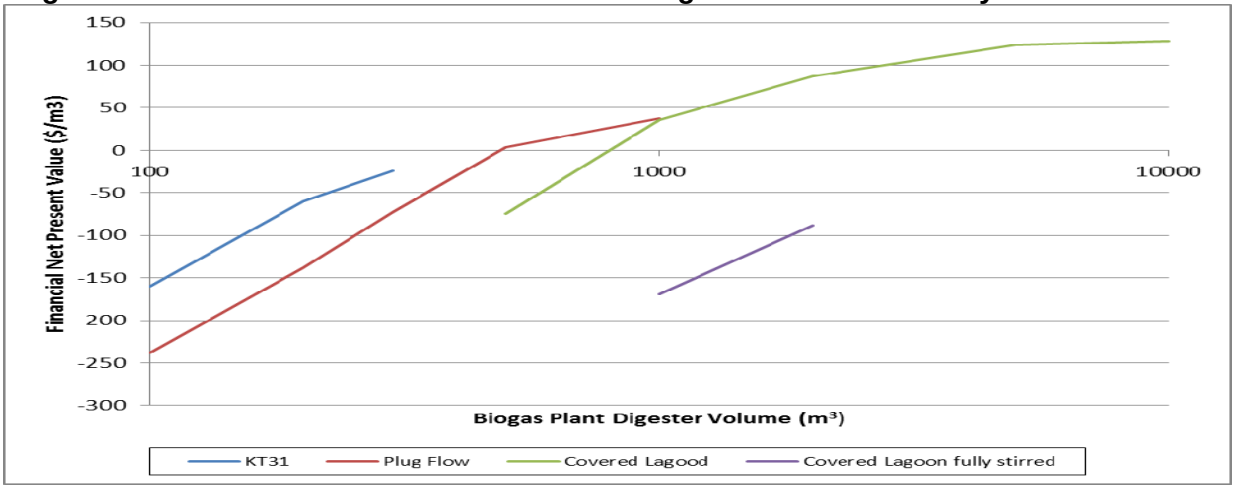
Source: Asian Development Bank estimates.

Figure A.7: Estimated Net Present Value for Biogas Plants with 40-Day Retention Period



Source: Asian Development Bank estimates.

Figure A.8: Estimated Net Present Value for Biogas Plants with 55-Day Retention Period



Source: Asian Development Bank estimates.

143. The indicative MBP and LBP—500 m^3 and 2,000 m^3 covered lagoons—have FNPVs at a discount rate equal to the WACC in excess of zero both without- and with-CER revenue, other than in the case of the MBP with a 55-day retention period where the FNPV is -$74/$m^3$, confirming that this scale of investment should not be supported in the southern provinces without additional investigations.

B. Economic Viability Criteria

144. The EIRRs for the selected MBPs and LBPs are summarized in Table A.13 and shown graphically in Figures A.9, A.10 and A.11 for the 30-, 40-, and 55-day retention periods, respectively. Since the cut off point for economic viability is 12% it is evident that KT31 type biogas plants are viable at a minimum capacity of 200 m^3 with a 40- and 55-day retention period and for all sizes with a 30-day retention period. In the case of the plug flow type, economic viability requires 200 m^3 for the 30-day retention period, 300 m^3 for 40 days, and 500 m^3 for 55 days with smaller sizes being marginal. The CSTR type, which only has a 30-day retention period, requires a minimum capacity of 2,000 m^3 for economic viability. For covered lagoons the investment is economically viable at 500 m^3 capacity, other than for the 55-day retention period

where it needs to be 1,000 m^3. The fully stirred covered lagoon is economically viable at a minimum of 1,000 m^3 for a 30- or 40-day retention period and 2,000 m^3 for a 55-day retention period.

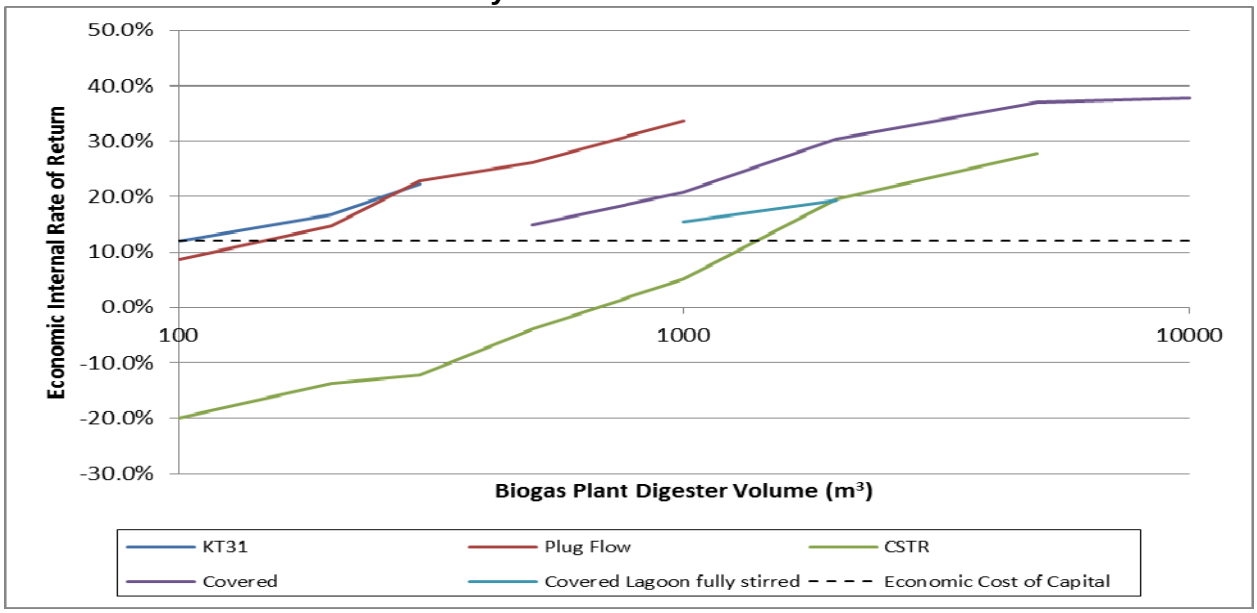
Table A.13: Economic Analysis of Medium-Sized Biogas Plants and Large Biogas Plants

Biogas Plant Type	Retention Period (days)	Capacity (m^3)							
		100	200	300	500	1,000	2,000	5,000	10,000
KT31	30	12.0%	16.7%	22.2%					
	40	9.4%	14.5%	19.5%					
	55	5.9%	11.6%	13.8%					
Plug Flow	30	8.6%	14.7%	22.8%	26.2%	33.6%			
	40	5.4%	11.5%	17.1%	20.5%	25.6%			
	55	2.0%	6.6%	10.2%	16.1%	19.7%			
CSTR	30	(20.0%)	(13.7%)	(12.3%)	(4.0%)	5.1%	19.5%	27.7%	
Covered	30				14.9%	20.9%	30.4%	37.0%	37.8%
Lagoon	40				12.4%	17.7%	28.7%	36.4%	37.4%
	55				6.9%	15.1%	23.8%	35.7%	36.8%
Covered	30					15.4%	19.3%		
Lagoon	40					13.8%	16.8%		
fully stirred	55					8.2%	12.0%		

( ) = negative. CSTR = completely stirred tank reactor.
Source: Asian Development Bank estimates.

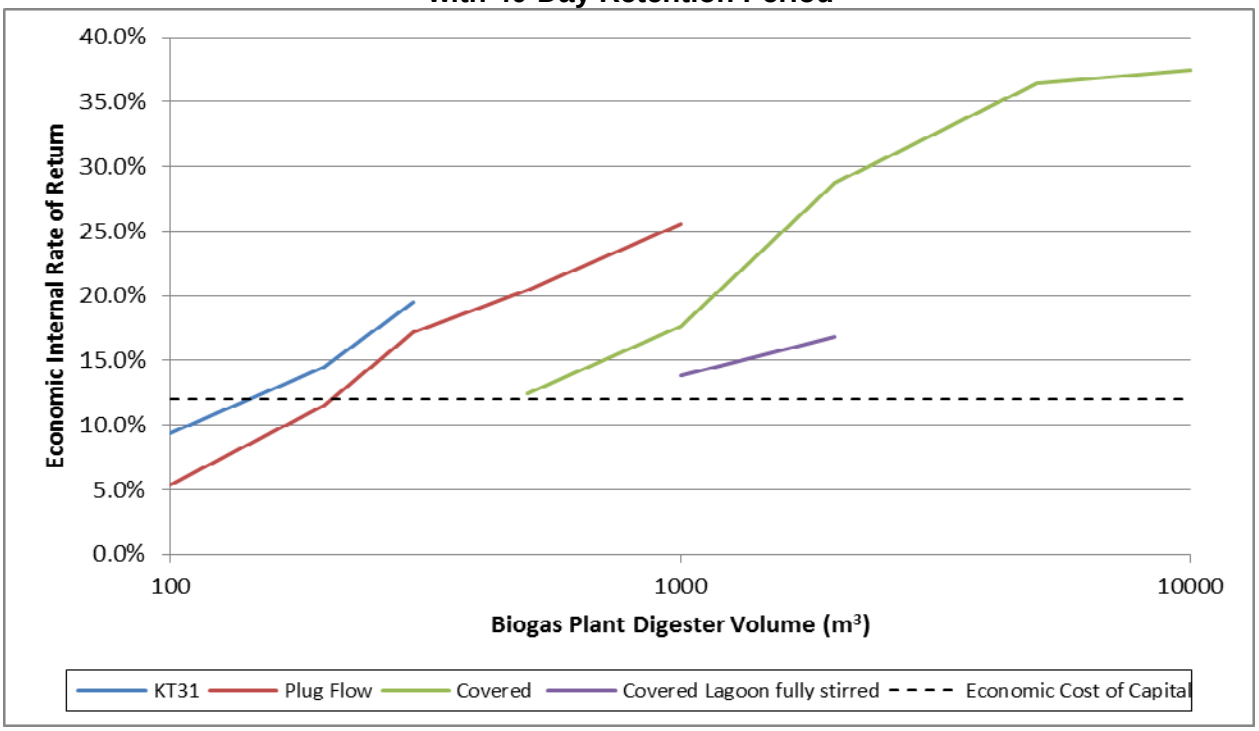
145. The indicative MBP and LBP—500 m^3 and 2,000 m^3 covered lagoons—have EIRRs in excess of 12% other than in the case of the MBP with a 55-day retention period. The EIRR of this investment is only 6.9%, indicating that it is not economically viable. The MBP with a 40-day retention period has an EIRR of just 12.4%, which is acceptable, but marginal.

Figure A.9: Estimated Economic Internal Rates of Return for Biogas Plants with 30-Day Retention Period



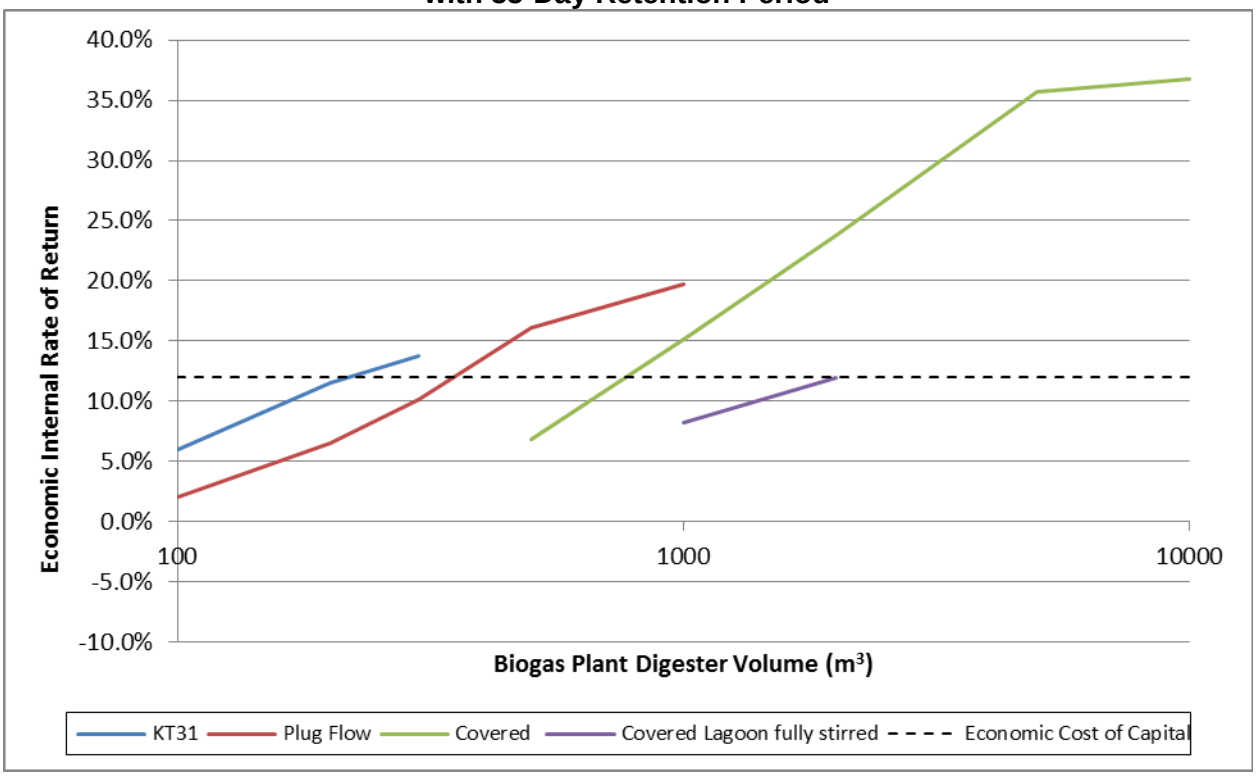
Source: Asian Development Bank estimates.

Figure A.10: Estimated Economic Internal Rates of Return for Biogas Plants with 40-Day Retention Period



Source: Asian Development Bank estimates.

Figure A.11: Estimated Economic Internal Rates of Return for Biogas Plants with 55-Day Retention Period



Source: Asian Development Bank estimates.

Table A.14: Estimated Economic Net Present Values for Various Medium-Sized Biogas Plants and Large Biogas Plants

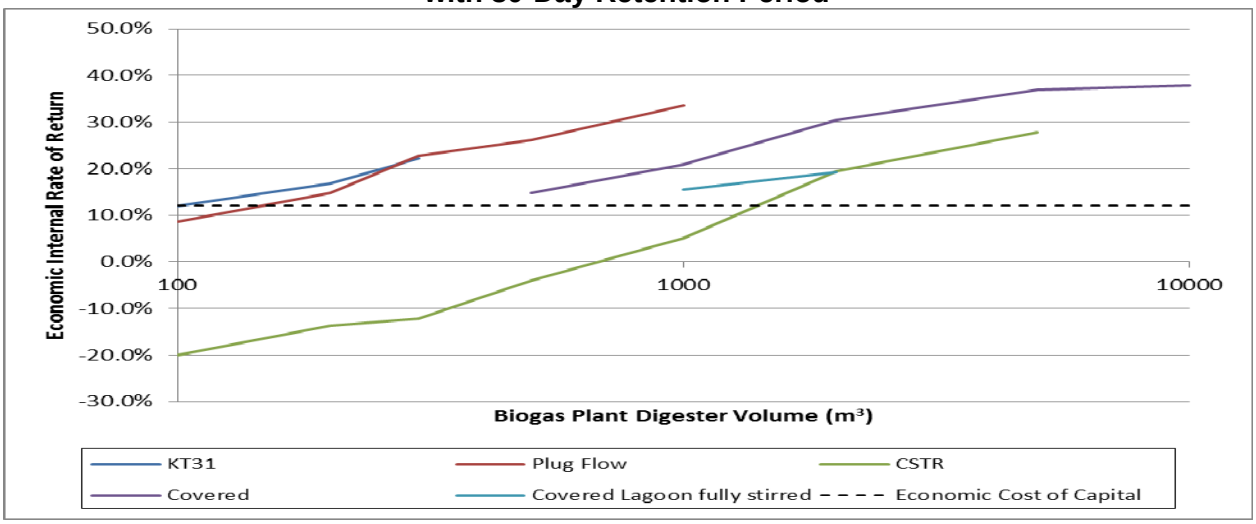
($/m^3 capacity)

Biogas Plant Type	Retention Period (days)	Capacity (m^3)							
		100	200	300	500	1,000	2,000	5,000	10,000
KT31	30	1	64	118					
	40	(34)	30	78					
	55	(68)	(4)	18					
Plug Flow	30	(63)	42	132	159	204			
	40	(102)	(6)	58	87	122			
	55	(132)	(69)	(21)	38	64			
CSTR	30	(838)	(768)	(732)	(482)	(192)	181	372	
Covered Lagoon	30				47	114	173	199	203
	40				6	67	135	161	165
	55				(82)	32	86	123	126
Covered Lagoon fully stirred	30					83	153		
	40					37	87		
	55					(74)	(1)		

( ) = negative. CSTR = completely stirred tank reactor.
Source: ADB estimates.

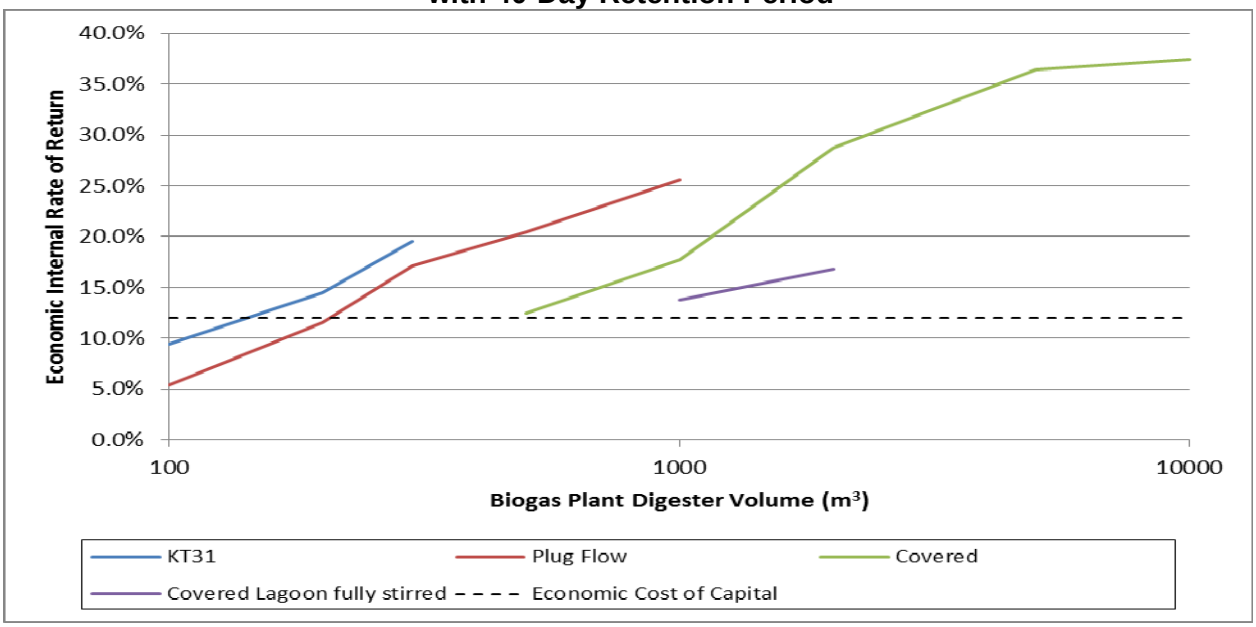
146. The ENPVs of the selected MBPs and LBPs are summarized in Table A.14 and shown graphically in Figures A.12, A.13 and A.14 for the 30-, 40-, and 55-day retention periods, respectively. These results indicate the volume of biogas digester that is required for economic viability in terms of achieving an ENPV in excess of zero based on a discount rate of 12%. The results confirm the findings of the EIRR estimates. Further, the indicative MBP and LBP—500 m^3 and 2,000 m^3 covered lagoons— are confirmed to be economically viable with positive ENPVs other than in the case of a medium-scale plant with a 55-day retention period where the ENPV is -$82/$m^3$. Even with a 40-day retention period the ENPV is only $6/$m^3$ suggesting that the investment is marginal. The ENPV graphs enable a more accurate assessment of the volume at which the investment becomes economically viable.

Figure A.12: Estimated Economic Net Present Values for Biogas Plants with 30-Day Retention Period



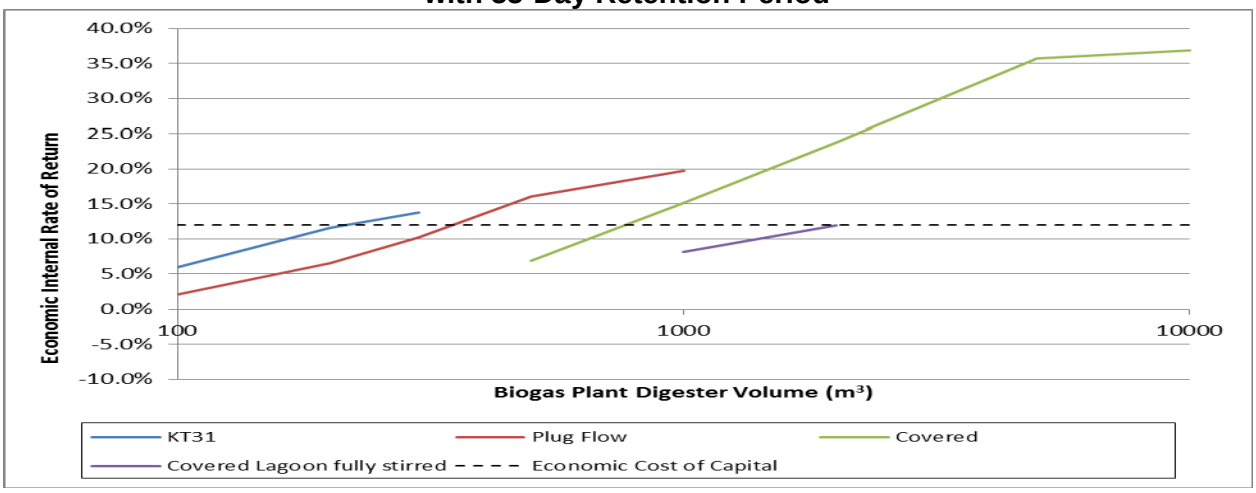
Source: Asian Development Bank estimates.

Figure A.13: Estimated Economic Net Present Values for Biogas Plants with 40-Day Retention Period



Source: Asian Development Bank estimates.

Figure A.14: Estimated Economic Net Present Values for Biogas Plants with 55-Day Retention Period



Source: Asian Development Bank estimates.