CLEAN DEVELOPMENT MECHANISM

PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

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SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

The title of the project activity: Hubei Eco-Farming Biogas Project Phase I

The current version number of the document: Version 05

The date of the document was completed: 27/07/2008

Revision history of this document

Version	Date	Description and reason of revision
01	June 5,2007	Initial adoption
02	October 20,2007	EB Approved AMS III R on Oct 19,2007, this document was revised to reflect new approved methodology
03	March 12,2008	According to DOE recommendation, this document was revised by including detailed project location
04	April 24,2008	According to DOE recommendation, Datum in this document was revised to keep consistence with spreadsheet
05	July 27,2008	Finalized this document with editor revision

A.2. Description of the small-scale project activity:

Project Objective: The project aims to demonstrate innovative technical approaches and a credible carbon trade process for a household-based Clean Development Mechanism (CDM) biogas digester program. Through developing, building, and putting into operation biogas digesters utilizing pig manure as raw material, the project will reduce the greenhouse gas emission (GHG). In addition, the project will improve the local rural environment and household living conditions, including household health.

Description of GHG Emission Reduction: The project will install biogas digesters so that the manure would be fermented in the biogas digester instead of being stored in a deep pit, in which, the manure is stored in anaerobic condition. In each household, the project will also support improvement of a toilet, pig

pen and renovation of the kitchen, and installation of a gas burner. The biogas will be used as thermal energy to replace the fossil fuel (coal) currently used to meet the households' daily energy needs for cooking and heating. In addition, the recovery and utilization of biogas from digested slurry in a biogas digester will reduce CH_4 emission from the slurry that would otherwise have been stored in a deep pit.

As a whole, the project intends to install "one biogas digester with 3 supplementary renovations" for 33,000 households in Enshi Prefecture, a mountainous poor area of Hubei Province, China. More specifically, the project plans to install 10,082 biogas digesters with reactor size of 8 m^3; 14,181 biogas digesters with reactor size of 10 m^3; 4,167 biogas digesters with reactor size of 12 m^3; and 4,570 biogas digesters with reactor size of 15 m^3, to treat the manure produced by 155,684 pigs. It is expected that the installation will be completed by the end of September, 2008. It is anticipated that the total biogas production will be about 12.17 million m^3 per year. The estimated annual emission reduction will be 58444.04 ton CO_2 equivalent.

Project Implementation Arrangements: When selecting project households, priority would be given to poor and relatively poor households. According to the CDM project management regulation issued by the National Development and Reform Commission (NDRC) of China, only one single legal entity can apply for a CDM project. Hubei Qingjiang Zhongye Company Ltd. has applied to participate in the project and has subsequently been assessed and selected as the project entity. The 33,000 individual household will undertake the project activities including the biogas digester installation and operation under the technical guidance, supervision and monitoring provided by Hubei Qingjiang Zhongye Company Ltd. and local government rural energy agencies. The households would authorize Hubei Qingjiang Zhongye Company Ltd. to complete the application, registration and CER verification of the proposed project activities on their behalf. The project Company will closely work with local government rural energy agencies in providing technical services to households, organize and supervise project implementation, and carry out project monitoring.

The project will finance the upgrading of service system facilities, equipment and materials; technician and farming training and technical service for the operation and maintenance of the biogas digesters in village level by building up/strengthening the technical service nets/stations, which will provide the grass-root services to the farmers, ensuring the effective and sustainable operation and maintenance of the biogas systems. The training will be provided to local technician and farmers by the Hubei provincial and local experts on biogas digester construction, operation and maintenance, biogas residues use, as well as the program monitoring methodologies.

The Project Entity will channel the large portion of the carbon credit sales revenues to the individual farmer households for the purpose of loan repayment, biogas digester maintenance, and livelihood needs. The Project Entity will also use the carbon trade revenues to cover the project operation cost and technical service being provided to farmers by Hubei Qingjiang Zhongye Company Ltd. , set-up/strengthen the community-level biogas service stations/nets for provision of technical services and farmer training in

project villages; as well as to finance the project management and monitoring by contracting with Project Management Offices (PMO) established within Enshi Prefecture and project county energy bureaus.

Project Contributions to Sustainable Development: The proposed project will improve the living conditions in the rural communities in the project areas consistent with the development priorities defined by China's central and local government. The project will improve the local environment and human health demonstrating a sustainable model in solving problems related to the animal manure management, facilitating agricultural restructuring and increasing farmers' income. The project supports China's overall sustainable development strategy by:

- **Reducing greenhouse gas (GHG) emissions to combat global climate change**. The project will adopt improved management methods changing the traditional practice of manure treatment to reduce CH_4 emissions. Through developing and putting into operation of biogas digesters to recover methane for household thermal energy needs, it will also replace coal with biogas reducing CO_2 emissions;

- **Improving local environment and public health.** The project will replace traditional coal stoves and reducing coal use by installing biogas burners for household cooking and heating Indoor air pollution will be significantly reduced, thus reducing the incidence of respiratory diseases, eye ailments etc., caused by coal burning. In addition. Also, through improved manure management, the project will reduce ground and surface water contamination, reducing spreading of zoonotic diseases and odor caused by animal manure. Finally, biogas recovery will diversify the sources of the rural energy supply reducing deforestation; and

- **Increasing local incomes**. The project will reduce expenditures for household energy (coal). The project will also increase employment locally for skilled labor during installation, operation, and maintenance of biogas digesters.

A.3. Project participants:

Table A1. Project participants

Name of Party involved (*) (host) indicates a host Party)	**Private and/or public entity(ies) project participants (*) (as applicable)**	**Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)**
The People's Republic of China (host)	Hubei Qingjiang Zhongye Company Ltd.	No

State of the Netherlands, acting through the Netherlands' Ministry of Housing, Spatial Planning, and the Environment	The International Bank for Reconstruction and Development (IBRD) as trustee of Community Development Carbon Fund	Yes

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

A.4.1.1. Host Party(ies):

The People's Republic of China

A.4.1.2. Region/State/Province etc.:

Hubei Province

A.4.1.3. City/Town/Community etc:

The project area covers 625 villages in 81 townships in the 8 counties of Enshi, Lichuan, Jianshi, Badong, Xuan'en, Xianfeng, Laifeng and Hefeng counties, under Enshi Prefecture of Hubei Province in People's Republic of China.

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity:

Project activities will be carried out in eight counties including Enshi, Lichuan, Jianshi, Badong, Xuan'en, Xianfeng, Laifeng and Hefeng. These counties are located in poor mountainous areas of southwest of Hubei Province. The location of the activities is shown in Table A2, Figure A1, Figure A2 and Figure A3 and figure 1~8 in Annex 3 of this PDD.

Table A2. Location of project counties

County/City	County/City capital longitude	County/City capital latitude	County/City longitude scope	County/City latitude scope

Enshi	109°28'30"E	30°16'13"N	30°04′N - 30°39′N	109°04′E - 109°58′E
Jianshi	109°43'20"E	30°36'12"N	30°06′N -30°54′N	109°32′E - 110°12′E
Badong	110°20'42"E	31°02'38"N	30°13′N - 31°28′N	110°04′E - 110°32′E
Lichuan	108°55'54"E	30°17'53"N	29°42′N - 30°39′N	108°21′E - 109°18′E
Xuan'en	109°28'47"E	29°59'36"N	29°33′N - 30°12′N	109°11′E - 109°55′E
Xianfeng	109°09'07"E	29°41'47"N	29°19′N - 30°3′N	108°38' E - 109°20′E
Laifeng	109°24'10"E	29°30'35"N	29°06′N - 29°40′N	109°00′E - 109°27′E
Hefeng	110°00'56"E	29°53'16"N	29°38′N - 30°14′N	109°45′E - 110°38′E

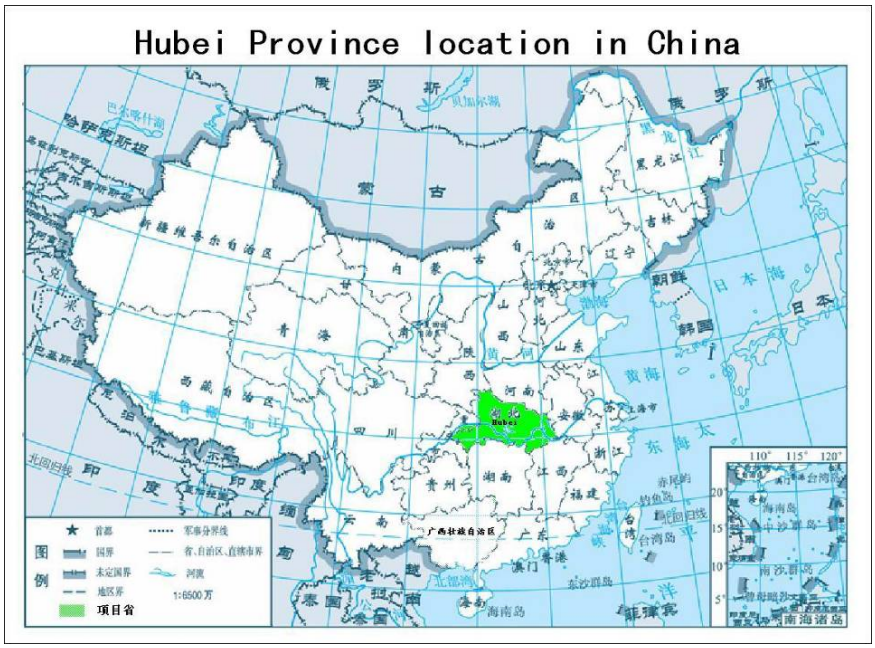


Figure A1. Hubei location in China

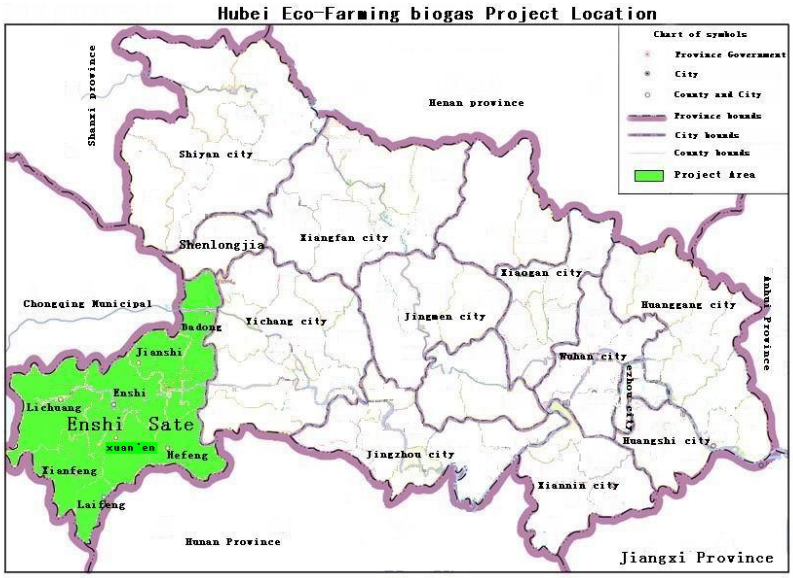


Figure A2. Enshi location in Hubei Province

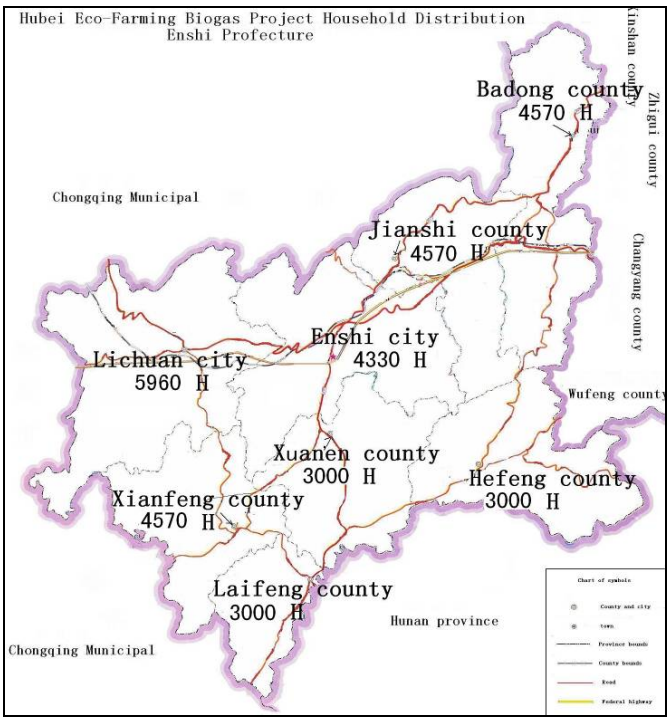


Figure A3. Activity location and biogas numbers in each county

Biogas digesters with reactor volume of 8 m^3, 10 m^3, 12 m^3 and 15 m^3 will be installed in the aforementioned project areas and are listed in table A3.

Table A3. Township numbers and expected numbers of biogas digester to be installed in 2007-2008

County/City	No. of township in each county	No. of Villages in each county	No. of biogas installations 2007-2008	No. of biogas digesters per digester volume			
				$8m^3$	$10m^3$	$12m^3$	$15m^3$
Enshi	15	47	4,330	1,918	2,412		
Jianshi	10	81	4,570	540	4,030		
Badong	12	75	4,570	1,581	2,989		
Lichuan	14	122	5,960	3,043	2,917		
Xuan'en	9	91	3,000		1,833	1,167	
Xianfeng	10	17	4,570				4,570
Laifeng	8	119	3,000	3,000			
Hefeng	3	73	3,000			3,000	
Total	81	625	33,000	10,082	14,181	4,167	4,570

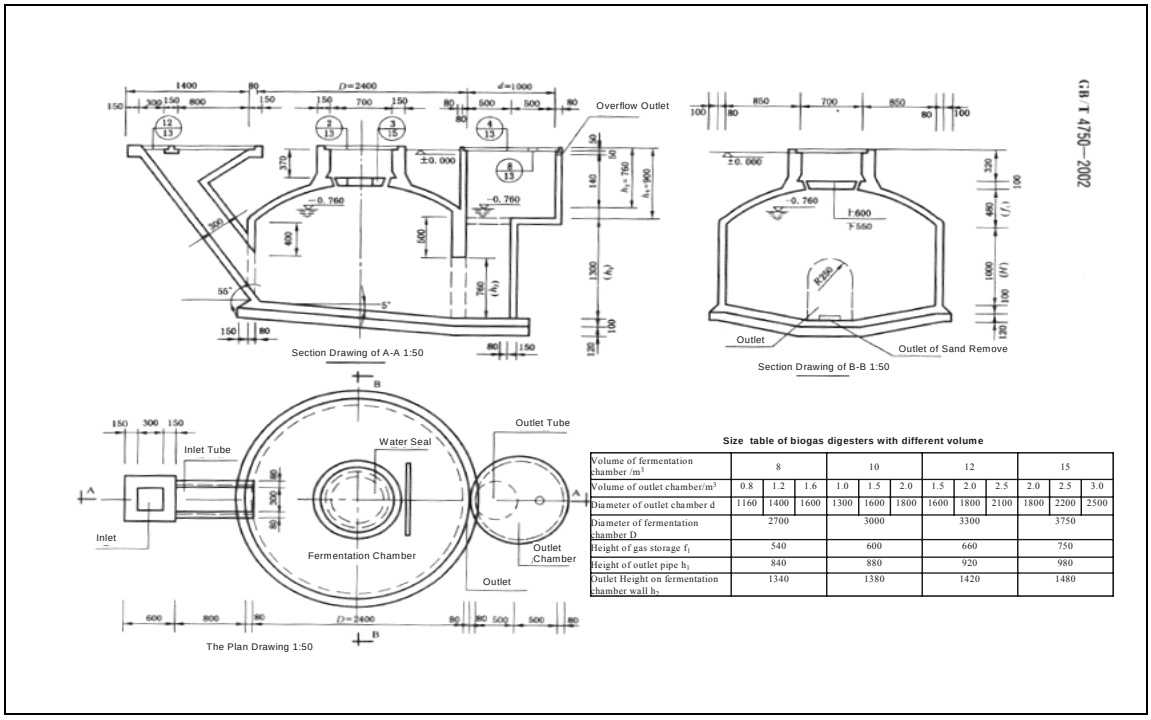
A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

Type of the project activity: The project activity described in this document is classified as a Type I.C (version 12) - Thermal energy for the user with or without electricity, Type III.R (version 1) - Methane recovery in agricultural activities at household/small farm level,

Technology of the project activity: The technology to be employed includes installation of 33,000 household-based biogas digesters to provide biogas for replacing fossil fuel thermal energy needs of households raising around 4-6 pigs. The project activity will comprise of two stages as follows:

Stage 1: Biogas production and Collection: The biogas digesters design will be based on the technical standards established by the Chinese government. The preferred and recommended sample design is displayed in Figure A4 but minor modifications are acceptable. The design and construction of the digesters is certified by a technician accredited by the Ministry of Agriculture. The digester is installed below the pig pen (Figure A5). The digester will ferment excreta from pigs that are housed in the pens

above the digester. To facilitate the supply of excreta, the inlet of biogas digester will be directly connected to the pigpen so that the dung can directly drain to the digester. In addition, a toilet will be installed in each household next to the pig pen so that human excreta are also treated in the digester. The retention time of slurry inside the biogas digesters is around 3-6 months.



Size table of biogas digesters with different volume

Volume of fermentation chamber /m³	8			10			12			15		
Volume of outlet chamber/m³	0.8	1.2	1.6	1.0	1.5	2.0	1.5	2.0	2.5	2.0	2.5	3.0
Diameter of outlet chamber d	1160	1400	1600	1300	1600	1800	1600	1800	2100	1800	2200	2500
Diameter of fermentation chamber D	2700			3000			3300			3750		
Height of gas storage f_1	540			600			660			750		
Height of outlet pipe h_1	840			880			920			980		
Outlet Height on fermentation chamber wall h_2	1340			1380			1420			1480		

Source: Ministry of Agriculture

Figure A4. Technical Design of Biogas Digesters

The biogas digester is composed of six parts: fermentation chamber, gas storage, inlet tube, outlet chamber, removable or sealed cover, and a gas pipe line (see in Figure A5).

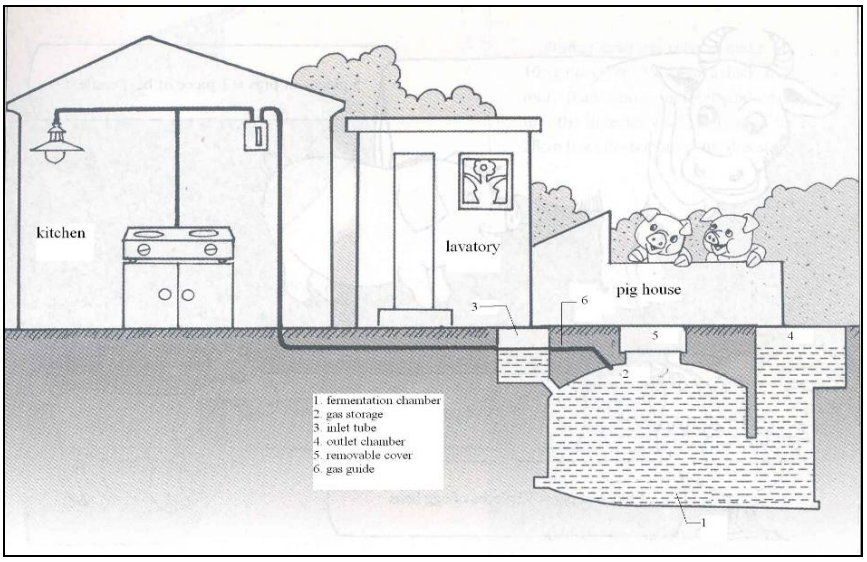


Figure A5. Schematic of "Three in One" combination of Household Biogas Digesters

The mechanics of biogas generation can be described as follows:

- The captured gas is stored in the upper part of the digester tank (gas storage area) which is constructed as an arc ship. Generation of biogas will gradually increase the pressure in the stored area. When the volume of the captured gas is larger than the amount consumed, the pressure in the gas storage will increase and slurry will be pushed into the outlet chamber. If the gas consumed exceed gas availability, the slurry level drops and the fermented slurry flows back into fermentation chamber;
- The placement of the digester tank (underground fermentation) keeps the temperature in the tank relatively stable ensuring that the slurry can be fermented at adequate temperatures throughout the year without requiring additional heating;
- The bottom of the digester inclines from the material-feeding inlet to the material-outlet, allowing free flow of the slurry;
- The digester has been designed to allow the effluent to be removed without breaking the gas seal, taking the effluent liquid out through the outlet chamber.

Stage 2: Biogas Combustion Replacing Coal Burning for Thermal Energy. The captured biogas will be routed to a biogas burner stove. A pressure indication device is installed to ensure proper control of gas flow at the flare, by the user. A sulfide capture device is also installed to clean the gas before burning.

Special maintenance procedures have been developed to ensure proper operation of the biogas system and proper utilization of digested slurry throughout the lifetime of the digester. This includes cleaning the sulfide capture device and periodic controls and replacements of burners.

In addition, the project will strengthen the capacity of local biogas service and technical extension systems, and improve village level services for biogas operation and maintenance. This includes guidance on biogas installation, supervision of biogas digester and stove operation, provision of training and technical services to local farmers, provision of relevant facilities maintenance, and implementation of a project Monitoring Plan. By working with the farmers on a day to day basis for many years, the project developer will ensure that the farmers will acquire appropriate expertise to operate the systems on a sustainable basis.

All technologies utilized in the project activity are domestic technologies and there will be no international technology transfer involved in this project.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

This project applies for a fixed crediting period of 10 years. The estimated amount of emission reductions over 10 years will be 584440.4 t CO_2 equivalents.

Table A4. Estimated amount of emission reductions over the 10 year crediting period

Years	**Estimated annual emission reduction of CO_2 e(ton)**
15/11/2008-31/12/2008	7305.51
2009	58444.04
2010	58444.04
2011	58444.04
2012	58444.04
2013	58444.04
2014	58444.04
2015	58444.04
2016	58444.04
2017	58444.04
01/01/2018-14/11/2018	51138.54
Total estimated reductions (tonnes of CO_2e)	584440.4
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO2e)	58444.04

A.4.4. Public funding for the small-scale project activity:

No public funding from Annex 1 countries is provided for the proposed project. World Bank support is in the form of a loan to the Government of China.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

According to the "debundling" rules specified in Appendix C of the simplified M&P for small-scale CDM project activities, a small-scale project is a debundled component of a large project if there is a registered small-scale activity or an application to register another small-scale activity:

- With the same participants;
- In the same project category and technology/measure;
- Registered within the previous 2 years; and
- Whole boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

This proposed project is the first CDM project of Qingjiang Zhongye Company, and there are no other similar projects in the project region. Therefore, the Hubei Eco-Farming Biogas Project is not a debundled component of any larger scale project activity.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:

Approved methodologies Version 12 of AMS-I.C titled "Thermal energy for the user with or without electricity" and Version 01 of AMS-III.R titled "Methane recovery in agricultural activities at household/small farm level" were applied.

Those baseline methodologies can be downloaded from the CDM website: http://cdm.unfccc.int /methodologies/PAmethodologies/approved.html.

B.2. Justification of the choice of the project category:

Category I.C - Version12. Thermal energy for the user with or without electricity is defined as follows:

- This category comprises renewable energy technologies that supply individual households or users with thermal energy that displaces fossil fuels.
- Where thermal generation capacity is specified by the manufacturer, it shall be less than 45MW.

The proposed CDM project activity will change the existing manure management system at the household level from deep pits to household biogas digesters. The biogas digesters provide biogas for cooking and other heating needs for households, replacing coal. Each project household has around 4-6 pigs.

The thermal energy production capacity for the bundled project would be about 42.2 MW_{th} which is less than 45MW. Therefore, this proposed CDM project qualifies under categories I.C, Thermal energy for the user with or without electricity".

Category III.R-Version 1. ***Methane recovery in agricultural activities at household/small farm level*** is defined as follows:

1. This project category comprises recovery and destruction of methane from manure and wastes from agricultural activities that would be decaying anaerobically emitting methane to the atmosphere in the absence of the project activity. Methane emissions are prevented by:

(a) Installing methane recovery and combustion system to an existing source of methane emissions, or

(b) Changing the management practice of a biogenic waste or raw material in order to achieve the controlled anaerobic digestion equipped with methane recovery and combustion system.

2. The category is limited to measures at individual households or small farms (e.g. installation of a domestic biogas digester). Methane recovery systems that achieve an annual emission reduction of less than or equal to 5 tones of CO_2e per system are included in this category.

3. This project category is only applicable in combination with AMS I.C.

4. The project activity shall satisfy the following conditions:

(a) The sludge must be handled aerobically. In case of soil application of the final sludge, the proper conditions and procedures that there are no methane emissions must be ensured.

(b) Measures shall be used (e.g. combusted or burnt in a biogas burner for cooking needs) to ensure that all the methane collected by the recovery system is destroyed.

5. Aggregated annual emission reductions of all systems included shall be less than or equal to 60 kt CO_2 equivalent.

This proposed project is to change swine manure management from deep pit storage to anaerobically digest in biogas digesters, recover methane produced by digester and use biogas for cooking and heating water for individual households. An annual emission reduction by each household biogas digester is less than 5 tones of CO_2e per biogas digester. Aggregated annual emission reductions of all systems included will be less than or equal to 60 kt CO_2 equivalent. The biogas residue will be used as high quality fertilizer for vegetable and crops under aerobic condition. Therefore, this proposed CDM project qualifies under categories III.R, Methane recovery in agricultural activities at household/small farm level"

B.3. Description of the project boundary:

The proposed CDM project will adopt biogas digesters to treat pig manure anaerobically. The produced biogas will be recovered and used for cooking meals and heating water for household members and livestock - replacing coal, firewood and crop straw. Only CO_2 emission from coal burning is included in calculating the project GHG emission reduction. Emission sources and gases included in the project boundary are listed in Table B1.

Table B1. Emission sources and gases included within the project boundary

	Sources	**Gas**	**Included/ Excluded**	**Justification /Explanation**
Baseline	*Emissions from manure*	CH_4	Included	Major source of emission in the baseline.
		N_2O	Excluded	Excluded for simplification. This is conservative.
		CO_2	Excluded	CO_2 emissions from the decomposition of organic waste are not included.
	Emissions from burning of coal	CO_2	Included	Major source of emissions in the baseline.
		N_2O	Excluded	Based on the survey, the coal consumption under baseline condition is higher than that in project condition. Therefore, N_2O emissions from burning of coal are not included. It is conservative not to consider N_2O.
		CH_4	Excluded	Based on the survey, the coal consumption under baseline condition is higher than in project condition. Therefore, CH4 emission from burning of coal in the baseline scenario is higher than that in project condition. It is conservative not to consider CH4 emission from burning of coal.
	Emissions from burning of biomass (firewood and crop	CO_2	Excluded	Based on the survey, firewood and straw consumption under baseline condition is higher than that in project condition. Therefore, CO_2

	Sources	Gas	Included/ Excluded	Justification /Explanation
	straw)			emission from burning of firewood and straw is not included. This is conservative.
		N_2O	Excluded	Based on the survey, firewood and straw consumption under baseline condition is higher than that in project condition. Therefore, N_2O emission from burning of firewood and straw is not included. This is conservative.
		CH_4	Excluded	Based on the survey, firewood and straw consumption under baseline condition is higher than that in project condition. Therefore, CH_4 emission from burning of firewood and straw is not included. This is conservative.
Project Activity	Emissions from biogas digester	CH_4	Included	Leakage from biogas digester is major emission source under project activity according to AMS III.R
		N_2O	Excluded	No N_2O formed in biogas digester
		CO_2	Excluded	CO_2 emissions from the decomposition of organic waste are not included.
	Emissions from burning of coal	CO_2	Included	Major source of emissions in the baseline
		N_2O	Excluded	Based on the survey, the coal consumption under baseline condition is higher than that in project condition. Therefore, N_2O emission from burning of coal is not included. This is conservative.
		CH_4	Excluded	Based on the survey data, the coal consumption under baseline condition is higher than that in project condition. Therefore, CH_4 emission from burning of coal is higher than in project condition. It is conservative not to consider CH_4 emission from burning of coal.
	Emissions from burning of biomass (firewood and crop straw)	CO_2	Excluded	Based on the survey, firewood and straw consumption under baseline condition is higher than that in project condition. Therefore, CO_2 emission from burning of firewood and straw is not included. This is conservative.
		N_2O	Excluded	Based on the survey, firewood and straw consumption under baseline condition is higher than that in project condition. Therefore, N_2O emission from burning of firewood and straw is not included. This is conservative.
		CH_4	Excluded	Based on the survey, firewood and straw consumption under baseline condition is higher than that in project condition. Therefore, CH_4 emission from burning of firewood and straw is not included. This is conservative.

B.4. Description of baseline and its development:

As described under section B.3, the GHG emissions under the baseline condition comprise two sources: (a) CH_4 emission from manure management; and (b) CO_2 emission from combustion of coal.

According to version 12 of AMS I.C. for biogas digesters with biogas recovered and gas burners that displace traditional stove using fossil fuels, the simplified baseline is the coal consumption, in the absence of the project activity. Baseline emission (BEy) is the coal consumption that would have been used in the absence of the project activity times an emission coefficient for replaced coal.

According to version 1 of AMS III.R, the baseline scenario is the situation where, in the absence of the project activity, swine manure is left to decay anaerobically within the project boundary and methane is emitted to the atmosphere. Baseline emissions (BEy) are calculated ex ante using the amount of swine manure that would decay anaerobically in the absence of the project activity, with the most recent IPCC tier 2 approach (please refer to the chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and other Land use' of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories). Because there are no country/regional-specific values, IPCC default values will be applied in this project.

B.5. Description of how the anthropogenic emissions of GHG by source are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

In order to explore the financing source and build up the incentive to farmer establishing biogas digester, the Project participant decided to prepare and undertake household biogas digester CDM project according to the project company board meeting agreements reached on October 16, 2006. After the project preparation, the project activity began from April 1of 2007. It is also indicate the early consideration of the CDM project.

According to the Attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities, Project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

(a) Investment barrier: a financially more viable alternative to the project activity would have led to higher emissions;

(b) Technological barrier: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;

(c) Barrier due to prevailing practice: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;

(d) Other barriers: without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher.

As the proposed household-based biogas digester will be installed for the household's self-use with no products what can be sold in the market to generate revenues, it is considered as a "non-productive" investment. Therefore, the Investment Analysis Approach is not suitable for the project additionality analysis. Instead, the Barrier Argument will be used for the analysis.

The project is facing several barriers that would prevent implementation of the project activities: (1) investment barrier; (2) technical barrier; and (3) barriers due to the prevailing practice.

1. Investment Barrier

According to the project design, a total of 33,000 biogas digesters will be installed by individual households in the project areas. The total project investment cost, including the biogas digester installation, operation and maintenance cost, is US$16.99million, of which, a World Bank loan will cover US$4.34 million, accounting for about 25.55 percent of the total investment; Government counterpart funding will cover US$2.43 million, about 14.28 percent of total investment and the participating farmers' are required to contribute US$10.22 million, accounting for 60.17 percent of the total investment.

Each biogas digester cost ranges from RMB3,085 (about US$ 406) to RMB3,970 (about US$ 576) depending on the digester size (see table B2). For the upfront installation cost, the World Bank loan and government counterpart funding will cover RMB1000 per biogas digester. About RMB 2,085 to RMB 2,970 out of the unit cost of each biogas digester installation, need to be mobilized by the participating household. In addition, the household will continue to pay the biogas digester maintenance cost during the lifetime of the project activities.

The project counties are located in remote areas and are all nationally designated poverty counties with a large portion of poor households. Despite the grant from local government, the farmers need to mobilize more than 60 % of own funding in order to be able to complete the biogas digester construction and related investments, and cover the biogas digester maintenance. Farmers' expected contribution presents a significant financing gap. For many households, the required counterpart funding is too much to allow them to participate in the project. According to the household consultations, most households expressed serious concern in this regard.

The project baseline survey indicated that the average household cash income of the proposed project households is around RMB 5,015 (about US$ 660), which is lower than the average household cash

income of RMB 6726 (about US$885) for those who have already built biogas digesters in the project counties, which reflects the relatively poorer income situation of the proposed project households and the additional financing needs to enable the households to install and operate the biogas digesters.

According to the project technical design, the initial investment for installing one biogas digester plus three innovations with different digester volumes of $8m^3$, $10m^3$, $12m^3$, and $15m^3$ will be RMB3,085, RMB3,410, RMB3,620, RMB3,970 respectively. See Table B2 for details.

Based on statistics from the China Agricultural Survey Institute (CASI) of the State Statistical Bureau, an investment capacity assessment was carried out. It is clear that households in the project counties have low disposable income and weak financial capacity for mobilizing the necessary funds to participate in the proposed project activities. The CASI survey shows that expenditures for agricultural production account for about 18.5 percent. Household daily consumption expenditures account for about 55.4 percent. These two items account for about 74 percent of a household's total expenditures. After that, other expenditures have to be covered such as children's education, medical expenses, housing renovation, consumer durables, etc, There is little if any left for other activities. Nearly 80 percent of the households in the project areas had a net cash flow of less than RMB1,750 in 2006. If the individual household would need to contribute RMB1,750 from their annual household income to the biogas installation, about 80 percent of the households in the project areas would have financing gap for covering their living expenses. Even if the households' cumulative net cash flow is used as an indicator for their financial capacity, more than 50 percent of the households in the project areas will have a cumulative net cash flow below RMB1,750 and consequently having difficulties to participate in the project.

According to table B2, the investment of RMB 2,085 to RMB 2,970 need to be mobilized by the participating households, which are more than RMB1,750, indicates that the project households are facing even more financing gaps to the biogas installation and difficulties to participate in the project.

Table B2. Cost of biogas systems (RMB)

Size of biogas digesters	$8m^3$	$10m^3$	$12m^3$	$15m^3$
Average cost	3,085	3,410	3,620	3,970
World Bank loan and government counterpart funds	1,000	1,000	1,000	1,000
Farmer Contribution	2,085	2,410	2,620	2,970

The investment barrier analysis report also showed that most of the rural households (over 86 percent), especially middle and low income households have difficulties in accessing financing from local commercial banks, rural credit cooperatives and other financial institutions. Furthermore, currently, the local financial sector does not have loan products suitable for "non-productive" investments. The biogas digesters will be installed for the households self-use with no products to be sold on the market generating revenues, the economic benefit of the biogas digester is reflected as savings in fuel expenditures (reduction of cash outflow) instead of income generation (cash inflow).

However, if this project will be registered as a CDM project, the transaction of Carbon Credit for a substantial time period would be a stable source of revenue. The participating households could use it as guarantee to improve their chances to borrow from the local financial market. This incentive from carbon revenue would enable the poor and the relatively poor households to mobilize the required funding to invest in the biogas digester construction. The project management office has held discussions with the local Rural Credit Cooperatives, which are the only officially-licensed intermediary financial institution to provide loans to rural individual households, and developed a loan guarantee mechanism by using the expected carbon income from the CDM project for loan repayment.

In addition, as each household biogas digester has a lifetime of 20 years, it is recognized that regular operation and maintenance needs to be carried out in order to ensure that the biogas digester systems are functioning to their design capacity over the long lifetime. Currently, there is a funding gap in financing these activities and facilities. Under the proposed project, about 12 percent of the carbon revenues would be used to finance relevant technical service systems and training programs to households.

2. Technical Barrier

The project villages are located in the remote areas, the farmers in the project areas lack to a large extent ready access to improved technologies and management methods. According to current practice, even a large proportion of the existing biogas systems are not functioning or are not functioning properly. The performance of the digesters is unstable, with varying levels of gas production. This is due to the lack of experience among the individual households, limited resources for biogas service support in most counties, and insufficient farmer training.

Expertise is required to ensure that the digesters function properly. For optimal biogas production, a certain environment needs to be created for the bacteria producing the methane through decomposing organic matter. In order to obtain proper bio-gas fermentation and an adequate gas yield, it is necessary that the basic conditions required by the methane bacteria are met. Such conditions include strict anaerobic environment, sufficient and suitable raw materials for fermentation, appropriate dry matter concentration, appropriate fermentation temperature etc.

The maintenance and management of biogas digesters require adequate support services and trained staff, which is not available to the project households without the project. Also, the biogas digester

systems in the proposed project are designed as an integrated technology package consisting of animal husbandry, biogas digester installation and digester maintenance requiring particular support and training. The project would provide new technologies and best practices in manure management and biogas digester construction and maintenance to the local communities. Also, the project would strengthen the biogas service support systems and improve training to farmer technicians and farmers.

Without the CDM revenues from the proposed project activity, the local communities and individual households are unlikely to obtain the competence and capacity to maintain and manage the biogas digester appropriately. Furthermore, without the project the institutional capacity at the village-level technical centres would remain sub-standard. Finally, no monitoring of the system operation including a variety of parameters for GHG emission reduction would take place without the CDM revenues.

3. Barrier from Prevailing Practice

For an individual farmer, the current practice of deep-pit treatment method is by far considered the most attractive option for manure treatment given that it requires very limited additional investment and labor input. For cooking, the cost of the traditional cooking stove fueled by a mix of coal, firewood, and crop straw is much less (cost of a traditional stove is about RMB10-20) than the installation cost of a biogas digester and a gas stove and it is easy to use and maintain. By contrast, the total investment cost of biogas digester ranges from RMB3,085 to RMB 3,970.

Though biogas system can provide clean biogas energy, prevent deforestation from burning of fuel wood; improve the local environment by reducing air pollution from cooking; and improve sanitation by avoiding disposal of aerobically treated manure. At this point there is no regulation in China that requires change of the current manure management system and cooking methods for households. The perceived practice for manure management and cooking is cheap and reliable. It is unlikely that the households will switch to a biogas digester and a gas stove requiring high upfront investment, regular maintenance cost, and special training to operate without clear incentives, including financial support.

According to the information from Hubei Province Rural Energy Office, to demonstrate the applicability of biogas digesters in different area and improve the rural environment, Hubei Province Government began to encourage rural families to install biogas digesters since 1970's, however, the number of biogas installation has been increased very slowly because of the high investment of biogas digester and lack of access to finance resource. With the limited financing support from the government to demonstrate the new initiation and best practice through national biogas program, around 1.38 million digesters (about 13.8% of rural families) in Hubei Province, which are spread to broad areas, have been installed by the end of 2006, and those households that have been selected to demonstrate the biogas digesters installation are relatively rich families , which could provide requested adequate counterpart

funding.[1] Now the families without biogas digesters are facing even more difficulty in mobilizing the counterpart funding because the biogas installation cost has been increased from RMB 2,841 Yuan in 2003 to RMB 4,445 yuan in 2007 in average due to the rapidly increased raw material and labor price in recent years. [2]

To help the poor rural household have an opportunity to use clean energy and improve their living conditions, the external funding and investment need to be mobilized. The CDM project revenue would provide incentive to attract counterpart funding and broaden the loan access from local banks to the households by developing a loan guarantee mechanism through using the expected carbon income from the CDM project for loan repayment. This would create equal opportunity for the poor farmers to have biogas digester installed to access new clean energy and improve their household sanitation conditions.

4. Other Barriers

The participating households are poor and located in the mountain rural area, they also face a series of other barriers that prevent them from switching traditional high GHG emission practice to installing and using biogas digesters with low GHG emission. The other barriers include lack of awareness of changing the traditional farming and living habit and limited information, which obstruct the households absorbing new technologies and accept new innovation. However, for this proposed CDM project, other barriers are not identified as the main factors that prohibit the biogas technology application with training program and technical services arranged under the project.

In conclusion, the barrier analysis demonstrates that the most plausible baseline scenario in the absence of the proposed project activity is that the poor cash-strapped households under the proposed project activity would continue the prevailing practice of deep-pit manure treatment method and continue using coal, firewood, and crop straw for cooking and heating. The most significant barriers the project activity faces are the financing difficulty of the individual households due to the high upfront investment cost and lack of access to commercial financing; barrier due to prevailing practice; and the inadequate technical services and training to the local farmers on effective manure management and biogas digester operation.

B.6. Emission reductions:

[1] Communication with Hubei Province Rural Energy Office, December 28, 2007

[2] Comparison of the biodigester installation cost of year 2003 and that of year 2007, March 2008

B.6.1. Explanation of methodological choices:

1. Baseline emission

(1) CH_4 emission from manure management

Four steps have been applied to determine CH_4 emissions from manure management:

- Step 1: Identification of baseline emission sources;
- Step 2: Identification of emission factor for methane emission from manure management;
- Step 3: Survey of swine population;
- Step 4: Calculation of baseline CH_4 emission from manure management for each household.

Step 1: Identification of baseline emission sources

Baseline emission sources for manure management have been identified previously in Table B1.

Step 2: Identification of emission factor for methane emission from manure management

Swine manure is stored in deep pits for 3-6 months before land application. Annual average temperature ranges from 13.2 to 17.6℃ in the project counties (see Annex 3). According to IPCC Tier 2 approach, formula (1) is applied to calculate methane emission factor for deep pit manure management system. Default IPCC values for Bo and VS will be applied because no national specific values.

$$EF_i = (VS \times 365) \times [Bo \times 0.67 kg/m^3 \times \sum_j \frac{MCF_{ij}}{100} \times MS_{ij}\%] \quad (1)$$

Where,

EF_i	Annual CH_4 emission factor for swine in county i, kg CH_4 $swine^{-1}yr^{-1}$
VS	Daily volatile solid excreted for swine , kg dry matter $swine^{-1}day^{-1}$, as per 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, and Chapter 10
365	Basis for calculating annual VS production, days yr^{-1}
Bo	Maximum methane producing capacity for manure produced by swine, m^3 CH_4 kg^{-1} of VS excreted, as per 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, and Chapter 10

0.67	Conversion factor of m^3 CH_4 to kilograms CH_4, kg/m^3
MCF_{ij}	Methane conversion factor for deep pit manure management system under Enshi climate, %, from IPCC 2006Guidelines Table 10A-7, chapter 10, volume 4.
MS_{ij}	Fraction of swine manure handled using manure management system j. In this project, 100 percent of manure is stored in deep pit.
i	County
j	Manure manage system j

Step 3: Survey of swine population

In order to obtain information on the swine population raised by households, an extensive household survey for 2,485 biogas users and 2,530 households without biogas digester was conducted. Table B3 presents the average swine population of the households which have built biogas digesters. Table B4 presents the average swine population for households without biogas digesters. There is no much difference in average swine population between the two groups.

Table B3. Average swine population after the installation of biogas digesters (head/household)

County	**Enshi**	**Jianshi**	**Badong**	**Lichuan**	**Xuan'en**	**Xianfeng**	**Laifeng**	**Hefeng**
8 m^3	4.3	4.1	4.4	4.4			4.3	
10 m^3	4.7	4.3	4.8	4.6	4.6			
12 m^3					5.1			4.8
15 m^3						5.9		

Table B4. Average swine population in households without biogas digesters (head/household)

County	**Enshi**	**Jianshi**	**Badong**	**Lichuan**	**Xuan'en**	**Xianfeng**	**Laifeng**	**Hefeng**
Swine population	4.7	4.3	4.6	4.4	5.0	5.6	4.2	4.6

Step 4：Calculation of baseline CH_4 emission from manure management for each household

Baseline CH_4 emission can be calculated based on equation (2):

$$BE_{CH4,i,k} = GWP_{CH4} \times \frac{1}{1000} \times LN_{i,k} \times EF_i \quad (2)$$

Where,

$BE_{CH4,i,k}$: Baseline CH_4 emission from deep pit manure management system for digester volume k, in County i, t CO_2 e yr^{-1}

GWP_{CH4} Global Warming Potential (GWP) of CH_4.

$LN_{i,k}$ Average swine population for household before the installation of biogas digester with different volume k, in County i.

EF_i CH_4 emission factor for deep pit swine manure management in county i, kg CH_4 $swine^{-1}yr^{-1}$

k Type of biogas digester volume

(2) Baseline CO_2 emission from coal consumption

Four steps will be applied to determine CO_2 emission in baseline:

- Step 1: Identification of baseline emission sources;
- Step 2: Identification of emission factors;
- Step 3: Survey and calculation of coal consumption before biogas digester construction;
- Step 4: Calculation of baseline CO_2 emission from coal consumption.

Step 1: Identification of baseline emission sources

Baseline CO_2 emission sources have been identified as listed in Table B1.

Step 2: Identification of emission factor of coal combustion

According to the baseline methodology for small-scale CDM project activity categories I.C titled "Thermal energy for the user with or without electricity" for renewable energy technologies that displace technologies using fossil fuels, the simplified baseline is the fuel consumption of the technologies that would have been used in the absence of the project activity times an emission coefficient for the displaced fossil fuel. In this project, national specific emission factor provided by National Development and Reform Committee (NDRC) will be adopted (www.ccchina.gov.cn). The emission factor for raw coal is 25.8 tC/TJ. Net Calorific Value (kJ/kg) of raw coal is 20908 kJ/kg. Fraction oxidized is 1. $EF_{Rawcoal}$ =25.8 ×20908×1×44/12/10^6=1.98 t CO_2/t coal.

Step 3: Survey and calculation of coal consumption before biogas digester construction

In order to obtain information on consumption of raw coal, survey on energy consumption before biogas construction for same group of households (2,485 households) was carried out. The information has been used to assess change in the households' behavior in relation to consumption of fossil fuels, fuel wood, and crop straw resulting from introduction of biogas digesters. Because fuel wood and straw are a renewable energy, the CO_2 emissions from burning of fuel wood and crop straw are not included in the overall GHG reductions, as described in Table B1.

The project households are physically distributed over a large area having different access to natural resources, such as coal and fuel wood. Coal consumption has been surveyed in all CDM project counties/cities. Table B5 and Table B6 show coal consumption for households before building biogas digesters and coal consumption for households without biogas digester in the project counties. There is no much difference in average coal consumption between the two groups. In order to calculate the coal displacement by different volume of digesters, the data on coal consumption for households before building a biogas digester was applied.

Table B5. Average coal consumption of the household before installation of biogas digesters (kg/household/year)

County	**Enshi**	**Jianshi**	**Badong**	**Lichuan**	**Xuan'en**	**Xianfeng**	**Laifeng**	**Hefeng**
8 m^3	1,416	1,460	1,387	1,453			1,296	
10 m^3	1,442	1,498	1,337	1,492	1,457			
12 m^3					1,504			1,675
15 m^3						1,589		

Table B6. Average coal consumption of the households without biogas digesters (kg/household/year)

County	**Enshi**	**Jianshi**	**Badong**	**Lichuan**	**Xuan'en**	**Xianfeng**	**Laifeng**	**Hefeng**
Average coal consumption	1423	1483	1415	1624	1495	1481	1353	1658

Step 4：Calculation of baseline CO_2 emission from coal consumption

Baseline CO_2 emission per household can be calculated based on equation (3):

$$BE_{CO2,i,k} = BG_{Coal,i,k} \times EF_{Rawcoal} \quad (3)$$

Where,

$BE_{CO2,i,k}$: Baseline CO_2 emission from coal combustion for household before the installation of digester with volume k, in county i, t CO_2 e yr^{-1} for each household

$BG_{Coal,i,k}$: Average annual coal consumption for household before the installation of digester with volume k, in county i, t coal of each household

$EF_{Rawcoal}$: Emission factor of raw coal, t CO_2e/t coal

(3) Total baseline GHG emission calculation per household

GHG emission for each household under the baseline scenario can be calculated based on equation (4)

$$BE_{y,i,k} = BE_{CH4,i,k} + BE_{CO2,i,k} \quad (4)$$

Where,

$BE_{y,i,k}$ Baseline GHG emission for household before the installation of digester with volume k, in county I, t CO_2 e yr^{-1} for each household

(4) Total bundled baseline GHG emission

Total bundled baseline GHG emission can be calculated based on equation (5)

$$BE_y = \sum_i (\sum_{k=1} (ND_{i,k} * BE_{y,i,k})) \quad (5)$$

BE_y Total bundled baseline GHG emission, t CO_2e/year

$ND_{i,k}$ Numbers of digester with volume k, in county i

2. Project Emission

Project emissions consist of CO_2 emissions from coal combustion and the physical leakages of methane from anaerobic digester.

(1) CH_4 emission from physical leakages of anaerobic digester

According to AMS III.R. The leakage from anaerobic digester is calculated using equation (6):

$$PE_{ly} = LF_{AD}\left[GWP_{CH4} \times D_{CH4} \times B_O \times VS_{m,y}\right]/1000 \quad \textbf{(6)}$$

Where,

PE_{ly} Project emissions from physical leakages in the biogas digesters in year y, t CO_2e

LF_{AD} Methane leakages from Anaerobic digesters, Default value of 0.10 can be taken according to Table 10A-8 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, and Chapter 10.

GWP_{CH4} Global Warming Potential of CH_4

B_O Maximum methane producing potential of the swine manure treated in the biogas digesters as per 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, and Chapter 10 (m^3 CH_4 per kg of dm by animal type).

D_{CH4} Conversion factor of m^3 CH_4 to kilograms CH_4 (0.67 kg/m^3, as per 2006 IPCC guideline, See Volume 4, Chapter 10, Page 10.42).

VS Annual amount of volatile solid treated in the biogas digesters on a dry matter weight basis as per 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, and Chapter 10 (kg of dm per year).

(2) Project CO_2 emission from coal combustion

Same as the procedures in baseline condition, four steps was applied to determine CO_2 emission under project activity:

- Step 1: Identification of project activity emission sources;
- Step 2: Identification of emission factors;
- Step 3: Survey and calculation of coal consumption after biogas digester construction;
- Step 4: Calculation of project CO_2 emission from coal consumption.

Step 1: Identification of project emission sources

Identified CO_2 emission sources under project activity are listed in Table B1.

Step 2: Identification of emission factor of coal combustion

Emission factor calculation is as same as for baseline condition.

Step 3: Survey and calculation of coal consumption after biogas digester construction

Same as for the baseline condition, an extensive household survey for same group of households (2,485 biogas users) was carried out to obtain the information on consumption of raw coal. Coal consumption for each household after they have built biogas digesters in the project counties is described in Table B7.

Table B7. Average coal consumption after the installation of biogas digesters (kg/household/year)

County	Enshi	Jianshi	Badong	Lichuan	Xuan'en	Xianfeng	Laifeng	Hefeng
8 m^3	809	827	728	843			610	
10 m^3	710	785	614	771	770			
12 m^3					740			926
15 m^3						811		

Step 4：Calculation of project CO_2 emission from coal consumption

Project CO_2 emissions from coal combustion can be calculated based on equation (7):

$$PE_{CO2,i,k} = PG_{Coal,i,k} \times EF_{Rawcoal} \quad (7)$$

Where,

$PE_{CO2,i,k}$ Project CO_2 emission from coal combustion of the household after installation of digester with volume k, in county i, t CO_2 e yr^{-1} for each household

$PG_{coal,i,k}$ Average annual coal consumption of the household after installation of digester with volume k, in county i, t coal of each household

$EF_{Rawcoal}$: Emission factor of raw coal, t CO_2/t coal

(3) Project GHG emission calculation for each household

GHG emission for each household under the project activity can be calculated based on equation (8)

$$PE_{y,i,k} = PE_{CO2,i,k} + PE_{ly} \quad (8)$$

Where,

$PE_{y,i,k}$ Annual project GHG emission of the household after the installation of digester with volume k, in county i, t CO_2 e yr^{-1} for each household

(4) Total bundled project GHG emission

Total bundled GHG emission can be calculated based on equation (9)

$$PE_y = \sum_i (\sum_{k=1} (ND_{i,k} * PE_{y,i,k})) \quad (9)$$

PE_y Total bundled project GHG emission, t CO_2 e/year

$ND_{i,k}$ Numbers of digesters with volume k, in county i

3. Leakage

For methodology AMS I.C (Version 12) titled "Thermal energy for the user with or without electricity," if the energy generating equipment is transferred from another activity or if the existing equipment is transferred to another activity, leakage is to be considered. For methodology AMS III.R (version 1) titled "Methane recovery in agricultural activities at household/small farm level", if the energy methane recover and combustion equipment is transferred from another activity or if the existing equipment is transferred to another activity, leakage is to be considered For this project, it is not the case. Therefore, leakage will not be considered.

4. GHG emission reduction per household

The emission reduction per household within the project activity during a given year *y* is the amount of the household GHG baseline emissions minus the household GHG emissions with biogas digester installed under the project, as follows:

$$ER_{y,i,k} = BE_{y,i,k} - PE_{y,i,k} \quad (10)$$

5. Calculation of total bundled project GHG emission reductions (ER_y)

$$ER_y = \sum_i (\sum_{k=1} (ND_{i,k} * ER_{y,i,k})) \quad (11)$$

$ND_{i,k}$ Numbers of digesters with volume k, in county i

B.6.2. Data and parameters that are available at validation:

Table B8 Data and parameters not monitored

Parameter:	MS percent
Data unit:	Fraction
Description:	Fraction of manure handled in system j in the baseline
Source of data:	Project proponents
Value applied:	100 percent
Justification of the choice of data or description of measurement methods and procedures actually applied:	Manure produced by pig was applied to deep pit
Any comment:	

Parameter:	LF_{AD}
Data unit:	%
Description:	Methane leakage from Anaerobic digester
Source of data:	2006 IPCC Guidelines
Value applied:	10%
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	

Parameter:	VS
Data unit:	kg dry matter/animal/day
Description:	Volatile solid excretion
Source of data:	2006 IPCC Guidelines
Value applied:	0.3 kg dry matter/animal/day
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	

Parameter:	Bo
Data unit:	m^3CH_4/kg-dm VS
Description:	Maximum methane production
Source of data:	IPCC 2006 Guidelines
Value applied:	0.29
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	

Parameter:	MCF
Data unit:	Fraction
Description:	Methane conversion factor
Source of data:	IPCC 2006 Guidelines
Value applied:	32% for Enshi City and Badong County, 22% for Lichuan City, 29% for Jianshi, Xuan'en, Xianfeng, Laifeng, and Hefeng Counties
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	

Parameter:	**GWP_{CH4}**
Data unit:	tCO_2 e/tCH_4
Description:	Global warming potential for CH_4
Source of data:	IPCC
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually	

applied:	
Any comment:	

Parameter:	D_{CH4}
Data unit:	kg/m^3
Description:	Conversion factor of 1 m^3 CH_4 to kilograms CH_4
Source of data:	2006 IPCC Guidelines
Value applied:	0. 67
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	

Data / Parameter:	$BG_{coal,i,,k}$
Data unit:	Kg/household/year
Description:	Average annual coal consumption for household before installation of biogas digesters with volume k, in country i.
Source of data used:	Sample survey
Value applied:	Table B5
Justification of the choice of data or description of measurement methods actually applied :	Data was collected as parts of baseline sample survey, sample size was 2,485 households with biogas digesters, 2,485 household is accounted about 7.5 percent of total number of project household.
Any comment:	

Data / Parameter:	$PG_{coal,i,k}$
Data unit:	Kg/household/year
Description:	Average annual coal consumption for household after installation of biogas digesters with volume k, in country i.
Source of data used:	Sample survey
Value applied:	Table B7
Justification of the choice of data or description of measurement methods	Date was collected as parts of baseline sample survey, sample size was 2,485 households with biogas digesters, 2,485 household is accounted about 7.5 percent of total number of project household.

actually applied :	
Any comment:	

Data / Parameter:	H
Data unit:	Hour
Description:	annual operational hours of biogas digesters
Source of data to be used:	Baseline survey
Value of data	8520
Description of measurement methods and procedures to be applied:	The data was collected as parts of baseline survey. Sample size was 2,485 households with biogas digesters, 2,485 households are accounted about 7.5 percent of total number of project household.
QA/QC procedures to be applied:	To cross-check the operation hour with the biogas volumes.
Any comment:	Data will be archived electronically during project plus 2 years

Data / Parameter:	NCV
Data unit:	kJ/kg
Description:	Default net calorific values of cooking coal
Source of data used:	Published data by China NDRC (www.ccchina.gov.cn)
Value applied:	20908
Justification of the choice of data or description of measurement methods actually applied :	
Any comment:	

Data / Parameter:	Carbon EF
Data unit:	tC/TJ
Description:	Carbon emission factor per unit of energy of coal that would have been used in the baseline in (tC/ TJ)
Source of data used:	Published data by China NDRC (www.ccchina.gov.cn)
Value applied:	25.8
Justification of the choice of data or description of measurement methods actually applied :	
Any comment:	

Data / Parameter:	Fraction oxidized
Data unit:	
Description:	Fraction oxidized
Source of data used:	Published data by China NDRC (www.ccchina.gov.cn)
Value applied:	1.00
Justification of the choice of data or description of measurement methods actually applied :	
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

1. GHG emissions under baseline condition

(1) Baseline emission from pig manure management

Based on equations (1) and (2) described above and average swine population in each household, baseline CH_4 emissions from swine manure management system is summarized in Table B9.

Table B9. Baseline emission from swine manure management system (t CO_2 e/ year/household)

County	Enshi	Jianshi	Badong	Lichuan	Xuan'en	Xianfeng	Laifeng	Hefeng
8 m^3	0.61	0.53	0.62	0.43			0.55	
10 m^3	0.67	0.55	0.68	0.45	0.59			
12 m^3					0.66			0.62
15 m^3						0.76		

(2) Baseline CO_2 emission from coal combustion

Based on the equation (3) described above and coal consumption before the installation of biogas digesters, baseline CO_2 emissions are summarized in Table B10.

Table B10. Baseline CO_2 emission from coal combustion (t CO_2/year/household)

County	Enshi	Jianshi	Badong	Lichuan	Xuan'en	Xianfeng	Laifeng	Hefeng
8 m^3	2.80	2.89	2.74	2.87			2.56	
10 m^3	2.85	2.96	2.64	2.95	2.88			
12 m^3					2.97			3.31
15 m^3						3.14		

(3) Total baseline GHG emission per household

Based on table B9 and table B10, baseline GHG emissions per household is listed in Table B11.

Table B11. Total baseline GHG emissions per household (t CO_2 e/year/household)

County	Enshi	Jianshi	Badong	Lichuan	Xuan'en	Xianfeng	Laifeng	Hefeng
8 m^3	3.41	3.42	3.36	3.30			3.11	
10 m^3	3.52	3.51	3.32	3.40	3.47			
12 m^3					3.63			3.93
15 m^3						3.90		

Based on Table A3 and equation (5), total bundled baseline emission is equal to 115,757.78 t CO_2e/year (table B12).

Table B12. Total bundled baseline emission (t CO_2e/year)

County	Enshi	Jianshi	Badong	Lichuan	Xuan'en	Xianfeng	Laifeng	Hefeng	Total
8 m^3	6540.38	1846.80	5312.16	10041.90			9330.00		33071.24
10 m^3	8490.24	14145.30	9923.48	9917.80	6360.51				48837.33
12 m^3					4236.21			11790.00	16026.21
15 m^3						17823.00			17823.00

Total	15030.62	15992.10	15235.64	19959.70	10596.72	17823.00	9330.00	11790.00	115757.78

2. GHG emissions under project activity

(1) Methane emission from anaerobic digester

Based on the equation (6) described above, CH4 emission from leakage of anaerobic digester for each household is listed in Table B13.

Table B13. Methane emission from anaerobic digester for each household (t CO_2e/year)

County	Enshi City	Jianshi County	Badong County	Lichuan City	Xuan'en County	XIanfeng County	Laifeng County	Hefeng County
8 m^3	0.20	0.19	0.20	0.20			0.20	
10 m^3	0.21	0.20	0.22	0.21	0.21			
12 m^3					0.23			0.22
15 m^3						0.27		

(2) CO_2 emission from coal combustion under project activity

Based on the equation (7) described above and coal consumption after the installation of biogas digesters, CO_2 emission under project activity is listed in Table B14.

Table B14. Project activity CO_2 emission from coal combustion (t CO_2/year/household)

County	**Enshi**	**Jianshi**	**Badong**	**Lichuan**	**Xuan'en**	**Xianfeng**	**Laifeng**	**Hefeng**
8 m^3	1.61	1.64	1.45	1.67			1.21	
10 m^3	1.41	1.56	1.22	1.53	1.53			
12 m^3					1.47			1.84
15 m^3						1.61		

(3) Total GHG emission under project activity

Based on equation (8), total GHG emission for each household under the project activity was calculated as table B15.

Table B15. Total GHG emission under project activity of each household (t CO_2e/year/household)

County	Enshi	Jianshi	Badong	Lichuan	Xuan'en	Xianfeng	Laifeng	Hefeng
8 m^3	1.81	1.83	1.65	1.87			1.41	
10 m^3	1.62	1.76	1.44	1.74	1.74			
12 m^3					1.70			2.06
15 m^3						1.88		

Based on Table A3 and equation (9), total bundled project emission is equal to 57313.74 t CO_2/year (Table B16).

Table B16. Total bundled emission under project activity (t CO_2 e/year)

County	Enshi	Jianshi	Badong	Lichuan	Xuan'en	Xianfeng	Laifeng	Hefeng	Total
8 m^3	3471.58	988.20	2608.65	5690.41			4230.00		16988.84
10 m^3	3907.44	7092.80	4304.16	5075.58	3189.42				23569.40
12 m^3					1983.90			6180.00	8163.90
15 m^3						8591.60			8591.60
Total	7379.02	8081.00	6912.81	10765.99	5173.32	8591.60	4230.00	6180.00	57313.74

3. GHG emission reduction by project activity per household

GHG emission reduction by project activity of each household is estimated using equation (10). Table B17 presents the emission reduction by each household.

Table B17. Emission reduction by each biogas digester (t CO_2e/year)

County	Enshi	Jianshi	Badong	Lichuan	Xuan'en	Xianfeng	Laifeng	Hefeng
8 m^3	1.60	1.59	1.71	1.43			1.70	
10 m^3	1.90	1.75	1.88	1.66	1.73			
12 m^3					1.93			1.87
15 m^3						2.02		

4. Total bundled project GHG emission reduction

Based on Table A3 and equation (11), the total bundled project emission reduction is 58444.04 CO_2e/year (Table B18).

Table B18. Total bundled project GHG emission reduction (t CO_2e/year)

County	Enshi	Jianshi	Badong	Lichuan	Xuan'en	Xianfeng	Laifeng	Hefeng	Total
8 m^3	3068.80	858.60	2703.51	4351.49			5100.00		16082.40
10 m^3	4582.80	7052.50	5619.32	4842.22	3171.09				25267.93
12 m^3					2252.31			5610.00	7862.31
15 m^3						9231.40			9231.40
Total	7651.60	7911.10	8322.83	9193.71	5423.40	9231.40	5100.00	5610.00	58444.04

B.6.4 Summary of the ex-ante estimation of emission reductions:

Table B19. Summary of the ex-ante estimation of emission reductions

Year	Estimation of Project Activity Emissions (tCO_2e)	Estimate of Baseline Emissions (tCO_2e)	Estimation of Project Activity Emissions Reductions (tCO_2e)
15/11/2008-31/12/2008	7164.22	14469.72	7305.51
2009	57313.74	115757.78	58444.04
2010	57313.74	115757.78	58444.04
2011	57313.74	115757.78	58444.04
2012	57313.74	115757.78	58444.04
2013	57313.74	115757.78	58444.04
2014	57313.74	115757.78	58444.04
2015	57313.74	115757.78	58444.04
2016	57313.74	115757.78	58444.04
2017	57313.74	115757.78	58444.04
01/01/2018-14/11/2018	50149.52	101288.06	51138.54
Total （tonnes of CO2e)	573137.4	1157577.8	584440.4

B.7 Application of a monitoring methodology and description of the monitoring plan:

The proposed project activity is a bundle of 33,000 household-level activities, which recover methane from pig manure and utilize the generated biogas to displace fossil fuel for cooking and heating. The monitoring methodology of version 12 of AMS I.C "Thermal energy for the user with or without electricity" and the monitoring methodology of version 1 of AMS III.R "Methane recovery in agricultural

activities at household/small farm level" were applied. http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html.

In the case of the Hubei Biogas Project, the bundled project activity involves installation of 33,000 household biogas digesters, of the same type, same category and same technology in each county. Therefore, the requirement of a common monitoring plan for bundle under condition for sampling is applicable for this project. The sampling methodology will follow the monitoring requirements of the version 12 of AMS I.C, and version 1 of AMS III.R.

Because an annual emission reduction is less than 5 tonnes of CO_2 a year per system, option (c) of version 12 of AMS I.C with the version 1 of AMS III.R will be applied. .

B.7.1 Data and parameters monitored:

Table B20. Data and parameters monitored

Parameter:	N_{BD}
Data unit:	Number
Description:	Total number of household biogas digester users included in the biogas digesters project activity.
Source of data to be used:	Project proponents
Value of data	Table A3
Description of measurement methods and procedures to be applied:	After the start of the project, project coordinator should monitor the number of operational biogas installation and establish a database containing all relative identification information of each household, such as name, address, date on installation and operation of biogas digester
Monitoring frequency:	Annually
QA/QC procedures to be applied:	Verify the household number of biogas digesters according to the sales record of biogas stove.
Any comment:	Data will be archived electronically during project plus 2 years

Parameter:	H
Data unit:	Hour
Description:	annual operational hours of biogas digesters
Source of data to be used:	Project proponents
Value of data	8,520
Description of measurement methods and procedures to be applied:	Operational hours of biogas digesters will be estimated based on the length of period biogas digesters are not operating because of discharging and restarting. The length of period biogas digesters are not operating will be collected by surveying 2,750 household participants. The sample size of household number will ensure a precision needed to give a precision at 95% confidence intervals (T-values).
Monitoring frequency:	Annually
QA/QC procedures to be	To cross-check the operation hour with the biogas volumes.

applied:	
Any comment:	Data will be archived electronically during project plus 2 years

Parameter:	T
Data unit:	℃
Description:	Annual Average ambient temperature at county weather station nearby project site
Source of data:	Enshi weather station
Value of data	See Annex 3
Brief description of measurement methods and procedures to be applied:	Purchase from County meteorology stations. Archive electronically during project plus 5 years
Monitoring frequency:	Monthly
QA/QC procedures to be applied (if any):	---
Any comment:	Used to select the annual MCF from IPCC 2006 Guidelines

Parameter:	LN
Data unit:	Number
Description:	Swine population in individual household in project case
Source of data:	Project proponents
Value of data	See Table B3
Brief description of measurement methods and procedures to be applied:	Record pig number from 2,750 household participants. The sample size of household number will ensure a precision needed to give a precision at 95％ confidence intervals (T-values).
Monitoring frequency:	Monthly
QA/QC procedures to be applied (if any):	---
Any comment:	- Archive electronically during project plus 2 years --

Parameter:	The amount of manure VS generated by pigs in individual household
Data unit:	kg dry matter/day
Description:	Volatile solid contained in the manure generated by pigs in individual household in project case
Source of data:	Project proponents

Value of data	Product of pig number in Table B3 and IPCC default VS values of 0.3 kg dry matter/animal/day
Brief description of measurement methods and procedures to be applied:	The amount of pig manure VS generated in individual household will be calculated as product of swine population (LN) in individual household in project case and IPCC default VS values
Monitoring frequency:	Monthly
QA/QC procedures to be applied (if any):	---
Any comment:	- Archive electronically during project plus 2 years --

Parameter:	Sludge
Data unit:	
Description:	Destination of biogas sludge application
Source of data:	Household
Value of data	---
Brief description of measurement methods and procedures to be applied:	The destination o f biogas residue for the 2,750 random sample households will be recorded and reported to Enshi energy bureau.
Monitoring frequency:	Every application
QA/QC procedures to be applied (if any):	---
Any comment:	Data will be archived electronically during project plus 2 years

B.7.2 Description of the monitoring plan:

Monitoring will be implemented according to the monitoring plan ensuring that the real, measurable and long-term GHG emissions reductions for the proposed project are monitored and reported accordingly.

1. What is required by the monitoring plan?

Project Entity and Enshi Prefecture and county Project Management Offices (PMOs) established within Enshi Energy Bureau and project county Energy Bureaus, as project coordinators of the proposed project, must be credible, transparent, competence to provide technical guidance on the monitoring work,

keep adequate relevant data - appropriately measured and collected, and tracking systems to monitor project implementation, data collection. These records and monitoring systems are needed to allow the selected DOE to verify project performance with the necessary documentation as part of the verification and certification process. The project monitoring process is also a key element for achieving the project objectives and ensuring that the project is managed effectively. This process also reinforces that CO_2 reductions are real and credible to the buyers of the Certified Emissions Reductions (CERs).

Emission reductions will be achieved by installing biogas digesters and using biogas for thermal energy production to displace fossil fuel, which is main energy sources of household's daily life, such as cooking and heating. Therefore, the number of digesters users, operation hours of biogas digester system, pig number are defined as the key activities to be monitored.

2. Who uses the monitoring plan?

The PMOs, working for and working with Project Entity will be responsible for coordinating the project participants, providing technical services including organizing training to farmers involved, supervising the project implementation, as well as to organize technical support panel (TSP) to carry out the monitoring of the project implementation, particularly on emissions reduction performance according to the project design and monitoring plan. The monitoring plan will be adjusted according to actual conditions and requirements of the DOE in order to ensure that the monitoring process is credible, transparent and conservative. As the project households are spread in very broad areas including 625 villages in 81 townships of 8 counties, the existing local government agriculture extension system would be used to support the project monitoring process.

More specifically, the Project Entity will be responsible for collecting the monitoring data and drafting the monitoring report by working with PMOs. The township agriculture station will assist the monitoring of the project day to day measurement, data collection and documentation filing. The relevant information and data will be documented and archived in both Project Entity and PMOs electronically and in hard copy.

The Chinese Academy of Agriculture sciences will provide technical guidance and training to county technicians and project entity staff on measuring and monitoring the GHG emission reduction generated by the proposed project activities.

3. Monitoring

According to version 12 of approved small-scale CDM project activity categories I.C titled "Thermal energy for the user with or without electricity" and Type III.R (version 1) titled "Methane recovery in agricultural activities at household/small farm level", following key indicators and procedures will be used in the monitoring process.

To ensure reliable field measurements and data collection quality, the following procedures will be followed for quality control:

- Standard Operating Procedures for the field measurements, including detailed processes for each element measured and provisions for documentation for verification purposes will be developed and adhered to over time.
- Training courses on field data collection and data analyses will be held for staff involved in the field measurement work. Training courses will ensure that each field-team member is fully aware of all procedures and the importance of collecting data as accurately as requested.
- The list of the names of the field team and the project leader who join the training and monitoring process will be filed accordingly.
- Any new staff will be trained adequately.
- Enshi Energy Bureau, as project coordinator, will keep the monitoring relevant data and records.

3.1 Recording the number of operating biogas digesters

After the project start, the project technical support panel would work with Project Entity to monitor the number of operational biogas installation and operation, and establish a database containing all relative identification information of each household, such as name, address, date on installation and operation of biogas digester. In the same time, the quality of the biogas digester installed under the project would also be checked according to the project technical design. The readout records of the number of operating biogas digesters and list of biogas stove delivered by county energy bureau will be recorded for DOE review.

3.2 Estimation of annual operational hours of biogas digesters

Operational hours of biogas digesters will be estimated based on the length of the period that the biogas digesters are not operating while they are discharged annually and restart. The length of the period that the biogas digesters are not operating will be collected by surveying a sample of 2,750 household participants. This sample size will ensure a precision at 95% confidence intervals (T-values). The files containing the estimation of Annual operational hours of biogas digesters will be recorded for DOE review.

3.3 Swine population

Pig numbers which manure treated in biogas digester for the 2,750 random sample households will be recorded and reported to Enshi Energy Bureau.

3.4 Amount of pig manure VS generated and fed into the biogas digester

Amount of pig manure VS generated in individual household will be calculated as the product of swine population of individual household multiplied by IPCC default VS values.

As described in A4.2, all the manure generated will be fed into biogas digesters directly. Therefore the amount of pig manure VS fed into the biogas digesters is same to what the pig manure VS generated.

3.5 Application of biogas residue

The destination of biogas residue for the 2,750 random sample households will be recorded and reported to Enshi Energy Bureau.

3.6 Climatic parameters

Monthly average temperatures will be brought from monitored by Enshi Meteorological Station.

4. Data Management System

A data management system will be established for record keeping. Record keeping is the most important exercise in the monitoring process. Without accurate and sufficient records being kept, project emission reductions cannot be verified. The following process for data management will be pursued.

The CDM manual sets out the procedures for tracking information from the primary source to the end-data calculations, in paper document format. If data and information are available via the internet, the website must be provided. It is the responsibility of the Enshi Energy Bureau, as project coordinator, to provide any additional required data and information for validation and verification to the DOE.

Data will be archived electronically at the end of each month. The electronic files will be stored in hard disk and cd-rom. In addition, a hard copy printout will be archived. At the end of each crediting year, a monitoring report will be compiled detailing the metering results and relevant evidence.

Physical documentation such as paper-based maps, diagrams, and environmental impact assessments will be collected and documented in PMOs and Project Entity, together with the project monitoring plan. All data records will be kept for a period of 2 years following the end of the crediting period.

5. Verification Procedure

The verification procedure for the monitoring results of the project is a mandatory process required for all CDM projects. The main objective of the verification is to independently verify that whether the proposed project has achieved the emission reductions as reported and projected in the PDD. It is expected that verification be carried out annually.

Main verification activities include:

- Project Entity and Enshi Energy Bureau, as project coordinator, will provide the required information for verification to the DOE before and during verification activities.

- Project Entity and Enshi Energy Bureau, as project coordinator, will cooperate with the DOE and, instruct its staff and manager to be available for interviews and respond honestly to all questions relevant to verification from the DOE.

Project Entity and Enshi Energy Bureau, as project coordinator, will designate a person in charge of the overall responsibility for the monitoring and verification procedure and to act as the focal point for the DOE.

B.8 Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)

Detailed baseline information is attached in Annex 3.

Date of completion of baseline study: 31/05/2007

Name of persons/entity carrying out the baseline study:

Dong Hongmin, Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences. 12, Zhongguancun South Street, Beijing, 100081, China. Tel: 0086-010-68919979. E-mail: donghm@cjac.org.cn; donghm@mail.caas.net.cn,

Li Yue, Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences. 12, Zhongguancun South Street, Beijing, 100081, China. Tel: 0086-010-62119681. E-mail: Yueli@ami.ac.cn, jinghonglv@gmail.com.

Dr. Dong Hongmin and Ms. Li Yue, who are responsible for the application of the baseline study and monitoring methodology, are not project participants.

To fully support the application of approved AMS-IC (version 12) monitoring methodology to the projects which emissions reduction per system is less than 5 tonnes of CO_2e a year, project team proposed new methodology, based on which ASM III.R was approved

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

The starting date of the project activity is 01/04/2007.

C.1.2. Expected operational lifetime of the project activity:

The expected operational lifetime of the project activity is 20 years.

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

N/A

C.2.1.1. Starting date of the first crediting period:

N/A

C.2.1.2. Length of the first crediting period:

N/A

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

15/11/2008 or the date of registration whichever is later

C.2.2.2. Length:

10 years

SECTION D. Environmental impacts

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

The Environmental Impact Assessment of the proposed project was completed by China Agricultural University, and approved by the Environment Protection Bureau of Enshi Prefecture on January 24, 2008 (Document No. [2008] 4). Main conclusions of the Environmental Impact Assessment are summarized as follows:

Through developing, building, and putting into operation 33,000 individual household based biogas digesters, by utilizing pig manure as raw material, the project will generate significant positive environment impacts improving the rural environment and living conditions in the project areas while reducing greenhouse gas emissions.

More specifically, in addition to reducing the GHG emissions from improved animal manure management and reducing burning of fuel-wood, coal and straw, the proposed project has the following environmental benefits:

(1) Non methane volatile organic compound (NMVOC) emissions into the atmosphere and odor caused by animal manure will be reduced.

(2) Through anaerobic treatment of farm-yard manure, water pollution and zoonotic diseases (diseases that can be transmitted from animals to people) will be reduced by improving the living environment of the households and communities. Furthermore, due to the integrated toilet, kitchen and animal shed facilities, the project will also improve sanitary and hygienic conditions which help keeping the areas inside and surrounding the households clean reducing the chances for the spread of infectious diseases.

(3) Improved indoor air quality from substituting coal, fuel-wood, and straw with cleaner bio-gas, the incidence of respiratory diseases, especially for women and children, eye ailments caused by smoke from fuel-wood, coal and straw, will decrease.

Smoke from the combustion of biomass fuels contains a large number of potentially hazardous pollutants. Exposure to these pollutants, especially suspended particular matter, is a risk factor for a wide

range of diseases, including acute respiratory infections (ARI), chronic obstructive pulmonary disorder (COPD), cancers, cataract and low birth weight[3].

(4) Animal manure will be utilized more efficiently reducing pollution to soil and water caused by direct discharge of animal waste, by using biogas slurry instead of traditional non-fermented animal manure. The process of generating biogas will kill many of the pathenogenic bacteria found in manure that can be passed on to humans causing intestinal diseases.

(5) The energy generated by biogas digesters will be used for cooking and heating replacing coal and fuel-wood, mitigating land degradation by reducing over-cutting of wood in the surrounding mountains.

(6) During project implementation and operational phases, the potential environmental issues identified are environmental risks potentially caused by poor construction quality and if project design will be not followed. Such impacts may include water pollution if water bodies are close to the biogas digester and the surrounding area is sloping; and the potential soil pollution through over application of waste sludge. Adequate training to local technical staff and farmers and timely monitoring of the project implementation will mitigate the potential environmental risks.

D.2. If environmental impacts are considered significant by project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

As indicated above, the proposed project will improve the rural environment and living conditions in the project areas while reducing greenhouse gas emissions. No significant negative environment impacts have been identified.

SECTION E. Stakeholders' comments

[3] Larson, B. and S. Rosen (2000). Household Benefits of Indoor Air Pollution Control in Developing Countries, Prepared for the USAID/WHO Global Technical Consultation on The Health Impacts of Indoor Air Pollution and Household Energy in Developing Countries, May 3-4, 2000, Washington, DC.

E.1. Brief description how comments by local stakeholders have been invited and compiled:

Project stakeholder consultations have been carried out by local project management agencies with guidance from social science experts, to inform the project stakeholders about the project objective and activities; and with the purpose of getting a better understanding of their wishes, needs, opinions and comments on the project design. Two townships in each project county and 2 villages in each township took part in the consultations. Village consulting meetings took place in each selected village. More than 700 farmers and other stakeholders were interviewed and consulted. The consultation process is summarized as follows:

(1) **Distribution of leaflets.** A project information leaflet introducing project objective, main activities, expected benefits, and the modalities and procedures of the CDM biogas project was prepared and distributed to the proposed project communities and other stakeholders before the consultation process.

(2) **Village meetings with farmers' representatives**. To better understand the needs and wishes, and obtain comments on the project design from local farmers, a meeting with farmer representatives was held in each selected village. Participants included village leaders, farmer representatives, and town/township management staff responsible for agriculture and rural energy management, and officials from the local energy agencies.

(3) **Questionnaire and interview**. Questionnaires were developed and distributed among stakeholders, including households (10-15 households randomly selected from each selected villages), township governments, potential project entities, local rural energy stations. Interviews using a semi-structured approach were carried out with selected farmers and other stakeholders.

E.2. Summary of the comments received:

Comments from local farmers, villages and companies/farms, etc. are summarized as follows:

(1) **Farmers/communities**

Through undertaking above mentioned consultation process, local farmers/communities express their strong interests to participate in the proposed Biogas CDM project activity because they believe that by participating in the project activity they can obtain the following benefits:

- Their household living environment will be improved as human and animal waste will be collected instead of being directly emitted into the surroundings.

- Incidence of respiratory diseases, especially for women and children and eye ailments will be decreased as cooking and heating using biogas will reduce pollution caused by smoke from ordinary coal stoves.

- Household savings will be increased by reducing spending on coal and fuel wood used for cooking and heating.

- Cooking with biogas saves time and labor for women.

- Reducing fuel wood collection will reduce deforestation.

- The households are interested in participating in the project. However, many household expressed their concern of the lack of counterpart funds which need to be mobilized by the individuals.

More specifically, the consultations indicated that: (a) there is a strong need to strengthen biogas technical service system including training program, (b) there is a financing difficulty for household to mobilize the needed counterpart funding; and (c) the households desire to have the project helping them to overcome the financing barriers. Data from the household interview and questionnaire survey shows that, around 98 percent of households consider that the CDM project is very necessary to local resident; around 99 percent households support and want to participate in the project; around 95 percent households expressed difficulties in financing the biogas digester installation; around 92 percent households believe that the project will improve the indoor and outdoor environment and reduce the burden of women; around 90 percent households consider that the project will generate significant positive benefit to improve the local environment; around 99 percent of household said that the project will increase farmers' income and around 100 percent households requests improved technical services and training provision.

(2) **Local Governments:**

County and Township governments in the project counties believe that the proposed biogas CDM project activity would make great contributions to better living conditions in the countryside, delivering both social and economic benefits to rural residents while addressing environmental degradation issues. At the same time the counties involved in the project would contribute to mitigating global climate change. The proposed project counties are located in poor remote areas and all of the project counties are nationally designated poverty counties with a large portion of the poor farmers. The income generated by selling Carbon Credit for a substantial time period would also provide financial support to enable poor households to participate in the biogas establishment program and strengthen community technical support facilities to a sustainable management of biogas systems in the rural areas.

E.3. Report on how due account was taken of any comments received:

Comments and suggestions received from the stakeholder consultations were fully taken into account in the project design as follows:

- Participation of local farmers and company is on a voluntarily basis.
- To address the issue of inadequate training and technical support to users in the grassroots level, the project would introduce the improved biogas technical extension services and provide training to households to improve the efficiency of the biogas digester operation and maintenance. Farmer technical training will focus on training farmers in biogas trouble shooting at the village level, where there are currently insufficient technical resources.
- To address the financing difficulty of the households, the project would use the income generated by selling the carbon credit as an incentive to develop a payment guarantee mechanism to enable the poor and relatively poor households take loans from the local commercial bank for the biogas installation.
- To address the requirement of enhancing the institutional capacity at the village-level technical centers, the project will include activities to improve technical support facilities for sustainable operation and maintenance of the biogas systems, ensuring sustainable management of the biogas systems.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Hubei Qingjiang Zhongye Company Ltd.
Street/P.O.Box:	Xueyuan Street,
Building:	No. 126
City:	Enshi City
State/Region:	Hubei Province
Postfix/ZIP:	445000
Country:	P.R. China
Telephone:	+86-718-8434246
FAX:	+86-718-8431092
E-Mail:	qjzygs@263.net
Represented by:	Xie Ruili
Title:	General Manager
Salutation:	Mr.
Last Name:	Ruili
First Name:	Xie
Department:	
Mobile:	+86-13607248371
Direct FAX:	+86-0718-8431092
Direct tel:	+86-0718-8434246
Personal E-Mail:	qjzygs@263.net

Organization:	DNA of the Netherlands (VROM)
Street/P.O.Box:	Rijnstraat 8 30945
Building:	
City:	The Hague
State/Region:	
Postfix/ZIP:	2500 GX
Country:	The Netherlands
Telephone:	+310703393456
FAX:	+310703391306
E-Mail:	Ferry.vanhagen@minvrom.nl
URL:	
Represented by:	

Title:	Director for International Environmental Affairs
Salutation:	
Last Name:	De Jonge
Middle Name:	
First Name:	Lex
Department:	International Environmental Affairs
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	Ferry.vanhagen@minvrom.nl

Organization:	International Bank for Reconstruction and Development (IBRD) as a Trustee of Community Development Carbon Fund
Street/P.O.Box:	1818 H Street, NW
Building:	MC Building
City:	Washington
State/Region:	DC
Postfix/ZIP:	20043
Country:	United States of America
Telephone:	1202 473 9189
FAX:	1202 522 7432
E-Mail:	IBRD-carbonfinance@worldbank.org
URL:	www.carbonfinance.org
Represented by:	Ms. Joelle Chassard
Title:	Manager Carbon Finance Unit
Salutation:	Ms.
Last Name:	Chassard
First Name:	Joelle
Department:	ENVCF
Mobile:	
Direct FAX:	+1-202-522 7432
Direct tel:	+1-202-458-1873
Personal E-Mail:	Jchassard@worldbank.org

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding from Annex I Parties for the Project.

Annex 3

BASELINE INFORMATION

Table 1. Average temperature and MCF of each county

County	Enshi	Jianshi	Badong	Lichuan	Xuan'en	Xianfeng	Laifeng	Hefeng
10 Years' average Temperature (℃)	16.6	15.5	17.6	13.2	16.0	16.2	16.2	15.9
MCF	32%	29%	32%	22%	29%	29%	29%	29%

Table 2. Survey number of biogas digesters with different volume in project counties

County Size of digester	Enshi	Jianshi	Badong	Lichuan	Xuan'en	Xianfeng	Laifeng	Hefeng
8 m^3	93	44	121	248			300	
10 m^3	207	256	179	137	169			
12 m^3					131			300
15 m^3						300		

Table 3. Surveyed family numbers without biogas digester in project counties

County	Enshi	Jianshi	Badong	Lichuan	Xuan'en	Xianfeng	Laifeng	Hefeng	Total
Family	300	300	300	405	300	300	300	325	2530

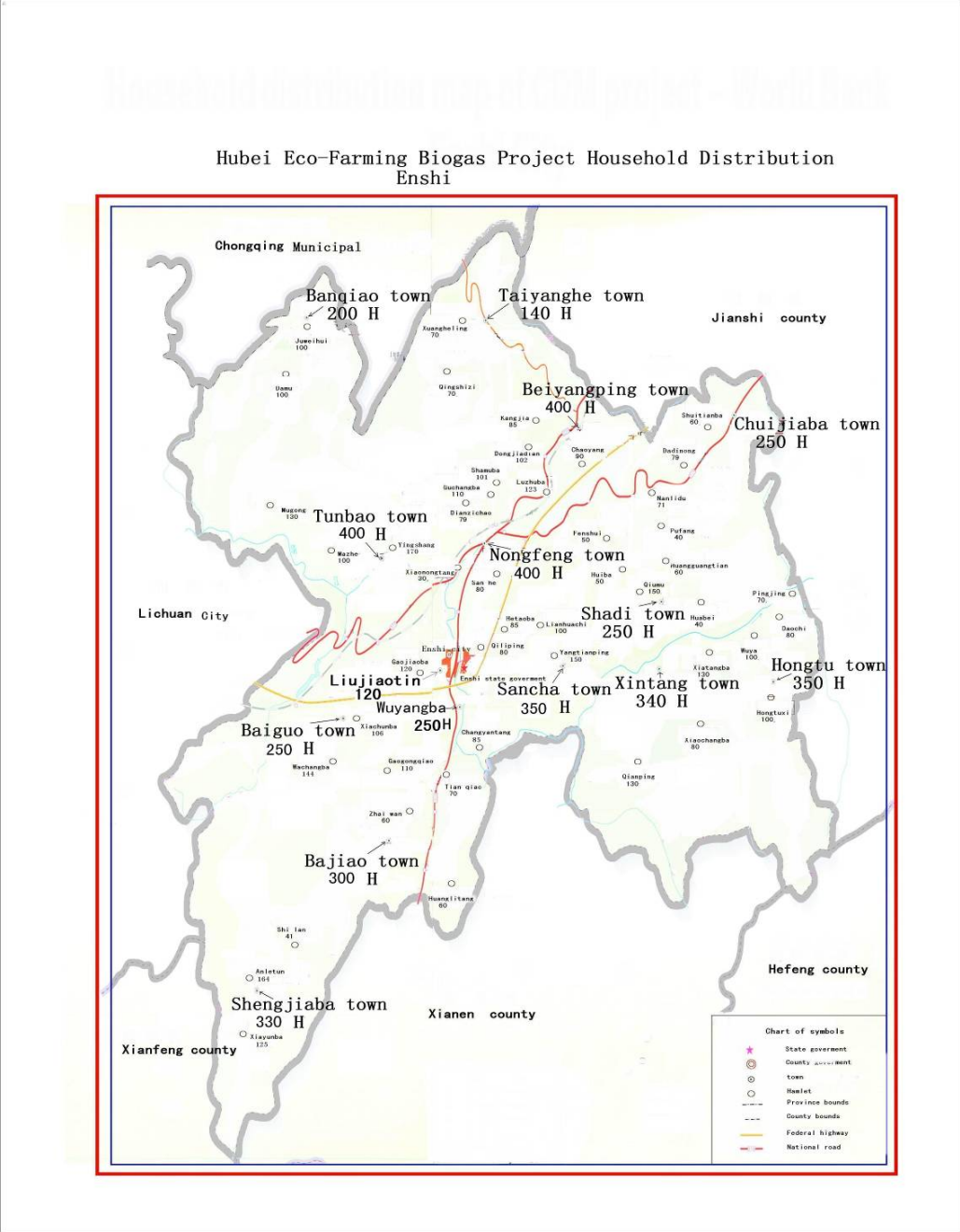


Figure 1. Project Activity Locations in Enshi City

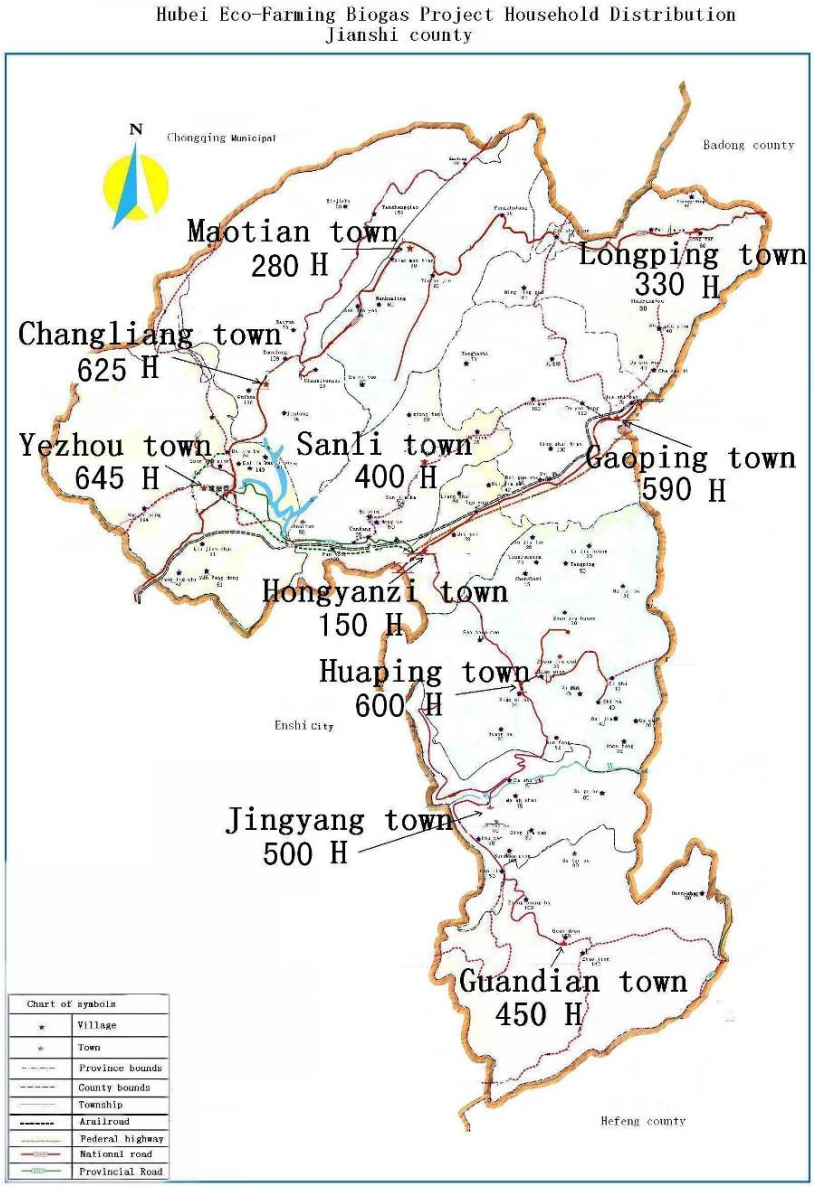


Figure 2： Project Activity Locations in Jianshi County

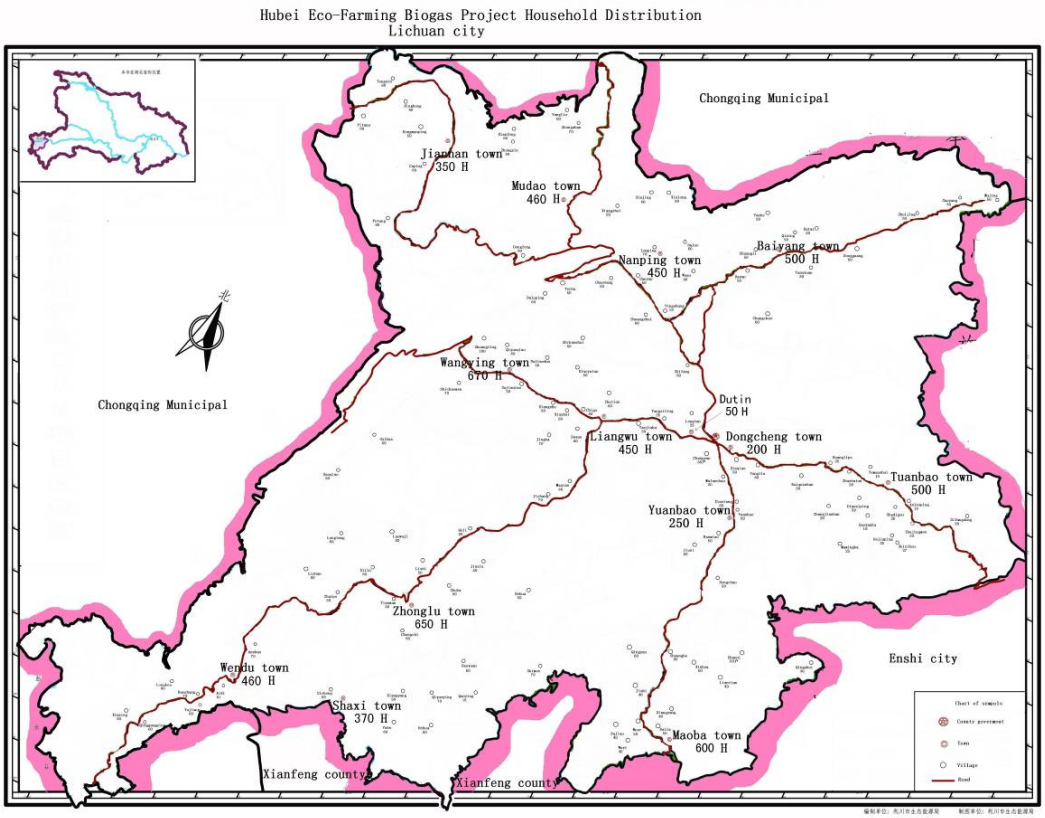


Figure 3. Project Activities in Lichuan City

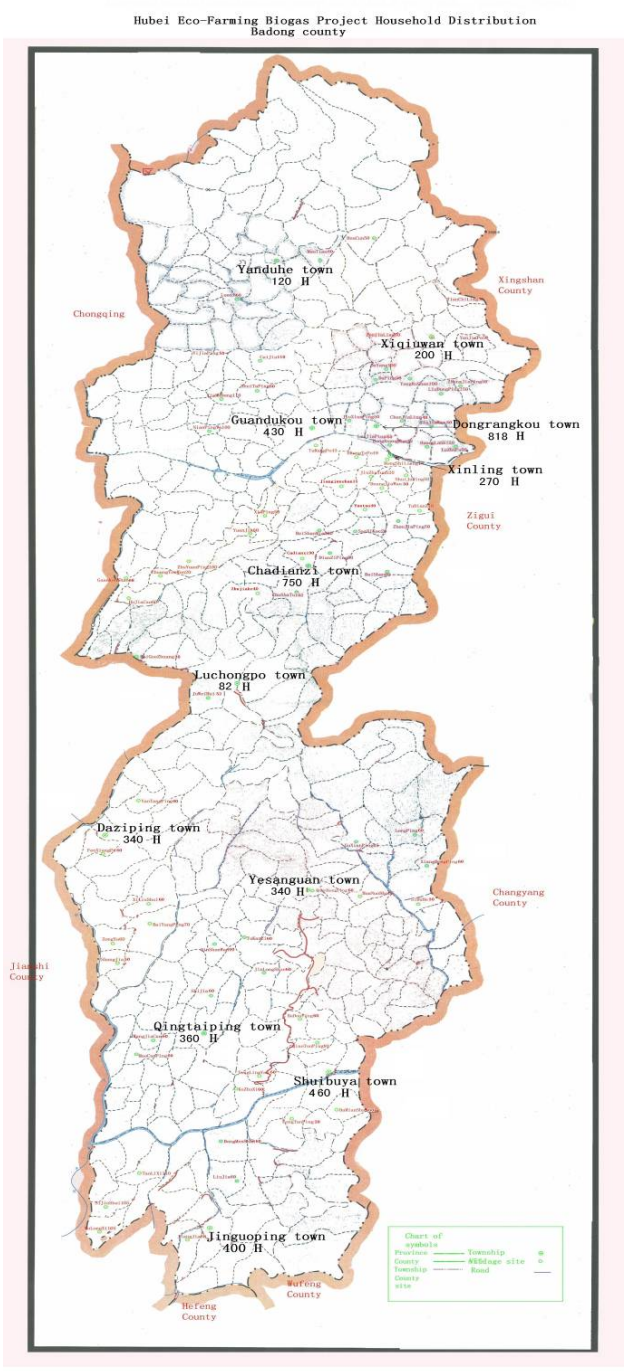


Figure 4. Project Activities in Badong County

Figure 5. Project Activities in Xuan'en County

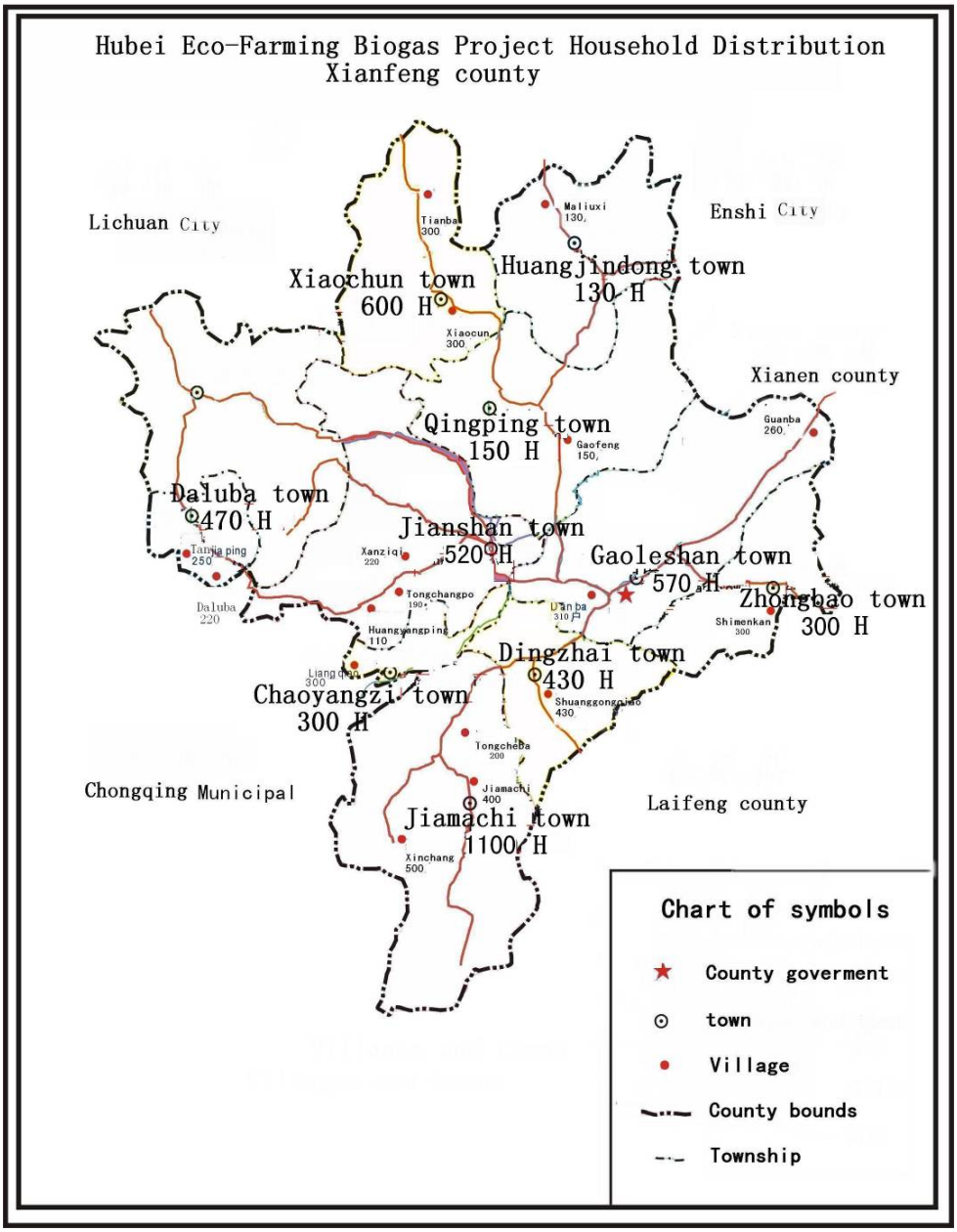


Figure 6. Project Activities in Xianfeng County

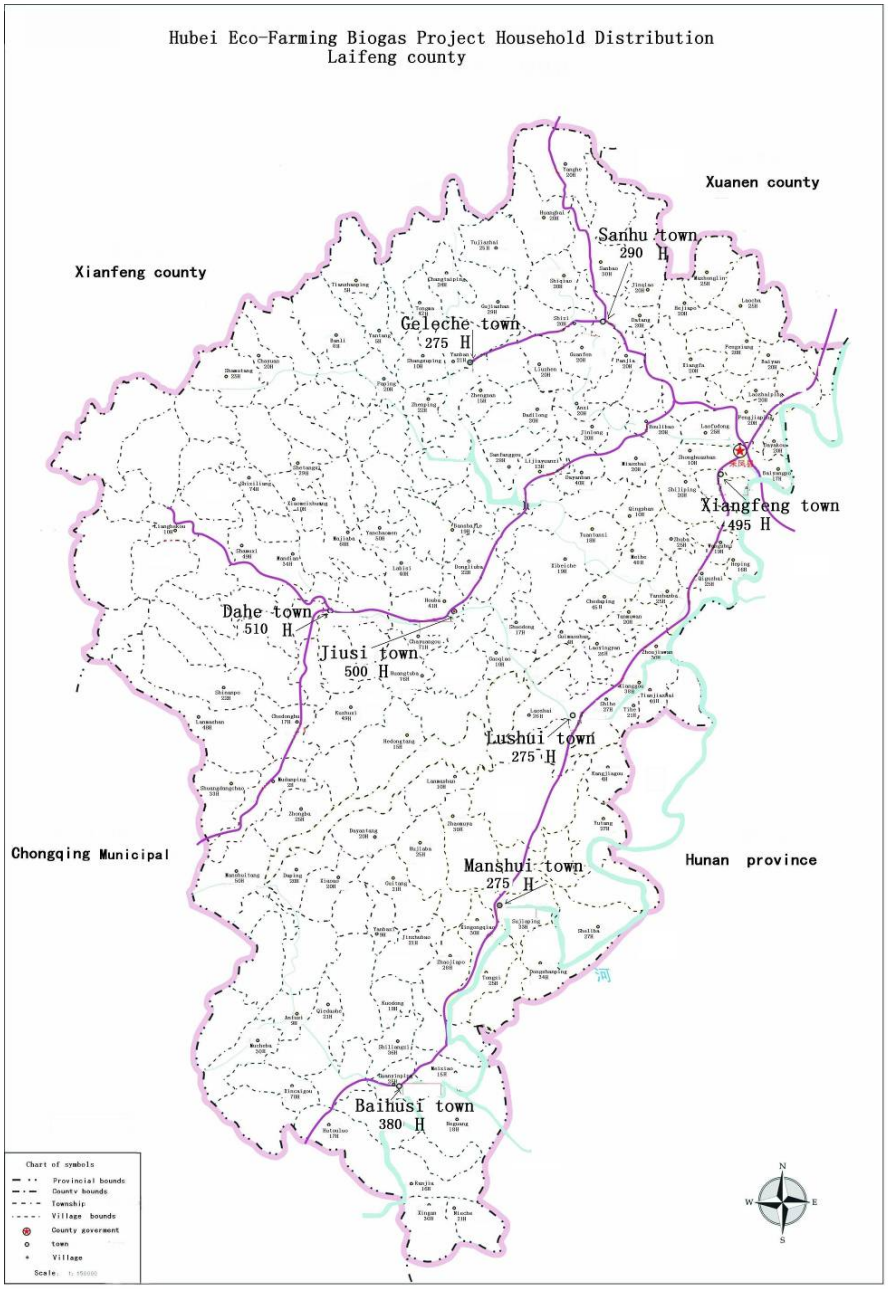


Figure 7. Project Activities in Laifeng County

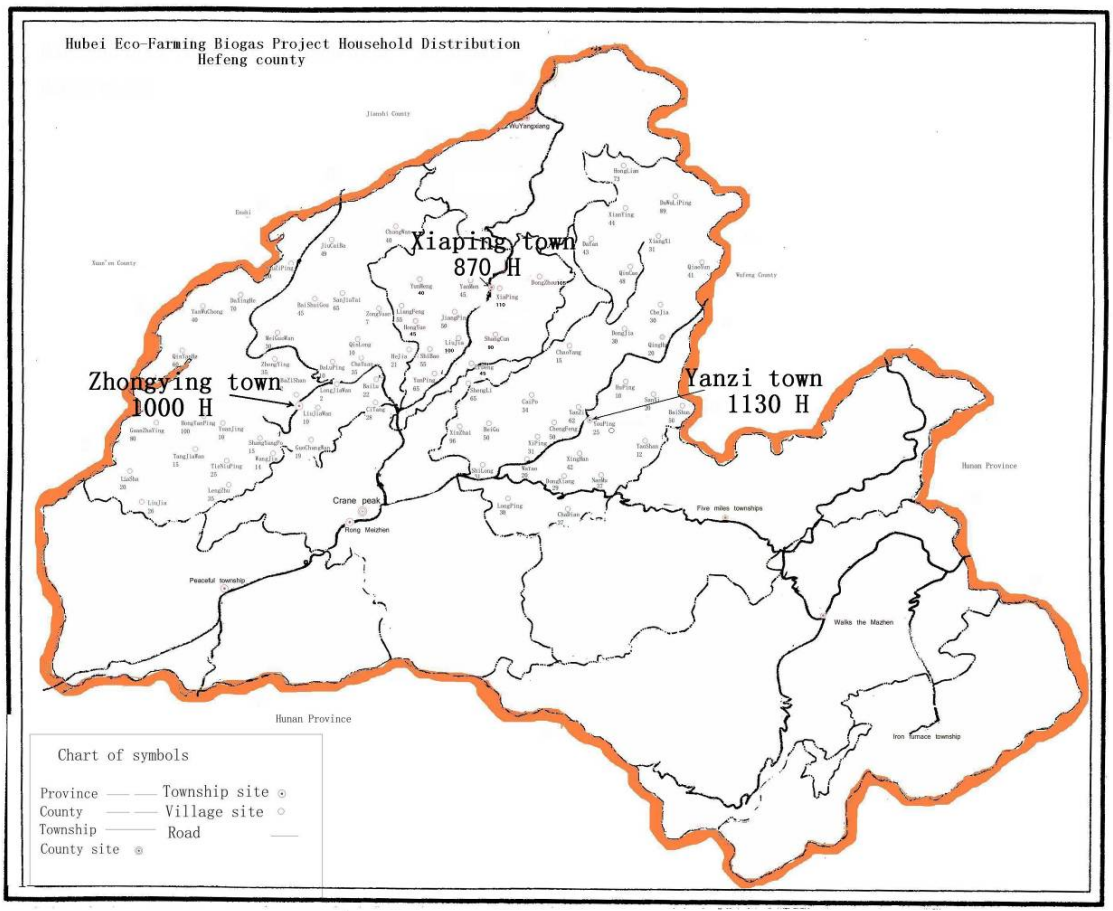


Figure 8. Project Activities in Hefeng County

Annex 4

MONITORING INFORMATION

Project Monitoring Plan has been incorporated into the PDD Main text.