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FINAL REPORT ON BIOGAS USER SURVEY 2009

Biogas Programme for the Animal Husbandry Sector in Vietnam
Phase II, 2007-2012

Hanoi, January 2010

ABBREVIATION

BĐ	-	Bình Định
BR-VT	-	Bà rịa-Vũng Tàu
BT	-	Bến Tre
BUS	-	Biogas User Survey
HY	-	Hưng Yên
NB	-	Nình Bình
QN	-	Quảng Ngãi
VND	-	Vietnamese Dong
VP	-	Vĩnh Phúc
CPC	-	Commune People Committee
BPD	-	Biogas Project Division
PBPD	-	Provincial Biogas Project Division
TOR	-	Term of Reference
VET	-	Veteran Association

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EXECUTIVE SUMMARY

I. INTRODUCTION

"Biogas Programme for the Animal Husbandry Sector of Vietnam" hereafter called as project has been started since 2003. At the end of October of 2009, there were 75,000 biogas plants constructed in 36 provinces and cities in the nationwide. It is projected that at the end of 2012, biogas plant of the project will be constructed at 50 provinces and cities of Vietnam.

Every year the project conducts biogas user survey (BUS) to collect and gather information and feedbacks from biogas users under scope of the project. Until now there were 4 BUS's implemented namely BUS 2005, BUS 2006, BUS 2007-2008 and BUS 2009.

As of third quarter of 2009 on average, 84% of the biogas plants were constructed at the selected provinces compared with the plan of 2009. Until 3/10/2009, there were 4095 biogas plant been constructed in the 7 provinces. Most of provinces have met its progress.

II. SURVEY RESULTS

Result of the BUS 2009 survey can be expressed as following points:

Out of total 211 household selected for interview, there were 5 plants constructed in 2004, 10 plants constructed in 2005, 4 plants in 2006, 34 plants in 2007, 106 plants in 2008 and 52 plants in 2009.

The average size of biogas digester of surveyed household was 11. 2 m^3, 1.5 m^3 higher than that of biogas user survey in 2007-2008. Average construction cost for 1m^3 of biogas digester in 2009 was 0.92 million VND. According to the assessement of biogas users, the very well-operating plants were 104 plants accounting for 49.3%, well-operating accounted for 43.6%, normal operating plants were 6.6%.

Regarding the quality of the plant, based on user opinion, the number of plants that produced enough or even exceeded biogas were 200 accounted for 94.7% total surveyed biogas users.

Most of biogas users and potential users (registered households) gave very good comments on technicians' and mason's ability, education level, and working capability. Assessment on quality of the construction work is the best indicator on mason work efficiency. At the survey time, there were almost 94% number of plants been assessed as well to very well operation, only 4% were assessed as fair operation .

To find the reason why household decide to construct the biogas plant, the answer were , 91.5% of households said due to clean and convenient for cooking, 72.5 % having substitution energy and saving cost and 84.4% household recognized the biogas plant brought an improvement on environmental pollution and better sanitation. There were a number of household saying that they had to wait 1-3

months until they could have their plant constructed as the mason team were busy in constructing other household biogas plants.
Result on energy expenditure in a month of biogas households showed that thank to the biogas plant a biogas user household could save some expenses such as: 47 thousand VND from collecting wood, 69 thousand VND from buying wood, 28 thousand VND from propane gas, 16 thousand from agricultural by-product. Total saving of one household on general average was 180,340 VND per month.
Of the 211 obsevations on biogas user, there were 79 households accounting for 37% that released livestock waste to public drainage or open space before constructing biogas plant. After got biogas plant constructed the number of households kept releasing to open space was 13 or 6.1% of total observation.
Total number of household utilized slurry was 106 or occupied 50.2% of total biogas users. 89% slurry used under liquid type and applied for crops.

III. OUTCOMES

1. Strong points

The project has contributed positive impacts on rural development, reducing environmental pollution caused by livestock waste and creating job opportunities for farmer's households.
With number of 75000 biogas plant showed that construction technology of KT1, KT2 designed type obtained great confidence and trusted from user, especially for small and medium scale of livestock raising farmer (5-30 heads/herd).
The project shows the good management scheme, unique network from central to grassroots level, and mobilization of many social elements participated in the programme. Provincial agricultural extension centers or water supply and sanitation centers showed the ability of organization, monitoring, guiding and updating information timely. Most surveyed provinces achieved their 2009 plan; some provinces exceed their 2009 planning on number of built biogas plants.
The project has built up a technician and mason team with good knowledge on biogas and construction technique as well as professional skills that ensure the trust of biogas users in surveyed provinces.

2. Constraints

During project designing stage, the counterpart fund is a key to ensure the involvement of provinces in biogas development programme. However the counterpart fund is also a constraint, especially for "poor" provinces. As a result the number of biogas plant allocated to provinces somehow not reflects the real demand of biogas plant construction need in those provinces.
KT1, KT2 technology might only be suitable with small and medium scale. While the number of large scales livestock raiser such as 100-500 head/herd keeps increasing so that more customers at this scale are looking for other biogas technology than technology developed by project.
In some provinces the number of creative, active technician is still lacking and

unsustainable. The technicians are also lack of consultancy skill on size of digester, location, maintenance and utilization of biogas and bio-slurry.
Relation between implementing agencies and local commune authorities is weak. There was lacking of exploration ability of local mass organization or individual people (Farmer Union, Women Union, VET, village heads, and others).
Most of technicians are in charge two duties at the same time: working as biogas technician and work as extension workers or other assignments, quantity of technician and mason is not fit with number of biogas plants increasing in most provinces that lead to the weakness of technical support or new technology transfer.

IV. CONCLUSION

Result from surveyed 211 observation of biogas users in 7 selected provinces (Bà Rịa- Vũng Tàu, Bến Tre, Quảng Ngãi, Bình Định, Ninh Bình, Vĩnh Phúc and Hưng Yên) revealed that 93% biogas users gave high value on quality of the plant specifically in construction quality, biogas production, waste treatment, pollution reduction. As many as 74% of respondents answered that thank to the biogas plant so that their raising scale is increased. Beside the households recognized that training class, materials, guidance have good impact on operation and maintenance their biogas plant.
Same as assessments from BUS 2005, 2006, 2008 the clear benefit of biogas plant is fuel wood substitution and lighting. Monthly, household in some surveyed provinces could save from 200-300 thousand VND. Biogas plant could help household to control pollution of living environment and treat almost of the livestock waste.
In some extend, the farmer could be trained to become to be a service provider (guiding technique, supporting, trading equipments…) in the rural area and could contribute in the economic efficiency, and living standard improvement.

V. RECOMMENDATION:

It is a need to have a flexible planning and allocation of number of biogas plants. For provinces having enough or abundant of counterpart fund, should project discuss and increase number of plants. Give more number of plant to Quảng Ngãi, Hung Yen, Ba Ria Vung Tau). Speeding up the biogas development in not yet participated provinces. According to the plan, the project will last in the next 3 year while there are still 11 provinces not yet participated in the project. As a result in the year 2010 the remaining provinces will enter implement project's activities. Study those provinces and development plans are crucial task.

Improvement of accessibility of project through getting involment of mass organization (strong recommending Woman Union, Famer Union) in the biogas development process especiallly at province having enough couterpart funds.

Encouragement of household invest biogas plant by themselves in order to reduce the dependency or philosophy of wating project. Simultaneously the project also need to provide technical support for non-project households.

Need to be trained more technician and the mason

- Need pay more attention on selling technical work of the mason to livestock raisers. (The programme office may develop a hotline number and this number should inform from upper level or at grassroot level (i.e printed or noted by commune, village)
- Increasing collaboration of technician, mason within or outside province and increasing information exchange and collaboration between technicians and foreign partners.

The market of electricity using biogas is starting to develop so that the project should emphasize the communication activities and collaborate with other organization in expanding the use of biogas-electricity generator.

Facilities equipped for provincial offices are still lacking of. Some provinces requested to have support on computer, projector that serves for communication and training activities.

Support gasoline fee for technician: the increasingly number of biogas plants (average biogas plants/technician is 50) and recently the price for gasoline is going up therefore it is a need to raise the support for technician in order to sustain the control quality.

Continue support in R&D of refining equipment. Creating chances for biogas user and the producer meeting each others.

It is recommended establishing the biogas user club in order to create the relation and collaboration among biogas users or potential biogas user and also with the mason. This will facilitate the information exchanges, communication and experience sharing.

Many of household proposed to have a punishment regulation for those livestock raisers polluted environment.

MAIN REPORT

PART I. GENERAL INFORMATION ON BPD AND LIVESTOCK SECTOR OF VIETNAM

I. GENERAL INFORMATION ON LIVESTOCK SECTOR OF VIETNAM AND THE BIOGAS

1. Introduction on livestock sector of Vietnam

Livestock is one of vital sector in agricultural production of Vietnam, increasingly proportion of livestock in agriculture reveal the important role of the sector in economic development, especially in the rural area. Maintaining the growth rate and increasing livestock share are crucial measurements for maintaining and developing the value of agriculture. According to Department of Livestock Production, estimated total live meat production in 2009 will be 3.7 million tons; more than 5 billion poultry eggs; about 300 thousand tones of milk. In 2009, based on the forecast the number of livestock head will increase by 10% comparing with 2008. Growth rate of livestock sector in recent years always is at high level, average annual growth rate in period 2001 - 2008 is 8.7 %. At present, livestock proportion in agriculture accounted for 22.3% (General Statistical Office). There are 10 provinces with livestock proportion greater than 35% and another 11 provinces having more than 30%. (Report on Livestock Development Strategy until 2020)

The growth of livestock sector could be able to help in income generation, job creation and living standard improvement of farmers, especially for those are living in the remote and less developed areas. The growth of livestock also helps to increase agricultural products processing as well as to shift labor force in agriculture. However, there are some negative impacts of livestock development on environment. The solid or liquid wastes coming from livestock raising units, slaughter houses, meat processing factories are also contributing to air or soil pollution, water sources polluted and of bad impacts to human health. This issue addresses to livestock raisers, policy makers that there is a must to have appropriates policies, sanctions for livestock development as well as reduction of environment polluted by livestock.

2. Livestock production of Vietnam during 2000 – 2009

From 2000 up to now the livestock production keeps increasingly, data shown in the table 1 revealed that:

Cow herd has 6.7 million head; increased 1.8 times as comparing with 2000, average annual growth rate is 5.25%;

Cow milk herd has 160.1 thousand head; 4.5 time increase if compared with 2000, average annual growth rate is 20, 9%;

Pig herd at present is 26.56 million head; 1.3 time increase if compared with 2000, average annual growth rate is 3.56%;

Number of goats, sheep is 1.78 million heads increasing 3.2 times with average annual growth of 15.95%;

Number of horse reduced from 126.5 thousand of 2000 down to 103.5 thousand in 2008 with reduction rate of 2.5% annually.
Poultry is increasing quickly reached to 254.06 million heads in 2003 however due to the impact of Avian Influenza the number of poultry the number of poultry was 247 million heads. Average annual growth from 2000-2008 is 3%

Table 1. The situation of livestock of Vietnam during 2000 - 2008

Unit: 1000 head

Items	2000	2005	2008	Average growth rate 2000 - 2008 (%)
1. Buffaloes	2,900	2,920	3,000	0.42
2. Cattle	4,130	5,540	6,725	6.28
3. Dairy cows	35.0	104.1	160.1	20.93
4. Horses	126.5	110.2	103.5	-2.48
5. Goat, sheep	543.9	1,314.2	1,777.6	15.95
6. Pig	20,190	27,430	26,700	3.56
7. Poultry	196,100	219,910	247,000	2.93

Sources: Livestock Department, 2009

Minister of MARD Mr. Cao Đức Phát stated that even facing with many difficulties due to calamities, diseases in recent year, however the livestock sector is still growing gradually. Proportion of livestock in agriculture increased from 22% (in 2005) to 24% in 2007. According to the newly approved Livestock Strategy, at 2010, the proportion of livestock will be occupied about 32%, at 2015 will be at 38% and reached 42% in year of 2020. Consequently, during period of 2008-2010, the Livestock Sector should keep an annual growth rate of 8%-9%; 6%-7% at period of 2010-2015 and about 5%-6%/year during 2015-2020.
On average, a person will consume 56 kg of meat, 140 eggs and over 10 kg mill yearly. Number of livestock, poultry in 2000 – 2008 increased rapidly, the livestock sector has been directed and encouraged livestock raisers to develop their production in concentrated area and with large scale, several hundred feed processing factories have been established as well as large scale slaughterhouses in provinces. In the Livestock Development Strategy until 2020, the LPD forecasted that the traditional backyard and small scale raising type will be reduced and replaced by large scale, which is a social distribution and allocation.

3. Development direction and new livestock policy till 2020

According to policy makers, the Vietnam livestock sector will have many opportunities to come for development. There are many reasons but the main is that the livestock development trend of the World will expand to the Asia- Pacific The Livestock Development Strategy until 2020 has projected the target of carcass meat at 5,500 thousand ton of which pork meat accounted for 63%, poultry of 32%, cattle of 4%. With this target, the pig herd will be developed rapidly following the direction of raising pig at concentration area with large scale and

industrialized production. The raising place should satisfy the land conditions, disease control as well as environment such areas may be at hilly area in Northern provinces, North and South Central Coast and some areas in Red River Delta, and South East provinces.

4. Livestock situation and economic and environmental sectors

As forecast for the next few years, the demand of food like: meat, milk, egg in Vietnam keep increasing stably so that livestock sector will be certainly developed. As estimated, with economic growth rate of 7-8% yearly, and population growth at 1.3% a year, the livestock sector should be at growth of 9-10% annually to meet the demand of the country.

LIVESTOCK DEVELOPMENT STRATEGY OF VIETNAM UNTIL 2020 (extraction)

1. Overall Objective

a) Until 2020 the livestock sector will change majorly into production mode of concentration and large scale, industrialization, meeting most of domestic demand and ensuring quality for consumption and export;

b) Proportion of livestock in agriculture till 2020 will achieve 42%; of which in 2010 is 32% and 2015 is 38%;

c) Ensuring diseases safety and food security, controlling effectively dangerous diseases in the livestock sector;

d) Livestock producer, especially for those having large scale production, industrialized and slaughterhouses, processing units should install waste treatment facilities to protect and reduce environmental pollution.

2. Specific Targets

a) Average growth rate: period of 2008-2010 achieve 8-9% annually; period of 2010-2015 achieve 6-7% yearly and 2015-2020 achieve about 5-6% annually.

b) Meat carcasses production: until 2010 will be at 3,200 thousand tons, of which : pork meat accounted 68%, poultry 27%, cow meat 3%; to 2015 achieve 4,300 thousand tons, of which : pork meat accounted 65%, poultry 31%, cow 3%; 2020 achieve 5,500 thousand tons, of which : pork meat accounted 63%, poultry 32%, cow 4%.

c) Milk, eggs production: until 2010 achieve 7 billion eggs and 380 thousand ton, respectively; until 2015: about 11 billion eggs and 700 thousand tones; until 2020: approximately 14 billion eggs and over 1.000 thousand tons.

d) Average livestock production/capita: till 2010 achieve: 36 kg meat of carcass, 82 eggs, 4.3 kg of milk; to 2015 achieve : 46 kg meat of carcass, 116 eggs, 7.5 kg of milk and 2020 achieve 56 kg meat of carcass , over 140 of eggs and over10 kg of milk.

e) Proportion of meat processed by slaughterhouse or processing factories as compared to total meat production in 2010 reach about 15%; to 2015 reach at 25% and until 2020 will be over 40%.

Pollution from livestock waste, especially for pig raising, not only is on air pollution but also heavy impact on living environment, on land and water resources. Free grazing method, or raising on the slope land, at sources of steams are being seen as common in rural area and it is causing the soil erosion, reduction of land and water quality as well as decreasing agricultural production on the large areas. Therefore, it is a need to develop livestock production in parallel with applying environment protection measurement so as the living quality of people in rural area can be improved and increased significantly. In addition, polluted

environment in turn will have negative impact on livestock sector that made the sector to be challenged with production ability, competitiveness capacity and sustainable development issues.

As a result, attaching between development of production, improving income of livestock sector and protecting, environmental treatment during raising livestock process is crucial and necessary works.

5. Biogas development in Vietnam

Biogas is renewable energy received from the biomass broken up process in fastidious environment of waste coming from agricultural by-products, livestock, water treatment... Biogas potential of Vietnam from livestock wasted is about 2 billion m^3. If taking averagely 200m^3 of biogas per one ton of material and 10% biomass transfer to biogas, there will be a production of biogas of 2 billion m^3. Plus with 2 billion cubic meter of biogas produced from livestock waste so total biogas production may be reached at 4 billion m^3 a year.

At present there are many organizations, projects participating in research and development of biogas utilization. There are also several individual persons who paid attention on research and innovation biogas appliances, especially concentrated on electricity generator using biogas as a fuel material.

At present time, majority of biogas plants in the country are used for cooking, and lighting. In the farms where are raising more than 50 head of pigs, the produced biogas become abundant for cooking and lighting demand so as the surplus biogas is released to open air. While the methane will cause glass house effect 23 times greater than CO_2 so that releasing biogas to open air will make the environment pollution more serious. Utilization of biogas from different sources for electricity generator is necessary to reduce the glass house effects and could save the fossil energy.

6. Importance of biogas technology

The producing biogas process creates many advantages for farmers in both: expanding production scale for increasing income and reducing the environment pollution in the production area as well as in living areas. At the national level, the government can be reduced the dependency on carbon energy so that can reduce the expenditures from importing oils.

Biogas technology is not sophisticated technology so that it can be developed widely in the rural area. Especially, the farmers can save a certain amount of money from buying fuel/wood by utilizing biogas for cooking, lighting and slurry from biogas digester is organic manures which are quite suitable for crop production, particularly in organic cultivation.

In America until the year of 2006 there were 380 big dumping grounds equipped with methane collection system and transfer to electricity. In the next few years it is estimated that about 700 dumping grounds will be installed the system. A typical instance at Irvine, California the methane from Bowerman dumping

ground will be utilized as fuel source for the public transportation means in the city.

Considering the environmental benefit the bio-methane is a cleanest energy until today. If methane is not collected from dumping places, lagoon etc, it will be a pollution source that have a big impact on global warming. If the biogas is placed by carbon energy so there will be more benefits because of less methane released to the air. Beside, the other benefit can be recognized as reduction of waste and new income source for the users.

7. Biogas development market and applied biogas technology in Vietnam

Common applied biogas technology in Vietnam has been seen as for cooking and lighting. However, recently there is several ways to utilize biogas such as for water heater, pumping and especially for electricity generation.

Using biogas as a fuel source for electricity generator brings a countable economic benefit. According to research group of Technology College, Da Nang University, if a family raising more than 50 pig heads, that family can utilize the biogas for small electricity generator and that could be able to save about 24 million VND in a year. The motor used biogas can transfer 1 cubic meter of biogas become 2 kWh of electricity, and save 0.4 liter of diesel.

At that time, biogas collected from waste is almost free, and can help farmer actively having electricity source for their place, not only reducing the fuel expenditure cost led to obtain higher income but also utilizing it for tractor, harvest machines, irrigation system or reservation tools for agricultural product.

At present, there are several large scale farms building biogas system and applying the new innovation on changing diesel consumed motor into biogas consumed motor with the equipment called Gatec (developed by Da Nang University's engineers). This is considered as new technology to solve the actual issues such as reduction of environmental pollution, actively producing electricity source and save the electricity from national grid network.

A clear evident is at joint stock farm named Trung Sơn, Đà Nẵng city specialized in pig breeding, Mr. Nguyễn Phỉ Tâm, Executive Director said: "The farm has installed the electricity generator using biogas about 5 month with the digester size of 1,700m^3. Since the time of biogas system operated, the smell of pig dung reduced greatly and the pig dung is used as input for the digester. Beside, the biogas-consumed electricity generator, every hour the farm can be benefit from electricity expenditure about 40 – 50 thousand VND, every day the electricity generator run 12 hours, the benefit from this system is not small".

Mr.Tâm's farm has received support from Toyota Company in programme Go Green. At present there are 24 farms in the country got benefit from the programme. With the cost of system of 353 million, innovated from diesel motor, the programme is implemented in Northern and Central provinces and focused on livestock farms. In plan, with in 2 year of 2009 and 2010 there are 500 new packages being installed with supporting cost about 500 million VND.

There are many organizations participating in research on how to utilize biogas such as the Văn Lang University is implementing a study on "Treatment of livestock waste and waste from living livelihood for producing biogas and electricity generation". This study has been accepted by the University committee. From May 2007, Center of science and technology allocation of Bình Dương has been implemented the project "Construction of innovated biogas digester and getting biogas for electricity generator at livestock farm" at Gia Nam company , Village 9, Long Nguyên, Bến Cát with the farm scale over 10,000 pigs. Total investment cost for the biogas system was 642 million VND (of which the farm has been supported by project 30% of the investment cost). After 18 month of implementation, the investment cost was recovered and the benefit for the farm for fuel saving was 90%. Compared as electricity demand of the farm enterprises from national grid network of 29,500 kWh/month, if the electricity unit cost at the time of implementing project was 1,155 VND, the farm has to pay 34 million a month (if applied the new electricity unit cost, this expense should be higher). In the mean time, the electricity generated from biogas source can provide 100% of the farm electricity demand. With the same level of electricity consumption, every month the farm enterprise could save 34 million. After 5 year of implementing project, the benefit that the enterprise could collect at 2,04 billion VND. According to Institute of Energy Science, for those farms with raising scale of 10 pigs, they can construct biogas system and it can provide enough gas for cooking and lighting demand of 4-5 persons in a household. For those farms have bigger raising scale from 10-20 pigs, they could construct biogas system and that can produce enough biogas amount for running 1.5kW electricity generator and electricity can be used for fan, TV, lamp etc.

II. BIOGAS DEVELOPMENT PROGRAMME

1. General information on the programme

The project "Biogas Programme for the Animal Husbandry Sector in Vietnam" has been started since 2003. One of the major objectives of the project is to "Improve the livelihood and quality of life of rural farmers in Vietnam through exploiting the economic and non-economic benefits of domestic biogas technology at household level". As a result, the "sustainable development of biogas sector towards market oriented" is given high priority level by the biogas programme recently.

As of 6th of November 2008 - "Biogas Program for the Animal Husbandry Sector in Vietnam" has organized an inauguration ceremony for the 50,000th biogas plant at Nam Thanh 1 commune, Nam Đàn district, Nghệ An province. The project has been evaluated as the most successful biogas project in Vietnam.

2. Achievement of the project as of October 2009

As of October of 2009, the programme has constructed about 75,000 biogas plants in 36 provinces, cities in the whole of Vietnam. As planned until 2012, the biogas

plants will be developed at 50 provinces and cities.
Based on survey results, average size of biogas digester is 10-11m^3 in total the programme has built up around 850,000 m^3 of biogas digester. This is a valuable contribution in the development of sustainable livestock production and food safety.

Table 2. List of benefited provinces as of 2009

Region	First phase	Bridge Phase	Year 2007-2009
Red River Delta	Bắc Ninh Hải Dương Hà Nội/ Hà Tây	Hải Phòng Ninh Bình Hà Nam	Thái Bình Vĩnh Phúc Bắc Giang Hưng Yên Nam Định
North East	Lạng Sơn Thái Nguyên	Phú Thọ Yên Bái	Quảng Ninh
North West	Hòa Bình	Sơn La	Lào Cai
North Central Coast	Nghệ An Thừa Thiên Huế	Thanh Hóa	
South Central Coast	Bình Định		Quảng Ngãi Khánh Hoà Quảng Nam
Central Highland	Đắc Lắc		Gia Lai Lâm Đồng
South East	Đồng Nai		Bà Rịa – Vũng Tàu
Mekong River Delta	Tiền Giang		Trà Vinh Kiên Giang Cần Thơ Vĩnh Long Bến Tre

Source: Biogas Developement Programme, 2009

PART II. BIOGAS USER SURVEY - BUS 2009

I. OBJECTIVE OF THE SURVEY

1. General objective

Biogas User Survey is aimed at providing information at beneficiary level on construction quality, training, communication, livestock waste management, awareness and opinions of household on biogas. Moreover the biogas user survey will provide information that help in improving and strengthening of project implementation until 2011 on the aspect of policy development, construction guideline, training, quality control, financial subsidy, etc. Beside the biogas user survey will continue to provide the evidence of positive impact of the programme on environment and social and economic issues.

2. Specific objective

TOR of BUS 2009 has given out of 5 main specific objectives as following:

Firstly, a specific objective is to survey the products and services rendered by the BP like:

User training;

Construction quality and investment cost;

Quality control job and acceptance procedure;

Operation and maintenance, specifically input (dilution, material);

Slurry used;

Gas used;

Subsidy payment;

Dissemination of the project to removable areas in district;

The function of BP technician as perceived by users.

Secondly, verification and assessment of the social, economic, and environmental impact from the use of bio-digesters are multi-benefits claimed by the programme. The impact on finance (returns and savings), fuel substitution, time saving, sanitation (on farm, manure management, toilets, wastewater) health and environment will be assessed by mirroring between group of household having bio-digesters and control group of comparable households without bio-digesters.

Thirdly, providing general information on socio-economic conditions of the three segments: Relative poorer households; average household; well-off households. That will make recommendations for the programme how to increase its outreach to the different types of rural households in Vietnam.

Fourthly, a survey on current biogas appliances used by farmer. These aspects are: what kind of appliance (stove, filter, lamp, electric generator, etc) type, price and typical technical error of them;

Fifthly, the biogas user survey may study the development trend of bio-digesters in the coming years, and recommend BP to respond to it in the coming years.

II. APPROACHES AND METHODOLOGY

1. Approach

In order to meet the above objectives the consultant team applied 2 approaches in the assessment that are from people and from product.

1.1. ASSESSMENT FROM PEOPLE POINT OF VIEW

The nature of this approach is to utilize the knowledge; experiences of those participated in a certain field, subject to draw opinions, judgments and recommendations on that field or subject.
Using this approach the consultant team will assess the following contents:

- Assessment on the support of local authorities for the BPD
- Assessment on level of understanding and obtaining information on biogas
- Assessment of biogas plant construction demand of households
- Assessment on acceptance level of household toward the effectiveness of biogas plants
- Assessment on operation and maintenance, using biogas and slurry of the farmers
- Assessment on level of support from technician and mason team...

1.2. APROACH OF ASSESSMENT FROM PRODUCT

This approach allows the assessment of product quality by using statistical methods, surveys and observation. The consultant is using this approach to assess the biogas product through getting related information from several sources such as from BPD office, PBPD's, and survey.
This approach will apply for analysis the below items:

- Assessment on quality of the biogas plant
- Assessment on quality of the biogas appliances
- Assessment on quality of project services: training, support, guarantee, operation and maintenance....
- Prediction of demand on bio-digester size in coming year.

1.3. APROACH TARGET

Project office, administrative authorities: collection information on energy, agriculture, livestock, health, environment, economics, and level of accessibility of farmers to biogas utilization.
Technician and the mason: assessment of works and activities done according to technical requirements of the plant
Biogas users and non-biogas users: conducting survey, inventory by using questionnaires to get information at household level.

2. Methodology

The BUS 2009 conducted through 4 steps: desk study, field survey, analysis and reporting. During BUS implementation, the consultants has maintained close link to Central Project Office to ensure all activities are followed the plan as well as requirements.

2.1. DESK STUDY

The consultant group conducted the reviews of all documents that related to the content of the survey, including some of project documents, biogas information, livestock sector of Vietnam, BUS reports of 2005, 2006, BUS 2007-2008 and reviews information from 7 proposed provinces for field survey namely Vĩnh Phúc, Hưng Yên, Ninh Bình, Quảng Ngãi, Bình Định, Bến Tre, Bà Rịa-Vũng Tàu.

2.2. DATA COLLECTION

2.2.1. Design of survey tool

The survey protocol included sets of integrated questionnaire that serve for household survey of both biogas user and non-biogas user, and that of in-depth interviews for those from administrative officers of provincial, districts, commune levels or extension workers, statistics record, progress checking lists and questionnaire guide.
Base on the study of TOR, documents reviews the group of consultant of the company designed 4 types of questionnaires that reflect requirements of TOR and further information that help for the analysis. (Questionnaire 1: Biogas user ; Questionnaire 2 – Non-biogas user; Questionnaire 3 – Investment cost by digester-size and Questionnaire 4 – open question types that use to work with related department, key informants and experiences people on biogas development).

2.2.2. Selection of surveyed province

Based on the database and requirements on biogas plants constructed (2003-2009) as TOR so there were 7 provinces had been selected: Hưng Yên, Ninh Bình, Vĩnh Phúc, Bình Định, Quảng Ngãi, Bến Tre, and Bà Rịa- Vũng Tàu. At each province, select 2 districts and each district selected 2 communes for the survey.

2.2.3. Adjustments and survey training

The group conducted survey test at Hung Yen province. All tools were tested at the province under provision of BPD with participation of whole survey group. All difficulties (education level of respondent, way of posing questions that fit to respondent and local context) were recorded and made amendments for survey guideline. Time of conducting a questionnaire also recorded.

2.2.4. Data processing

Inputting data: A simplified programme for data input was designed and served for the easiness of inputting data and export raw data and information. Data set was categorized by list, by locality and by time dimension.
Data processing: In order to analyze of data, the available software like SPSS/Access, Excel will be utilized

PART III. SURVEY RESULTS

I. SOCIAL-ECONOMIC SITUATIONS OF SELECTED PROVINCES

1. Socio-economic conditions

The following table states the basic information of selected provinces for BUS 2009. The average population of those provinces is about 1 million people. However, there is a big difference in population density, from lowest 253 people/km^2 to highest 1,214 people/km^2. Only Ba Ria – Vung Tau has average income per capita of 9.3 million VND/person/year, the other six provinces have average income per capita about 6 million VND/person/year.

Hung Yen has smallest area of agriculture, 55.5 thousand hectares, Vinh Phuc has 59 thousand hectares and Ninh Binh has 62.7 thousand hectares. Southern provinces have area of agriculture of 1.7 to 2.4 times as high as Northern areas. This shows the potential for agricultural production of the southern provinces and they have more advantages compared to other northern provinces. Table below shows Hung Yen, Vinh Phuc's development of poultry with per capita poultry is 5-6. While the number of breeding pigs per capita among the provinces of Hung Yen, Vinh Phuc, Quang Ngai, Binh Dinh, Ninh Binh is about 0.4-0.5 head.

Table 3. The number of livestock per capita at survey provinces

Unit: head

No	Province	Ruminant	Pigs	Poultry
1	Hung Yen	0.04	0.53	5.68
2	Vinh Phuc	0.14	0.42	6.04
3	Ninh Binh	0.06	0.32	2.91
4	Quang Ngai	0.28	0.43	2.06
5	Binh Dinh	0.28	0.53	3.66
6	Ben Tre	0.15	0.24	3.05
7	BR-VT	0.05	0.24	1.59

Source: Calculation of the consultant group, BUS 2009

Based on the topographic conditions there is situation of disparity of livestock development between the provinces. Binh Dinh and Quang Ngai have larger hilly and mountainous area, and then the number of ruminant is much greater than other provinces. Specifically, Binh Dinh has 326.7 thousand head of ruminants; Quang Ngai Province has 329.6 thousand much more than the rest provinces from 1.3 to 6 times.

Table 4. General information about the selected provinces for BUS 2009

Province	Area (km2)	Population (1000people)	Density (pp/km^2)	Capita income (1000VND)	Agricultural land (1000 ha)	Ruminant (1000 heads)	Pigs (1000 heads)	Poultry (1000 heads)
Hung Yen	923.4	1,167	1,214	6,672	55.5	48.9	615	6,623
Vinh Phuc	1,231.8	1,014	823	6,480	58.9	168	490.5	7,050
Ninh Binh	1,388.7	937	674	6,108	62.7	65.8	372.3	3,394
Quang Ngai	5,152.7	1,302	253	5,460	122.6	329.6	502.8	2,405
Binh Dinh	6,039.6	1,593	264	6,636	135.6	326.7	621.4	4,269
Ben Tre	2,360.2	1,360	576	7,368	136.2	172.4	280.3	3,565
BR-VT	1,987.4	961	484	9,312	109	53.4	278.1	1,857

Source: Statistical yearbook 2008

While with the advantages of existing natural conditions and traditional breeding, there are four provinces including Hung Yen, Vinh Phuc, Quang Ngai and Binh Dinh with number of pigs from 500-600 thousand head, double compared with Ninh Binh or Ba Ria-Vung Tau.

Poultry production in Vinh Phuc and Hung Yen is also the largest number of poultry in the selected provinces with 7 million and 6.6 million heads, respectively. The rest provinces have number flocks of about 2-3 million.

2. Situation of animal husbandry and livestock development orientation in the provinces to investigate

The following table summarized the situation of livestock production and livestock development orientation of the selected provinces. Most provinces are paying attention on livestock development and practicing of raising livestock safety and reducing environmental pollution issues.

Table 5. Situation of animal husbandry and livestock development orientation in the surveyed provinces

Province	Breeding situation and development orientation
Hung Yen	Growth of the livestock sector achieved on average 9% per year; varieties of quality continue to improve towards "pigs are more lean, cow are more Sindhi" At present the percentage of lean pigs reached 57 % of total pig production and the proportion of hybrid Sindhi cows reached 88% . Livestock and poultry increased rapidly, the average growth rate of 5-6% per year. By the end of 2008, an estimated 50.4 thousand head of cattle with the production output of 2.3 thousand tons, 590 thousand pigs with production output of 68.4 thousand tons, poultry has 6.29 million with the production output of 17.2 thousand tons. Along with that, the concentrated raising method are being expanded, now pigs livestock concentration is 20% total population, 17% of cattle and poultry 7% **Orientation:** Continue to implement the propaganda "pigs are more lean, cow are more Sindhi" programs, implementing effectively the concentrated raising schemes which is away from residential areas,

Province	Breeding situation and development orientation
	intensive farming of tilapia, rice fish models; encouraging the development of a model livestock concentrated large-scale, high quality, waste treated associated with environmental protection.
Ninh Binh	Presently, number of livestock and poultry of the province has reached nearly 380,000 pigs, 62,000 buffaloes, cows, 3 million poultry, 21,000 goats, sheep ... The statistics of the husbandry and veterinary shows: in 2008 only has over 50 farms with large-scale industry and located away from residential area and has solutions for waste treatment, the rest of farms are backyard styles, in the village, and do not have any measures to handle livestock waste, causing environmental pollution, increases risk of diseases for cattle, poultry and affecting human health. Actual situation is that of many families without sanitary cages, no waste treatment causing the pollution of air, water sources for many households living nearby due to the livestock waste was discharged directly into public drainage system, to fish ponds, or used to apply directly for crops. **Orientation:** to make livestock and aquaculture becoming the main production sectors and toward industrialization that server for providing food source for urban and export processing. Successfully implementation the "pigs are more lean, cow are more Sindhi" programs. Rapidly growing pigs for meat in concentration areas and households backyard. Develop the dairy farming, the breeding of cattle, poultry and aquaculture with high economic value.
Vinh Phuc	**Orientation and objectives:** To better exploit the potential and strength of the livestock sector, Vinh Phuc Province has launched the solutions in order to "speed up" livestock development in 2010, set up target orientation until 2020. From now to 2010, the province maintains growth rate from 2 to 2.5%, which increased 8.2% livestock, raising the proportion of breeding from 31% to 37% in agriculture. In 2010, the province will raise the total to 43 thousands head of buffaloes, over 400 thousand cows, 700 thousands of pigs and over 10 million poultry. The province will have 50% of farms, family ranch having industrial cooling system, the automatic drinking system for cows, pigs and poultry. By 2020, livestock sector will be concentrated large-scale systems using automatic feed chain, collecting eggs or cleaning cages.

Province	Breeding situation and development orientation
Quang Ngai	Continue to develop in the direction of commodity production, in association with the market and for export, livestock sector of Quang Ngai at the end of 2007, buffalo – cows are already up to 350,000 heads (including 284,500 cows), nearly 400,000 pigs, and 2.5 million poultry. In 2007, the value of agricultural production reached 1,631 billion VND, up nearly 4% compared with 2006, in which, breeding accounts for 31% of raising the proportion of agriculture. **Orientation:** To develop the pig production that will provide more lean meat, high quality; to continue improving and upgrading cow herd; applying form of hybrid breeding birds rotation to give high commercial production; develop the production systems of small animals and clean production technology for breeding; research capacity to develop breeding a new animal breeds.
Binh Dinh	Livestock and poultry according to survey October 1, 2008 and compared to the time of investigation of August 1, 2007 as follows: Buffalos are 19,217, down 4.6%; Cow are 307,477, decreased 8.4%, 82,421 pigs, down 6.1%; poultry 4,269,575, up 17.5%. Although cow herd and pigs decreased, livestock products increased significantly with the production of beef slightly marketed 18,390 tons, up 17.0%, pork production slightly marketed 61,829 tons, up 2.5% and output of poultry meat is 6245 tons, up 31.9%. **Orientation:** Focusing and using solutions to promote the development of animal husbandry and poultry in the form of goods and concentration livestock development with intensive bio-security and product diversification to meet the market demand in both domestic and international area. Continue to implement the improvement and development programs of breeding cows for meat, lean pigs. Livestock development in the direction of farms, livestock concentration zones are eligible for intensive and increase productivity, quality, raising efficiency, disease safety and environmental protection.
Ben Tre	**Development goals by 2020:** ***Animal husbandry:*** Developing farms, industrial and semi-industrial, combining the practice of raising bio-secure and diseases free, in which: ▪ Cows: increase 200,000 heads, the proportion of high quality beef from 25-30%. ▪ Pig: increase to 400,000 heads, meat output reached 90-100000 tons per year.

Province	Breeding situation and development orientation
	▪ Poultry breeding**:** Development towards the farm, industry, ensuring biological safety, combined with the breeding control, scale: 6 million heads and 100 million eggs per year. ▪ Develop synchronously the management system, control the veterinary facilities from the province to lower levels, consolidation of research units, the scientific and technical activities; strive to ensure high quality breed source supply from the spot 90-95%, and a system husbandry and veterinary services in accordance with market mechanism is the control of the State, develop synchronously the poultry slaughter cattle concentrated in the districts and towns commune....
Ba Ria - Vung Tau	For years, BR-VT livestock sector has also achieved some results, such as rate of livestock and poultry breeding in the concentration farms, makes up 68.82%, while in households declining only 31.18%; veterinary system was developed from province to district and commune **Orientation**: As planned, from now until 2020, BR-VT province will build breeding farms, slaughter facilities - processing - consumption of animal products - poultry concentrated in the districts, towns and cities with the method and modern techniques to create high quality and competitive products with reasonable prices; Ability to actively supervise and control the disease risk insurance, especially bird flu, foot and mouth disease ... overcome environmental pollution from livestock operations, slaughter, transport and business ... Strive to 2020, the value of livestock production sector farming in the province will reach around 1,460 billion or 36% of the total value of agricultural production, sufficient to meet the needs of the production and partly through the neighboring provinces

Source: Report on breeding plan, plans of animal husbandry of provinces

II. GENERAL ASSESSMENT OF THE DEVELOPMENT OF BIOGAS IN THE SURVEYED PROVINCES

1. Advantages and disadvantages when implementing biogas projects in the provinces

The information collected by the survey shows that in the selected provinces there are information channels such as radio and television to disseminate knowledge of biogas such as application of biogas technology to livestock waste treatment, creating gas for livelihood activities and environmental protection. As a result, awareness of the community gradually changing, many people are interested in biogas models.

The attention and activities paid by local government are also positive factors, contributing to the success of the program. Especially in Quang Ngai, the households who have built biogas plants are supported by the province an additional amount of 1.5 million (excluding from project support's source) per biogas plant. Another consideration is indispensable to the direction of the agriculture extension center, the center of Water supply and Sanitation in the provinces, the dynamic technician's teams. Since then create momentum and favorable opportunities for service teams to play their role in the community, biogas service providers.

Difficulties in the development of biogas must consider to the blue ear pig outbreaks and foot and mouth disease, avian influenza has occurred in a row in the provinces in recent years caused livestock herd reduction. Farmers are no longer enough ability to build biogas plants.

Besides the objective difficulties are also limitations from the people – Many households are relying or increasing dependency to the programme finance so that significantly reduce a certain number biogas plants supposed to be built for example some better off households can be able to build biogas plant using their own money without relying on programme finance, however they are trying to delay from 6 months to 1 year to be in the list of project beneficiary. The delays go with two purposes: i) getting support and ii) sound of being a "project participant"; in some places, the government has not really participated actively in biogas development.

In some provinces, due to economic conditions the counterpart fund for biogas development is limited, therefore limited biogas development, while the demand and abilities of people still are accountability.

2. Review and evaluation of general recommendations posed by previous BUS

Current trends of building bigger size of biogas in the provinces under the programs become clear so that the biogas marketing and propagation of biogas as well as research activities on technology, up scaling of the project are being conducted by the programme.

In addition the project is continuing to improve accessibility and participation of

above poverty line households through promotion programs, finding fund sources or loans source of international donors.
Support mason teams to establish private enterprises in developing biogas is a proper direction follow the direction of PPP (Public Private Partnership) in order to draw resources from the private sector to participate in the process of reducing pollution and enhancing cooperation between economic sectors.
In 2009 the project is also supporting two studies on technology that are research of developing the biogas filters and electricity generators using biogas.

3. Results of the Biogas project to 2009 in the provinces to investigate

So far, the project has developed a Biogas program in 37 provinces and cities throughout the country, the table presented below shows the list of provinces in the project by the ecological, economic, and the stage.

Table 6. Implementation progress of the surveyed provinces in 2009

Province	Planning (biogas plant)	As of 3rd quarter 2009 (biogas plant)
BR. Vung Tau	200	107
Ben Tre	600	460
Hung Yen (initial)	400	490
Ninh Binh	800	580
Binh Dinh	900	750
Vinh Phuc	695	590
Quang Ngai	500	472
Total	**4,095**	**3449**

Source: Biogas project, 2009

In the surveyed provinces, at third quarter of 2009, on the average the province has reached 84% of the plan. As of 3rd of October, 2009 in total 7 provinces have constructed 4,095 biogas plants. Most provinces have achieved its progress. Hung Yen province has exceeded 122.5% of the plan. In 2009 the target of the biogas plant is 400 but the province has built 490 biogas plants. Only Ba Ria Vung Tau province has reached 53.5% of the progress. It is easy to understand that this is a newly province participated in the project, so reaching 107 biogas plants is a big effort for project staff of Ba Ria-Vung Tau.

III. RESULTS OF SURVEY 2009

1. Information on household surveys

1.1. DISTRIBUTION OF SAMPLE SURVEY

BUS 2009 selected sample survey of 301 households (exceeded 1 household as required) in 7 provinces of the program.
The sample survey had 211 households of biogas user and 90 households of non-biogas user. Among non-biogas households there were 45 households have same standard of living with biogas users and the rest may have a lower standard of living.

Table 7. Sample distribution of biogas user and non-biogas user by provinces (household)

No.	Item	Province							Total
		BĐ	BR-VT	HY	VP	NB	QN	BT	
1	Of households with the construction period 2003 - 2005	20							**20**
2	Of households with the construction period 2006 - 2008	4	24	24	24	24	24	25	**149**
3	Of households with the construction phase in 2009	6	6	6	6	6	6	6	**42**
4	Non-Biogas household having same living conditions	7	7	7	6	6	6	6	**45**
5	Non-Biogas household having lower living conditions	7	7	7	6	6	6	6	**45**
	Total	**44**	**44**	**44**	**42**	**42**	**42**	**43**	**301**

Note: VP-Vinh Phuc, HY-Hung Yen, NB-Ninh Bình, QN-Quang Ngai, BĐ-Binh Dinh, BT-Ben Tre, BR-VT- Bà rịa-Vung Tau

The selected provinces located in the North, Central and South of Vietnam. In each province conducted survey in two districts, two communes for each district and at least two villages of each commune, using the data source from the project. Based on the requirements of the TOR, and the selection of biogas samples users, the team was selecting households that meet the requirements of the three phase project (2003-2005; 2006-2008 and 2009). 20% of biogas user households in sample survey having biogas plants built in 2009. For biogas users the sample selection was conducted as following way: from the database of BPD central office on the list of households constructed biogas plants, the consultant team had selected randomly the following way: on the list every tenth households were selected for the surveyed list. Each surveyed province had a list of 40 households (in which 10 households for contingency). For non-biogas users, sample survey was selected based on the commune profiles as well as consultation from local

authorities. A list of non-biogas users having same conditions with biogas users (similar livestock raising scale was key indicator for selection) was made. For those having lower living conditions, the selection was made by using the average income line of a certain commune and livestock raising scale as key indicators. Household having lower income as compared with average income line and having livestock was selected into the long list and after that was randomly selected.

1.2. INFORMATION ON HOUSEHOLD SURVEYS

1.2.1. Some general information on household surveys

An average number of members in a household are from 4 to 5 people, where labor accounts for 2-3 people. Men and women's average rate of household surveys is quite balanced with men accounting for 2.44 and women are 2.33. The average number of members and labor of the biogas user household and non-biogas user household has no significant difference between provinces. The scale of demographic surveys of households is in the average. According to calculations, at the raising scale level of 4 pigs (total weight 150 kg) and if a household construct a biogas digester with size of 4-5 m^3 that will satisfy the need of waste treatment and providing enough energy for cooking and lighting.

Table 8. The basic information of biogas user households and non-biogas households

No.	Item	Unit	Total	BR-VT	Ben Tre	Binh Dinh	Hung Yen	Ninh Binh	Quang Ngai	Vinh Phuc
1	**The average number of members of each household**									
-	**Biogas user household**	person	**4.77**	5.13	4.13	4.57	4.60	4.59	5.27	5.07
-	**Non-biogas user household**	person	**4.63**	4.58	5.15	4.36	4.79	4.25	4.25	5.00
2	**The average number of labor of each household**									
-	**Biogas user household**	person	**2.89**	3.60	3.03	2.40	2.84	2.62	3.20	2.53
-	**Non-biogas user household**	person	**2.96**	3.17	3.38	2.64	2.79	3.00	2.83	2.92
3	**Academic standard of household survey**									
	Biogas user household	**%**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
-	Primary, secondary school	**%**	**65.37**	80.00	74.19	63.33	52.00	82.76	63.33	40.00
-	High school	**%**	**32.20**	20.00	25.81	33.33	40.00	13.79	33.33	60.00
-	Upper high school	**%**	**2.44**			3.33	8.00	3.45	3.33	
	Non-biogas user household	**%**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

No.	Item	Unit	Total	BR-VT	Ben Tre	Binh Dinh	Hung Yen	Ninh Binh	Quang Ngai	Vinh Phuc
	Primary, secondary school	%	**78,94**	90,00	91,67	76,92	76,92	100,00	45,45	71,43
	High school	%	**19,74**	10,00	8,33	23,08	23,08		45,45	28,57
	Upper high school	%	**1,32**						9,09	

Source: Survey of biogas users in 2009

There were not much differentiated condition of members or labors in a household in the three segments but slightly different in education level. Biogas user households tended to have a higher education level than non-biogas user households. Percentages of households heads obtained higher education level in biogas user households are higher than that of non biogas user households.

1.2.2. Situation of livestock between households using and not using biogas

In terms of population size, labor, there is no difference between biogas user and non-biogas user household. But in terms of agricultural production, there is a very big difference between the two groups investigated. The following table illustrates the difference.

Table 9. Livestock Production comparison between the two type

Item	Biogas user	Non-biogas user with same level	Non-biogas user with lower income level
Buffaloes (head/household)	0.51	0.38	0.18
Pig (head/household)	26.65	24.12	12.68
Poultry (head/household)	71.40	51.62	30.77

Source: Survey of biogas users in 2009

Based on the results of calculations in the table above we can see that regarding to animal husbandry such as buffalo, pigs that the non-biogas user only equals to 70% production of the biogas user. Biogas user household raise about 27 pigs, 71 chickens and every two households have a buffalo as compared to 24 pigs, 50 chickens and every three households of non-biogas user with the same level of income. The lower income level of non biogas user even raises less: about 13 pigs, 31 poultries and every 5 households having one ruminant. The biogas user households have bigger-scale livestock production with and have more selling goods than non-biogas user household. It can be seen from BUS 2005, 2006, 2007 to 2009; the BUS biogas user households are capable of actively producing than the group not using biogas.

1.2.3. Income of biogas user and non-biogas user household

Average income of a biogas user household reached at 74.9 million VND per year, or 16.6 million VND/person/year (equivalent to 1.5 million VND/person/month).

Among survey provinces, Ben Tre has highest average income: 34.6 million per person per year, the lowest is in Binh Dinh is 8.1 million VND/person/year. Difference is mainly due to the livestock production scale of households surveyed in Ben Tre is bigger than other provinces.

Compared to the households near the poverty line, income of the households with livestock raising are 2-3 times higher. Thus, households with livestock scale equivalent to the 5 pigs/herd obtained the income level from medium to moderate. Average income of non-biogas user household reaches 48.1 million VND per household per year, or 11.9 million VND/person/year (equivalent to 960 thousand VND per month). In particular, Ba Ria –Vung Tau province has highest income per capita of non-biogas user household, approximately 20 million VND/person/year; the lowest is in BInh Dinh with 7.3 million VND/person/year.

Table 10. Average income of surveyed household

Unit: million VND

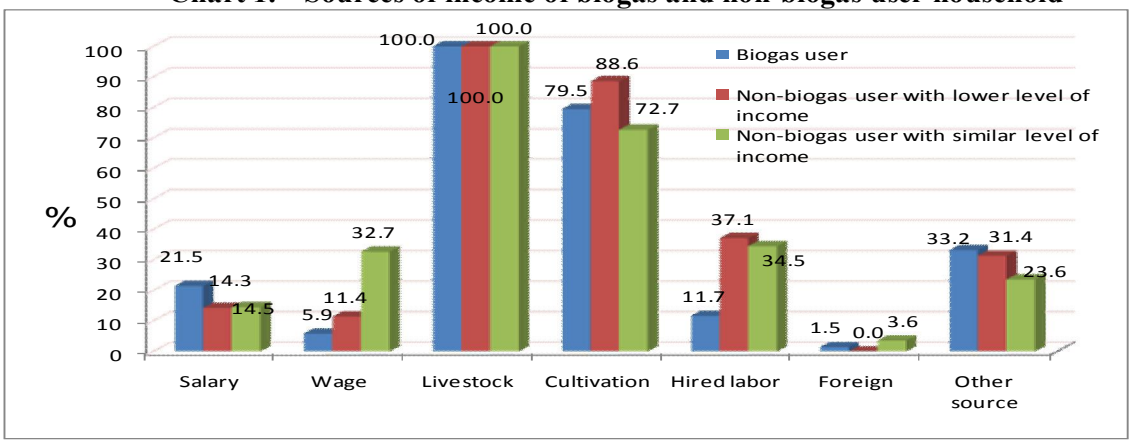
No.	Item	Total	BR-VT	Ben Tre	Binh Dinh	Hung Yen	Ninh Binh	Quang Ngai	Vinh Phuc
1	**Average income per household per year**								
-	Biogas user household	74.9	128.2	122.8	36.0	87.1	43.3	59.4	47.6
-	Non-biogas user household	48.14	52.4	59.9	32.0	58.0	48.7	43.3	42.7
2	**Average income per person per year**								
-	Biogas user household	16.6	26.0	34.6	8.1	21.3	11.9	12.3	12.2
-	Non-biogas user household	11.9	20.2	11.6	7.3	12.1	11.5	10.2	10.1

Source: Survey of biogas users in 2009

Average income of non-biogas user household is lower than that of biogas user household in all provinces. This reflects the fact since the actual samples for investigation were selected for 45 households with the same living condition and 45 poorer households than other groups.

Revenue of biogas user household is coming from animal husbandry (100% of survey sample; 55% of income), cultivation 79.5% of households; 18% of income) and other income sources such as business, services, hired labour (50% of households; 27% of income).

Chart 1. Sources of income of biogas and non-biogas user household



For non-biogas user household, the source of income from livestock is 100.0%, over 80% from cultivation, other sources of income such as employee, labor salary accounts for 20-30% of households

It can be said that the sources of income of biogas user and non-biogas user household (both lower income level and similar income level) are almost similar and coming from livestock and cultivation. However the non-biogas users tend to have more income from hired labor, salary, wage and other sources. The group of lower income level of non-biogas user is earning more from cultivation and hired labor as compared to other groups. Only very few households have money to support from abroad. Actual survey shows that surveyed households exceed the new proposed poverty line of Vietnam for 2010-2015 [1] from 2.5 to 3 times

In term of financial needs for economic development, there were 89 households accounted for 42.2% of total surveyed biogas users had borrowed money from financial agencies for their production development (majority borrowed for livestock raising). On average, a borrower borrowed about 40 million in a year and the borrowing time was 2 years on average.

Table 11. Borrowing situation of surveyed biogas user

Item	Unit	Quantity	Compared with total (%)
Number of borrowers	Household	89	42,2
Number of non-borrowers	Household	122	57,8
Average borrowing amount	Mill. VND	40,5	

Source: BUS 2009

[1] Household living in rural area has monthly average income per head below 350,000 VND, urban household with monthly average income below 450,000 VND will be considered as poor household and benefit from supporting policies of the government.

2. *Assessment of service quality of the project*

2.1. INFORMATION ON BIOGAS PLANT CONSTRUCTION OF BIOGAS USERS

Of the 211 biogas user household being evaluated, 5 households built in 2004, 10 households built in 2005, 4 households built in 2006, 34 households built in 2007, 106 households built in 2008 and 52 households built in 2009

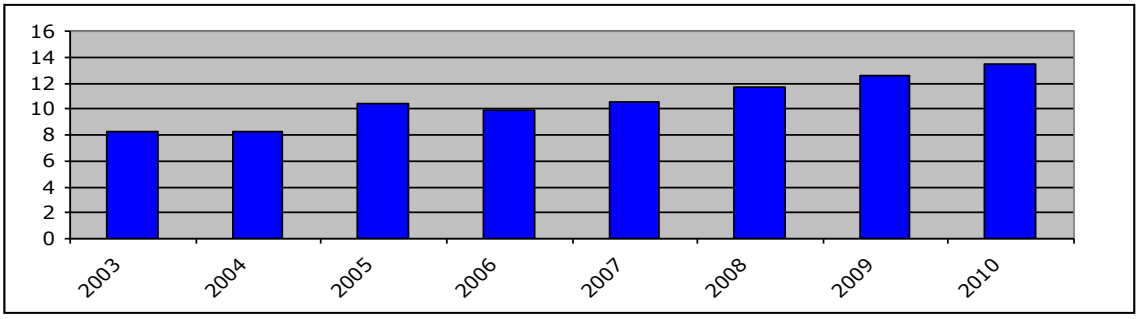
Table 12. Information on biogas construction of the households

Year to be built	Unit	Total	Vinh Phuc	Hung Yen	Ninh Binh	Binh Dinh	Quang Ngai	BR-VT	BT
2004	%	2.37	-	-	-	16.67	-	-	-
2005	%	4.74	-	-	-	33.33	-	-	-
2006	%	1.90	-	-	-	13.33	-	-	-
2007	%	16.11	30.00	-	16.67	16.67	50.00	-	-
2008	%	50.24	33.33	76.67	63.33	6.67	36.67	86.67	48.39
2009	%	24.64	36.67	23.33	20.00	13.33	13.33	13.33	51.61
Total	**%**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Size of biogas construction	m^3	11.2	14.7	15.7	9.8	8.3	7.2	8.4	14.5
+/- compared to average size ($11.2m^3$)	m^3		3.46	4.45	-1.36	-3.05	-4.07	-2.82	3.29

Source: Survey of biogas users in 2009

The average size of the biogas plant in BUS 2009 is $11.2m^3$, bigger than the average of the household's census from 2008: 1.5 m^3. In particular, the biggest belongs to the biogas plant of surveyed household in Hung Yen province, 15.7 m^3; the smallest average size is the biogas plant of the households in Quang Ngai 7.2 m^3. Three provinces: Hung Yen, Vinh Phuc, Ben Tre have bigger biogas plant than average size, the rest is smaller than average from 1.3 to 4 m^3.
The average size of the digester in BUS 2009 is increasing compared to earlier BUS's because the average size per year is increasing. The chart below is from the BP database.

Chart 2. Average size of the biogas plant (m3)



Source: BPD database

Assessing the suitable level of plant size: 88.2% of total households thought that the size of their biogas plant is appropriate to their family's usage, 1.9% of total households evaluated it was too big and 9.9% of total households evaluated it was too small. The size of biogas plant in previous years was small but now majority of the households said their biogas plant is suitable volume. Quang Ngai Province is involved in the second phase of the project and has smallest average volume of biogas plant with 7.2m^3/biogas plant, and the biogas plants with too small volume are 16.7%. Meanwhile, Vinh Phuc and Hung Yen have higher average volume of the biogas plants, there are 4 households of the two provinces evaluated it was too big.

Rate of the biogas plant attached with the latrine is 54.3% of total number of plants; of which in Vinh Phuc, Hung Yen province, there was highest rate of the plant attached with the latrine 83-87%. While in Quang Ngai, Ba Ria -Vung Tau, Ben Tre, only 13-35% of total number of households has plant attached with the toilet. In fact, the southern provinces have larger area of land, so, breeding facilities are located far from housing place, and then the rate of plant attaching to the latrine is low.

Table 13. Digester size and suitable level

No	Criteria	Unit	Total	Vinh Phuc	Hung Yen	Ninh Binh	Binh Dinh	Quang Ngai	BR-VT	Ben Tre
1	Average digester size per plant	m^3	**11.22**	14.7	15.7	9.9	8.2	7.2	8.4	14.5
2	Assessing the suitable level of digester size	%	**100**	100	100	100	100	100	100	100
-	Suitable	%	**88.2**	90.0	90.0	90.0	96.7	83.3	93.3	77.4
-	Too big	%	**1.9**	3.3	10.0	-	-	-	-	-
-	Too small	%	**9.9**	6.7	-	10.0	3.3	16.7	6.7	22.6
3	Rate of the plant having connection to the toilet	%	**46,0**	83.33	86.67	73.33	60	26.67	13.33	35.48

Source: Survey of biogas users in 2009

2.2. ASSESSING THE CONSTRUCTION PRICE BY YEAR OF CONSTRUCTION

The average construction cost for 1m^3 of biogas plant has changed by year and by area.

Common construction cost for households in the provinces of Vinh Phuc, Binh Dinh, Ninh Binh and Hung Yen is the same at 0.5 to 0.7 million for 1 m^3, Quang Ngai is 1 million for 1 m^3; of Ba Ria-Vung Tau and Ben Tre is 860 thousand for 1 m^3.

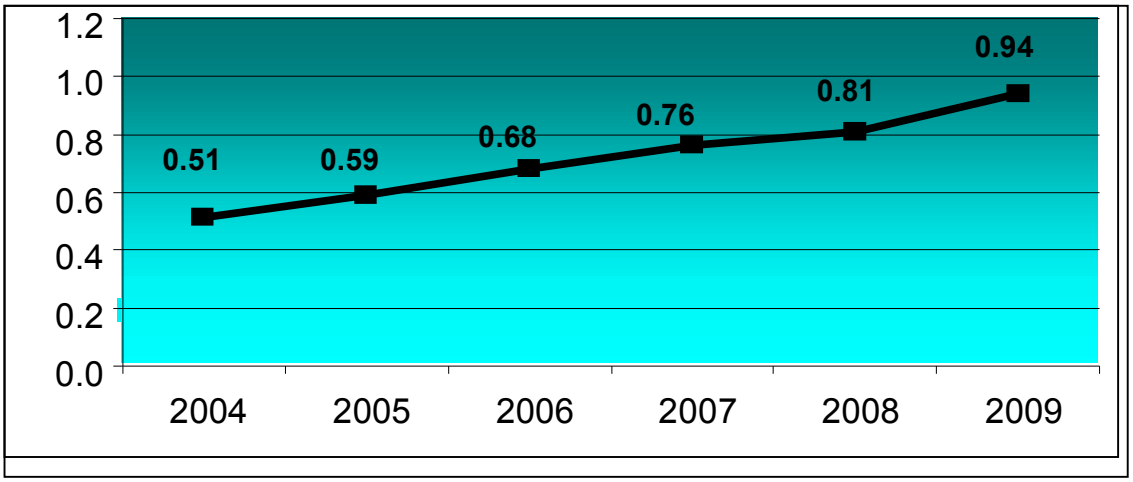
Table 14. The average construction cost for 1m3 of biogas plant in the surveyed provinces in 2009

Province	Vinh Phuc	Hung Yen	Ninh Binh	Binh Dinh	Quang Ngai	BR-VT	Ben Tre
Price/m3 (million VND)	0.60	0.51	0.62	0.68	1.07	0.86	0.86

Source: Survey of biogas users in 2009

The average cost of construction of the biogas plant increased from 0.51 million VND for one cubic meter of biogas plant size in 2004 to 0.81 million VND in 2008 and continues to grow to 0.94 million VND in 2009 per cubic meter. Households that build biogas plant are supported 1,2 million VND per biogas plant (before 2009 the support level is 1 million), particularly, in Quang Ngai province, out of 1,2 million VND supported by the project, the province also supports 1.5 million VND for each plant. The rest is invested by the households.

Chart 3. Cost of 1m3 built by years of construction works (million VND)



In recent years, the price's tendency of materials and labor increases, so construction costs increased in range of 0.8 to 0.9 million VND for 1 m^3. The construction cost's result by year of construction obtained from BUS 2009 was consistent with the result in BUS 2007-2008 (differences can occur due to different samples).

Despite the support of the project over the years remained at 1 million and in 2009 was 1.2 million per one plant, the households have seen benefit from the biogas plant for their life so they still actively participated in the project. In recent years, excluding from the amount of money supported by project, to construct a biogas plant the average amount of money invested by household is 7.02 million VND and the additional borrowed money from other sources is about 1 million VND. Through direct interviewing households in the provinces, it is seen that a biodigester in the southern provinces need much more brick than that of in the north as the size of brick there is nearly two times smaller. In a detail specific case

of biogas construction for digester size of approximate of $10m^3$ in the table below will show more about the different price.

Table 15. Detailed construction cost of a specific biogas plant in this survey.

(For construction of 10 m3)

No.	Item	Unit	In Ba Ria- Vung Tau province			In Vinh Phuc province		
			Quantity	Unit Price (1000 đ)	Amount (1000 đ)	Quantity	Unit Price (1000 đ)	Amount (1000 đ)
I	**Cost of materials**				**6,672.00**			**3,370.0**
1	Cement	ton	1.1	1440.0	1512.0	0.9	840.0	756.0
2	Solid brick	piece	3500	0.9	3150	1600	1.0	1600
3	Sand	m3	3.0	200.0	600.0	2	130.0	260.0
4	Gravel	m3	1.5	200.0	300.0	1	200.0	200.0
5	In-outlet pipes	m	3.0	190.0	570.0	3	80.0	240.0
6	Steel Ø 6	kg	15.0	12.0	180.0	12	11.0	132.0
7	Gas collecting pipe	m	0.5	20.0	10.0	1	18.0	18.0
8	Gas pipe	m	30.0	7.0	210.0	12	7.0	84.0
9	Pressure meter	piece	1.0	40.0	40.0	1	30.0	30.0
10	Valve T, cuzee and degree reduction	set	1.0	100.0	100.0	1	50.0	50.0
II	**Cost of biogas using**				**570.0**			**360.0**
1	Biogas double stove		1.0	500.0	500.0	1	320.0	320.0
2	Lamp	piece	1.0	70.0	70.0	1	40.0	40.0
III	**Cost of labor**				**3,760.0**			**3,480.0**
1	Mason	Manday	14.0	114.3	1600.0	13	150.0	1950.0
2	Assistant mason	Manday	7.0	80.0	560.0	7	90.0	630.0
3	Digging the earth	Manday	12.0	100.0	1200.0	10	100.0	1000.0
4	Other cost	VND			400.0			
	Total				**11,002.0**			**7,210.0**

Source: Survey of biogas users in 2009

2.3. ASSESSING THE OPERATION OF BIOGAS PLANTS IN THE HOUSEHOLDS.

The raw materials providing for the biogas plants in the households are human and livestock waste. No households use input from vegetation. The main materials used are dung of pigs (90 - 100% of total plants); 54% of total plants coupled with latrines. During the survey, most of surveyed household of biogas users were pig raising, one fourth of survey households were raised ruminant and about half poultry. Because the comparision among diferrent raising types was not addressed and required as from beginning of BUS 2009. As a result, the comparison among biogas users of different raising types on operation and

maintenance could not be done. The consultant team would recommend if there is a separated research on this matter or incorporate it in the TOR for BUS 2010.

Table 16. Method of inputting material for biogas plant

Unit: %

	Method of inputting material		
Province	**Guideline**	**Estimated**	**Other**
For all investigated households	**9.0**	**81.52**	**9.48**
Vinh Phuc	6.7	90.0	3.3
Hung Yen	3.3	80.0	16.7
Ninh Binh	13.3	73.3	13.3
Binh Dinh	6.7	70.0	23.3
Quang Ngai	16.7	83.3	0.0
BR-VT	10.0	83.3	6.7
Ben Tre	6.7	93.3	3.3

Source: Survey of biogas users in 2009

According to the survey, only 10% of households have inputted correctly material following the guidance of the project. The correct method is to put the manure in the dilute tank, add water to dilute in the ratio 1 liter – 2 liter water of 1 kg manure, stir and mix regularly, and then open the cover so that the mixture flows into the biogas digester. 9.0 % of biogas user provide materials quantitatively, 81.52% of the households provide by estimation; the rest (9.5%) of the households provide wrongly; as compared with BUS 2008 the respectively numbers were 35.6%, 49.4% and 15%.

Obviously, wrong inputting materials and not following the instructions will result in problems that households have a full bio-digester but no biogas and especially, some households have to rent sucking machine with the cost from 300,000 thousand VND to 700,000 thousand VND once, depending on the size of the digester.

2.4. ASSESSING THE QUALITY OF CONSTRUCTED BIOGAS PLANTS

Assessment of actual quality of a constructed biogas plant of the project may be based on the used technology and construction quality of the plant. By asking people in the 7 provinces on the existing biogas technology used in the local area as well as assessing the best biogas technology (with multi-choices selection), the answer from 199 respondents was that the project technology is the best, the next biogas technology is composite digester with 41 responds, 35 responds assessed the nylon digester in which 29 responds considered it as a worst technology. The below table showed the assessment on biogas technology in the local area.

Table 17. People's opinion on technology and design of biogas digester (opinion)

	Nylon Bag	Squared Digester	Composite	Vietnam-Holland Project	Other project
Best	0	1	9	112	1
Good	0	13	26	86	17
Medium	8	8	1	1	4
Worst	21	1	0	0	1
Don't know	6	6	5	0	5
Total	**35**	**29**	**41**	**199**	**28**

Source: BUS 2009

The biogas plant quality is assessed through operating process in each household. The households inquired will evaluate their plants by using the rank of very good, good, normal and degraded.

According to the evaluation of households using the biogas plants, the very well operating plants are 104 households 49.3%, the well operating ones are 43.6%, the normally operating ones are 6.6% and degraded one was 0.5%. One household in Binh Dinh province said that a biogas plant degraded due to construction near the canal so causing foundation was depressed.

Table 18. Assessing the status of the biogas plant (opinion)

Item	Total	Vinh Phuc	Hung Yen	Ninh Binh	Binh Dinh	Quang Ngai	BR-VT	BT
Status of work	**211**	**30**	**30**	**30**	**30**	**30**	**30**	**31**
Very good	104	18	11	8	12	14	19	22
Good	92	12	13	19	16	15	9	8
Moderate	14	0	6	3	1	1	2	1
Degraded	1	0	0	0	1	0	0	0
Gas produce	**211**	**30**	**30**	**30**	**30**	**30**	**30**	**31**
Enough only in summer	*6*	*0*	*2*	*1*	*2*	*1*	*0*	*0*
Exceeded	*35*	*8*	*4*	*3*	*3*	*7*	*1*	*9*
Always enough	*165*	*22*	*23*	*24*	*24*	*21*	*29*	*22*
Not enough	*5*	*0*	*1*	*2*	*1*	*1*	*0*	*0*
Households excess biogas	***35***	***8***	***4***	***3***	***3***	***7***	***1***	***9***
Process: For neighbors	8	1	1	0	1	3	0	2
Burned	20	5	3	2	2	3	0	5
Discharged into the environment	7	2	0	1	0	1	1	2
Number of biogas plant with bubbles	***211***	***30***	***30***	***30***	***30***	***30***	***30***	***31***
Can be seen	16	4	2	2	0	1	4	3
Can't be seen	160	20	26	21	26	14	26	27
No care	35	6	2	7	4	15	0	1

Source: Survey of biogas users in 2009

With the quality of biogas plant, under the evaluation of the user, the full and enough biogas production for usage is 200 households, accounting for 94.7% of household surveys, only 6 households have enough gas in the summer (2 households in each province of Hung Yen, Binh Dinh and one household in Ninh Binh and Quang Ngai province) constitute 2.8%. Households do not have enough gas is 5 households in the provinces of Hung Yen, Ninh Binh, Binh Dinh and Quang Ngai.

Table 19. Assessing the quality of biogas plant by province

Unit: %

Quality	Total	BR-VT	Ben Tre	Ninh Binh	Hung Yen	Binh Dinh	Quang Ngai	Vinh Phuc
Very good	**49,30**	60,00	68,00	43,30	36,70	29,00	53,40	60,00
Good	**43,60**	30,00	32,00	53,30	46,70	57,70	43,30	40,00
Moderate	**6,60**	10,00		3,40	16,60	10,00	3,30	
Degraded	**0,50**					3,30		
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Survey of biogas users in 2009

The table above assessed the quality of the biogas plants shows that in the investigated provinces, 90% -100% of the users admitted that the plants are operating well and extremely well. Particularly, in Binh Dinh province only one biogas plant is degraded (built 2007) and 2 other plants are evaluated as normal.

Table 20. Assessing the quality of construction by year

Unit: %

Quality	On average	2004	2005	2006	2007	2008	2009
Excellent	49.30	50.00	20.00	50.00	37.50	61.20	62.30
Good	43.60	50.00	80.00	50.00	59.40	34.40	30.20
Average	6.60					4.40	7.50
Was degraded	0.50				3.10		
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Survey of biogas users in 2009

Based on the quality of the construction mentioned above, it can be verified by the criteria of gas production of biogas plant. Of the total 211 households, 164 households evaluated biogas production is always full and well-operated. There are 35 households said that their biogas production is exceeded. This number is shared by 9 households in Ben Tre, 8 households in Vinh Phuc, 7 households in Quang Ngai. The rest is 3-4 households.

In terms of quality of gas production in 211 biogas plants, 11 biogas plants provide enough in summer or even not enough. This rate accounts for 5.2% of the

surveyed sample, distributed in the provinces of Hung Yen, Ninh Binh, Binh Dinh, each province has 3 households, and 2 other households are in Quang Ngai province. These are the provinces where assessed quality of the mason at average level is higher than that of other provinces.

For those households having abundant gas and released to open air, there was 7 cases accounting for 3.32% of total surveyed biogas users. The frequencies of releasing abundant gas was 1.9 time/month.

Table 21. Frequencies of releasing abundant gas to open air

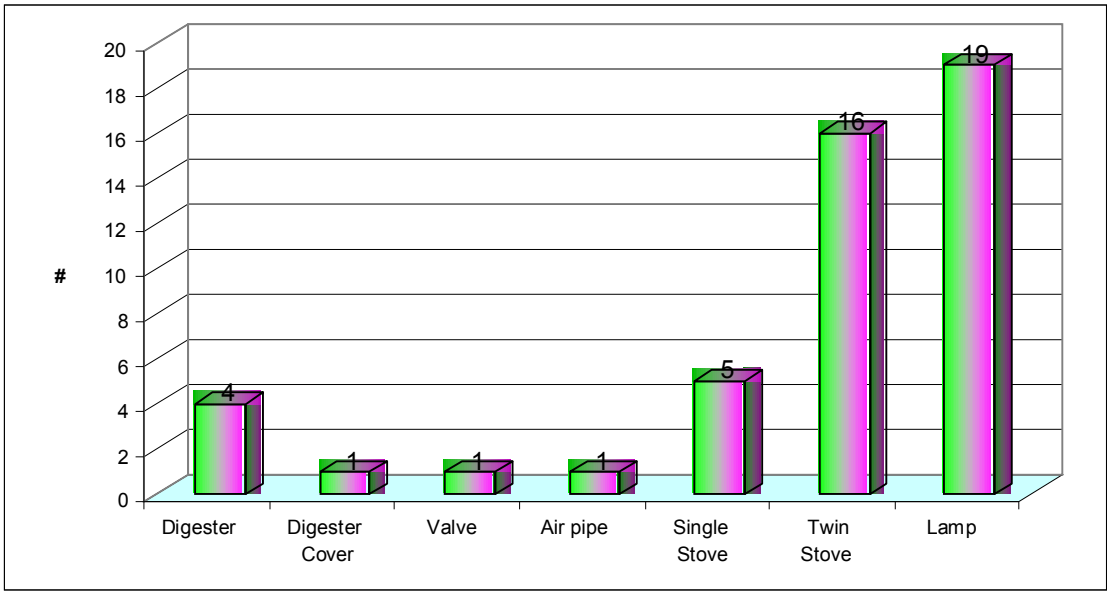
Province	Number of releasing (plant)	Average of releasing time per/month	Releasing plant/total plant (%)
Vĩnh Phúc	2	2	6.7
Hưng Yên	0	0	0.0
Ninh Bình	1	1	3.3
Bình Định	0	0	0.0
Quảng Ngãi	1	2	3.3
Bà Rịa-Vũng Tàu	1	2	3.3
Bến Tre	2	2	6.7
Total/average	7	1.9	3.8

Source: Survey of biogas users in 2009

2.5. ASSESSING THE QUALITY OF EQUIPMENT

Learning about the operation of the biogas equipment with 48 of total 211 households said their biogas equipment or accessories had been damaged. Most of the broken devices that use biogas are gas cooker (16 cases), lamps (19 cases) and 5 cases of single gas cooker.

Chart 4. Number of damaged equipments and applicances (piece)



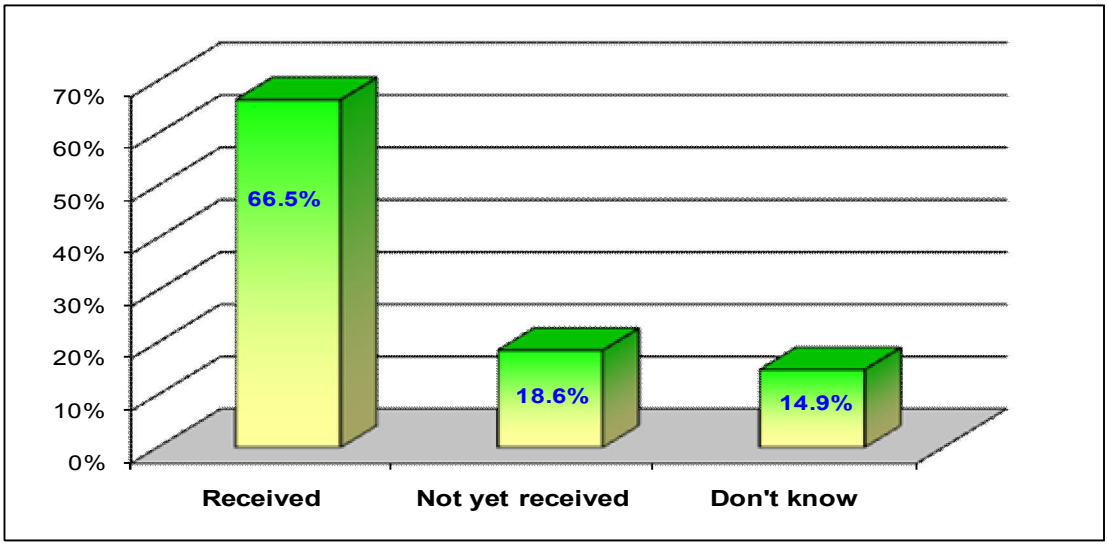
8 households have broken parts of biogas plants (digester body and digester components), accounting for 3.8% of the total 211 works. There are 4 plants have damaged digester body, in which, Quang Ngai province has 2 cases, Ben Tre and Hung Yen province, each has one case. The broken components of digester are compensation tank's cover (1 case), gas pipes (1 case), valves (1 case), and filter (1 case).

Thus, in the biogas system, the accessory equipment damaged most is bio-gas stove and lamp, account for 19% of households. Devices such as the main valve, gas piping, gas valves... are at lower rate (accounting for 2-3%).

2.6. ASSESSEMENT OF SERVICES ABILITY

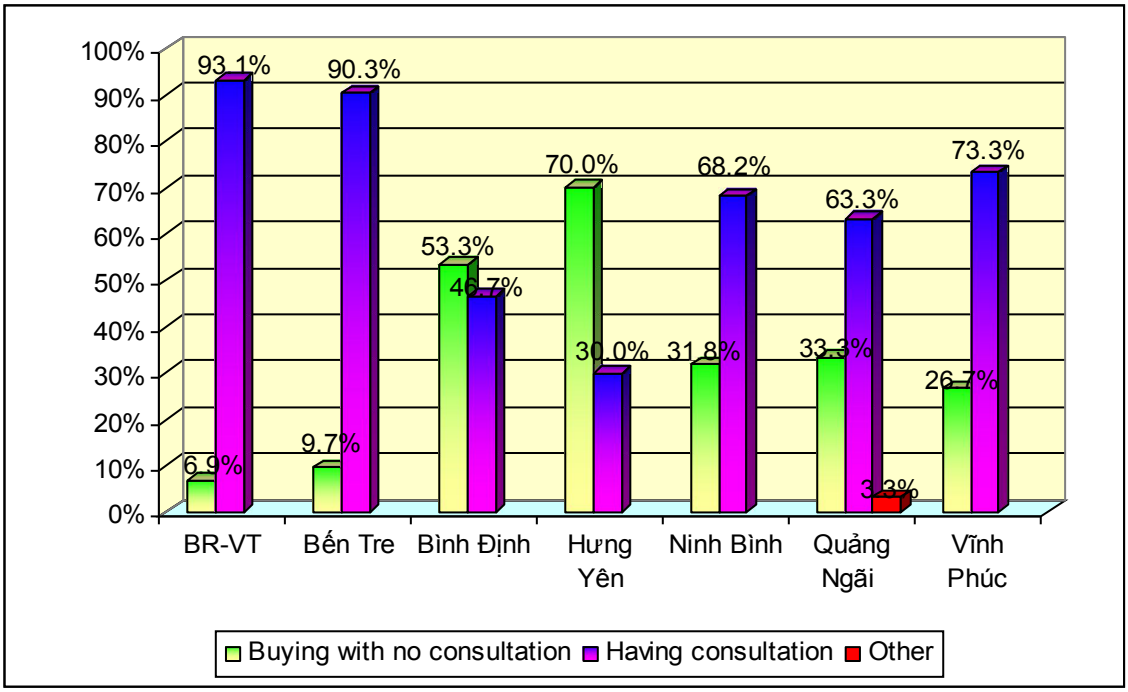
After completion of construction works, the masons are responsible to give warranty certificate to households and works directly for the warranty. Households who have received warranty paper account 66.5% of total household surveys, households not receiving warranty paper occupy 18.6%, and 14.9% did not know (some households cannot memorize whether they received warranty or not). The majority of households without warranty paper said they were not worried about it, because the masons provided phone numbers, when the devices or works are damaged, the household simply contacted to the masons to have devices repaired.

Chart 5. The rate of households receiving warranty after completion of construction works



The quality of construction depends heavily on the quality of materials and construction techniques. In the context, most of the households ask or hand over for the masons to choose materials. 70% of households in Hung Yen province have self-purchased materials without taking consultation from masons or technicians due to the high level of brick and sand availability, the other 5 provinces have rate of buying materials with consultation from 47% to 90% of household construction.

Chart 6. Construction materials purchased following consultancy (%)



2.7. ASSESSMENT OF THE TECHNICIANS AND THE MASONS

2.7.1. Assessment of technicians

The selected district technicians for the Project are the bridge that links the Project Office to the households. They not only help the households register to join the Project, introduce the masons trained by the Project, but also guide the households to operate, maintain the biogas plants and use the biogas equipments. By working with the district technicians in the field trip, the consultants have found the important role of the technicians in introducing the Project to the households, in consulting and assisting them in operation and buying the biogas equipments and maintaining their biogas plants...

District technicians are also responsible for managing the masons, monitoring the construction of the biogas plants, internal checking and solving any related problems and guaranteeing job of the masons.

In general, the households who use biogas give good comment about the district technicians. They have technician's phone number to solve any problems related to biogas and they always receive enthusiastic help and consulting.

The district technicians follow closely the plants; on average they come to check the for one biogas plant about 4 times in which two for technical guidance and two for quality control.

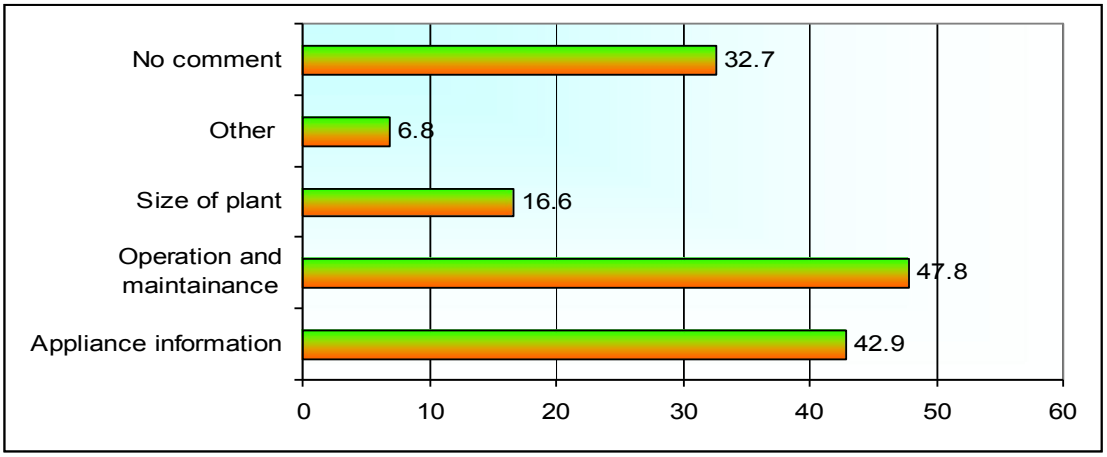
Table 22. Average number of visits for technicians (times/biogas plant)

	BR-VT	Ben Tre	Binh Dinh	Hung Yen	Ninh Binh	Quang Ngai	Vinh Phuc	Total
Technical guidance	1.50	1.58	1.63	2.50	2.64	1.52	2.33	**1.85**
Quality control	1.68	2.00	1.41	1.86	2.41	1.36	2.89	**1.90**

Source: Survey of biogas users in 2009

Most of biogas user household and potential households (households signed the application) have good reviews for the technician capacity, level, and working methods. When being asked to have wishing for further support from technical staffs , 47.8% of households wished to be consulted more about maintenance and warranty (actually, maintenance and warranty guidance are usually undertaken by the masons) and 42.9% of households would have more information and guidance on using equipments. Devices that households are interested in are pumps, generators, air filtration systems. Approximately 17% of households want technical adviser to consult for biogas plant size to be suitable for their conditions at that time and in the future.

Chart 7. Wishes to have assistance from technicians (%)



2.7.2. Assessment of the masons

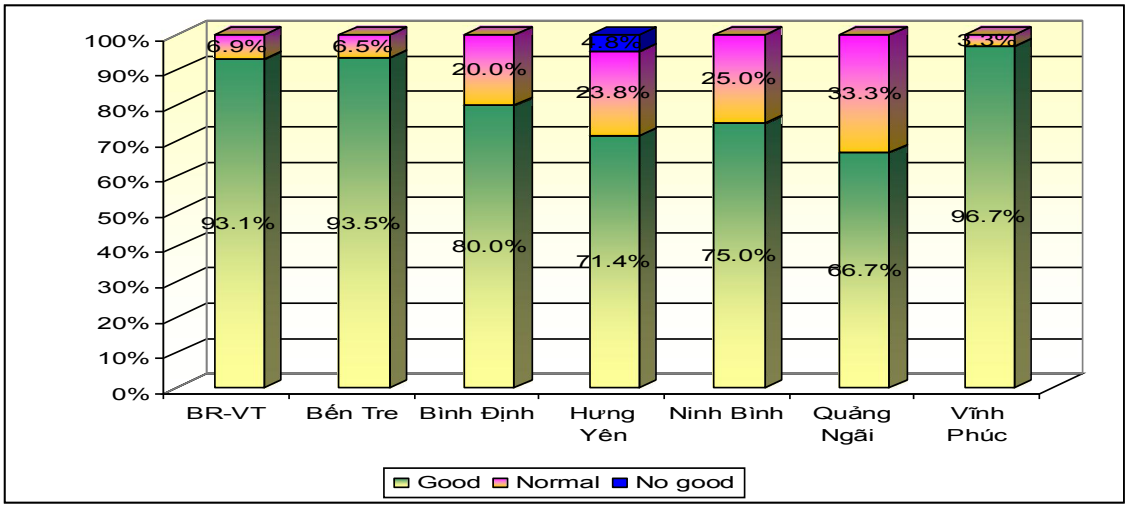
The Project's masons are trained and certificated by the Project to build the biogas plants when needed. In fact, not only constructing biogas plants in many places, the masons are also responsible for providing the households the warranty and guaranteeing and selling biogas devices such as gas stoves, lamps, and other accessories using biogas.

The mason quality is evaluated by the construction and guaranteeing quality and the households' evaluation. And the quality of mason works is indirectly assessed by directly interviewed households –their customer.

Quality of construction is a clear indicator that expresses the efficient work of the

mason teams. At survey time, there were 92,9% of biogas plants assessed as very well and good operation, about 6,6% surveyed biogas plants have been assessed as operation moderately and only one biogas plant in Binh Dinh was degraded (occupied 0,5%) (see 2.4 "assessing the quality of constructed biogas plants"). As can be seen in the Chart 8 below only one household in Hung Yen said that the construction quality is not good. As can be seen in the provinces of Binh Dinh, Hung Yen, Ninh Binh and Quang Ngai, the rate of the households giving normal comment of the masons is higher than that of other provinces. The reason is that, in those provinces, the rate of malfunction is higher than that of the other provinces.

Chart 8. Assessment of the masons



There are many households reflecting that they have to wait 1-3 months to get biogas plant having constructed by the masons as mason is busy for constructing biogas plant for other households.

2.8. ASSESSMENT OF FINANCIAL SUPPORT AFTER COMPLETING THE CONSTRUCTION

According to the Project's commitment, each household who joins the Project will receive 1.2 million VND for a biogas plant building technically and operating correctly from the year 2009. Before 2009, each household who joined the Project was supported 1 million VND. At the time of the survey, 140 households in a total 211 households have received subsidy. 34 households have not yet received money, all from the 42 2009's plants that were surveyed.
Evaluation on procedures for receiving cash assistance from the project shows that 63.69% of households said that the procedures are simple, 31.31% said that the procedures are normal and 1,19% commented that the procedures are complex due to they have to wait for certification of the commune and only person who hold the identification card can get money, other member of family cannot receive.

Table 23. Evaluation on procedures of subsidy received from the project

Unit: %

	BR-VT	Ben Tre	Binh Dinh	Hung Yen	Ninh Binh	Quang Ngai	Vinh Phuc	Average
Quick, simple	96.60	81.80	50.00	30.00	41.70	60.00	85.70	**63.69**
Normal	3.40	18.20	50.00	65.00	41.60	26.70	14.30	**31.31**
Complex				5.00		3.30		**1.19**
Not received					16.70	10.00		**3.81**
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Source: Survey of biogas users in 2009

When asking households about the time to register for the project, the time registration takes about 19 days, 2 days to be approved by the functional agencies (the Commune People's Committee) and 7 days to be approved by the Project. Particularly, it took 120 days for a household to register (due to quota allocated to the local was running out, so they have to wait for the complement).

Table 24. Percentage of participants in solving registration (%)

	BR-VT	Ben Tre	Binh Dinh	Hung Yen	Ninh Binh	Quang Ngai	Vinh Phuc	Total
Technician, agriculture extension staff		46.70	31.00	33.30	10.53	64.30	70.00	**37.00**
Masons		23.30			10.51	3.60	25.00	**9.10**
Commune staff, head of village	44.40	30.00	69.00	66.70	68.44	32.10	5.00	**43.60**
Member of women organization	55.60				10.52			**10.30**
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Survey of biogas users in 2009

Normally, the households with expectations to build biogas plants registered with technicians and ask them to give instructions to complete the application papers and procedures for registration.

2.9. ASSESSING THE ACTIVITIES OF TRAINING AND PROPAGANDIZING FOR BIOGAS USER

The activities of training and propagandizing on using the biogas plants are often organized by the project office through seminars on propagandizing, training and visiting the operating plants, popularizing the biogas technology along with the training courses of Livestock or clean water supply and rural environment hygiene…In the seminars, the training courses and the field trips, participants received books and materials related to the biogas technology which edited,

printed and distributed by the Central Project office and the provincial and district project office. Besides, all the households taking part in the project also received the user-handbooks and document's material of the project.

Table 25. Participating the training course (%)

	BR-VT	Ben Tre	Binh Dinh	Hung Yen	Ninh Binh	Quang Ngai	Vinh Phuc	Total
Promotion course			35.70	5.30	5.30		3.30	**7.10**
Using and operating course	34.50	18.50	57.10	73.70	63.20	60.00	50.00	**49.50**
Both courses	65.50	81.50	7.10	10.50	21.10	40.00	33.30	**39.00**
Not participated in yet				10.50	10.50		13.30	**4.40**
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Source: Survey of biogas users in 2009

The survey shows that, only 4.4% of the households have not participated in the training course. Nearly 50% of the households took part in the operating training courses, 7% of total households took part in the promotion courses and are aware of the advantages of biogas and 39% participated in both course.

Evaluation of training courses that the households have been involved: 171 households find that the training courses are easy to understand, easy to implement and follow; 40 households also said that they participated in training, but they did not understand clearly and found it is difficult to follow. Ben Tre, Ninh Binh, Vinh Phuc and Hung Yen provinces where the number of households commented that the training courses are also difficult to understand, difficult to perform with the corresponding rate for each province is 35.7%, 37.5%, 25% and 24% (however, when digging further, the consultant found that most of respondents were not participating in the training courses but their husband/wife took part so that the received information was not directly getting from the training class).

Most of the households (92.6%) found that the training courses are very essential, some considered that it is normal (6.4%) and some households stated that the training courses are not so necessary and the content should be changed content (comments of 3% of households surveyed).

Regarding on books, documentation of the project, and 80.4% of households said that they have understood and follow the guidelines; 19.56% of households complain that it is difficult to understand if they follow the manual; the households expressed their desire to be trained and having practiced at the training course.

Table 26. User's guide to operation and maintenance works of the project

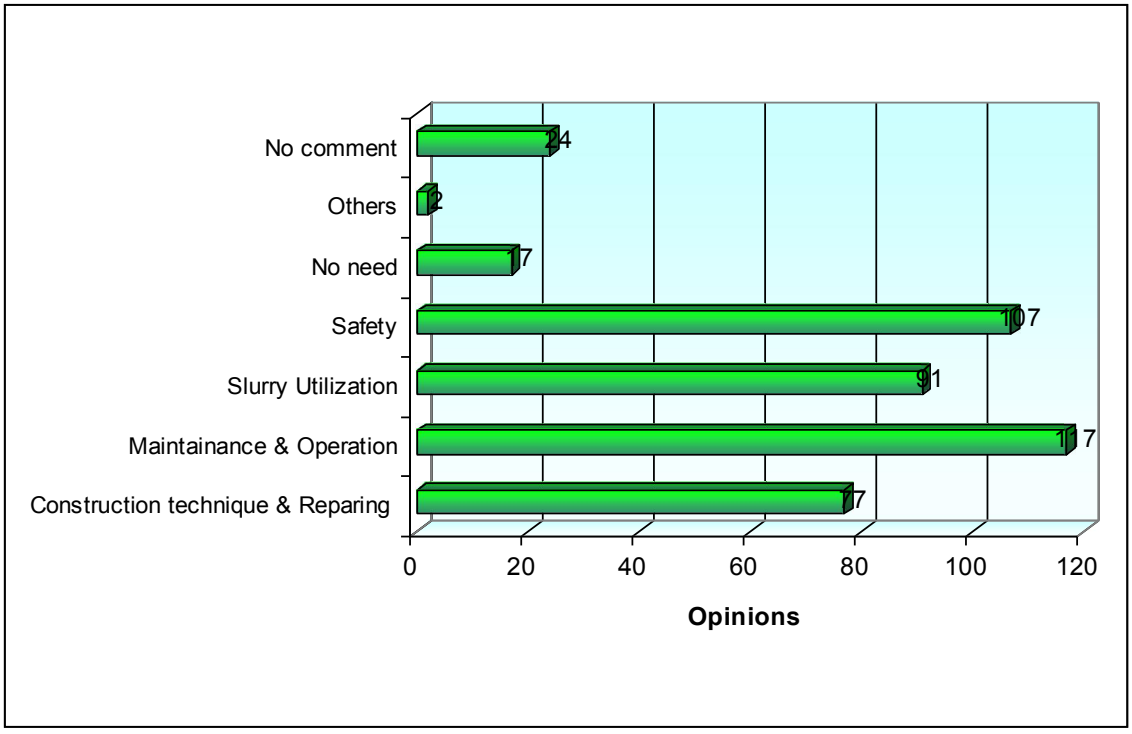
Unit: %

	BR-VT	Ben Tre	Binh Dinh	Hung Yen	Ninh Binh	Quang Ngai	Vinh Phuc	Total
1. Manuals								
- Complex, difficult to follow		24.00	7.10	23.10	36.00	13.80	25.90	**19.56**
- Clear, easy to follow	100.00	76.00	92.90	76.90	64.00	86.20	74.10	**80.44**
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
2. Training courses								
- Complex, difficult to follow		35.70		37.50	25.00		24.00	**16.20**
- Clear, easy to follow	100.00	64.30	100.00	62.50	75.00	100.00	76.00	**83.80**
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Survey of biogas users in 2009

Regarding to content that need to be enhanced in the training, there are 107 households said that the content of safety should be spoken in depth, 117 households are interested in the operation and maintenance; 91 households want to be trained more on the use of biogas slurry; 77 households wish to increase the instructions of construction and repairing.

Chart 9. Contents of training that need to be improved (opinion)



3. *Impacts of the biogas plant on economy, environment and society*

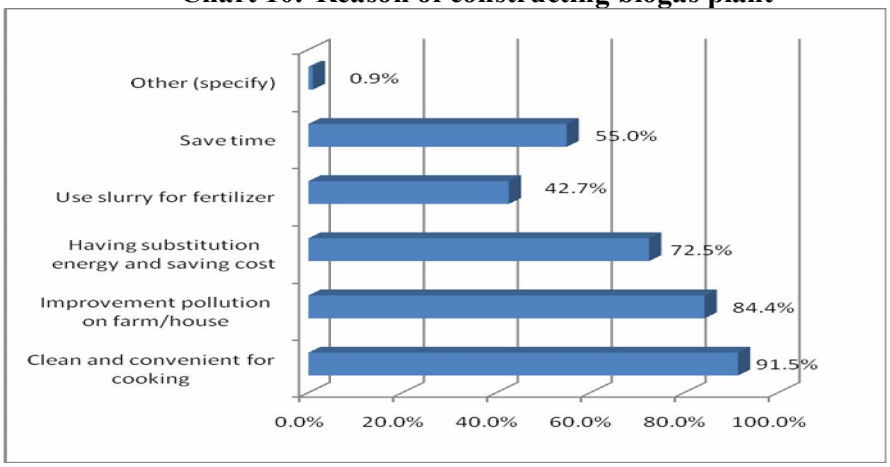
3.1. IMPACTS OF THE BIOGAS PLANT ON HOUSEHOLD ECONOMY

3.1.1. Reason for construction

Recent years, the project has made good propaganda and implemented model demonstration that could help famers to see the great benefits of the biogas and after that, people have increased their awareness and mobilized each other to construct. The reason that makes farmers participating in the project is to improve the living conditions, sanitation, and economic efficiency in the use of fuel. Additionally, there are some households using slurry to make basal material for crop cultivation and this also bring income for residents. It is clearly seen that, before building the biogas plant, the household already understand the benefits brought by biogas plants.

When asked about the purpose of the construction, 91.5% of households said due to clean and convenient for cooking, 72.5% having substitution energy and saving cost and 84.4% household recognized the biogas plant brought an improvement on environmental pollution and better sanitation. About 42.7% said they could utilize slurry for fertilizer and 55% of total biogas user admitted that biogas plant could help their family in saving time of wood collection or cooking.

Chart 10. Reason of constructing biogas plant

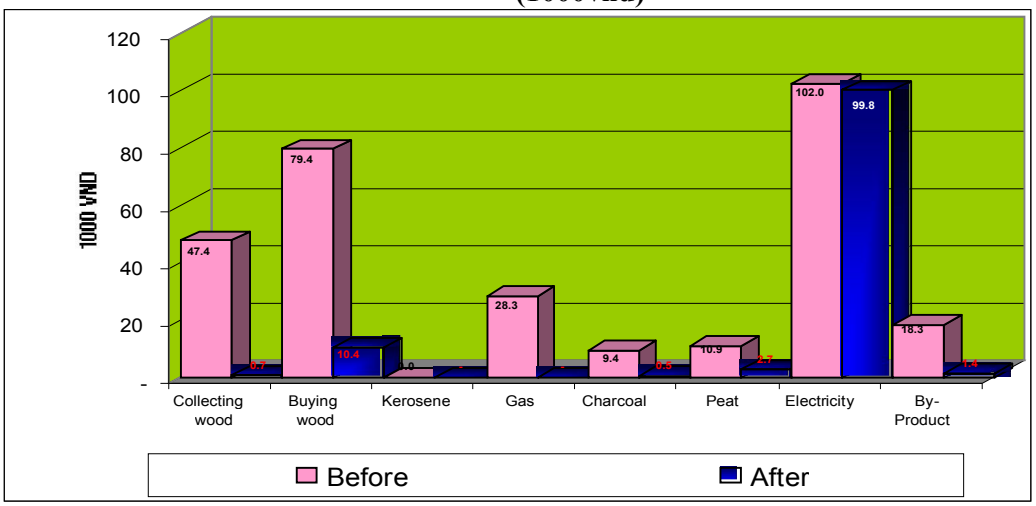


3.1.2. Energy savings

It is very clear to see that after having biogas plant many households could save money from expenditure of buying propane gas, wood, charcoal, as well as wood collecting. Excluding from environmental improvement, the biogas plants were indirectly contributing to the forest protection by less consumed firewood.

Before having the plant, a household paid 295,900 thousand VND a month for cooking and serving daily activities, in which money to buy fuel for cooking is majority including 102 thousand VND for electricity, 126 thousand VND for firewood; 28 thousand VND for bottled gas and others.

Chart 11. Expenditure on fuel as before and after construction of biogas plant (1000vnd)



When the biogas plant came into operation, using the biogas helped the households considerably reduce expense on fuel monthly. The monthly savings a household including 115.73 thousand VND for collecting wood and buying firewood, 28 thousand VND for bottled gas, 16 thousand VND for collecting agricultural by-products such as straw. Total savings on average of a household is 180,340 VND a month. Details of the savings for each investigated province are in the table below. Even after having biogas plant, electricity expenditure in Vinh Phuc and Ba ria –Vung tau was still greater. This can be explained that households in Vinh Phuc and Ba ria-Vung tau had higher income so that they used more electricity appliances like fans, refrigerator…

Table 27. Money saved per month after using biogas

Unit: 1000VND

Item	Averg	Quantity	Vinh Phuc	Hung Yen	Ninh Binh	Binh Dinh	Quang Ngai	BR-VT	BT
1/ Firewood buying	69.40	58kg	150.33	29.00	55.00	48.00	63.33	117.67	21.29
2/ Firewood collecting	46.73	39kg	14.55	34.00	22.00	25.67	47.33	33.00	147.1
3/ Kerosene	-		-	-	-	-	-	-	-
4/ Gas	28,32	1,4kg	26,67	16,33	19,33	24,70	31,50	65,00	15,16
5/ Charcoal	8,93		36,67	17,48	2,00	4,33	-	2,33	-
6/ Briquette	8,19	9,2kg	33,33	10,27	12,67	-	1,33	-	-
7/ Electricity	2,25	3,2kWh	(12,67)	10,97	2,67	12,50	5,67	(6,17)	2,74
8/ Agricultural by-products	16,92	67,6	23,33	62,00	11,33	0,67	21,67	-	-
Total	**180,34**		**272,22**	**180,05**	**125,00**	**115,87**	**170,83**	**211,83**	**186,29**

Source: Survey of biogas users in 2009

Detailed table below shows the expenditure of non-biogas user households. Total expenditures for fuel of non-biogas user household were about 182 thousand VND. There are four main fuel sources namely firewood, electricity, propane gas, and briquette.

Table 28. Average fuel and fertilizer cost of non-biogas user household

Unit: 1000 VND

Average cost/household	BR-VT	Ben Tre	Binh Dinh	Hung Yen	Ninh Binh	Quang Ngai	Vinh Phuc	Average
Fuel (monthly)								
1/ Firewood*	49,2	68,5	42,1	-	27,5	55,0	115,4	**50,7**
2/ Kerosene	-	-	-	4,3	-	-	-	**0,7**
3/ Gas	59,2	1,5	21,4	35,7	19,6	26,3	57,7	**31,4**
4/ Charcoal	5,2	2,3	4,2	6,1	6,5	3,2	5,0	4,6
5/ Briquette	27,5	9,2	-	35,7	30,0	-	8,1	**15,7**
6/ Electricity	185,8	53,1	58,0	83,2	64,6	32,1	56,9	**75,5**
7/Agricultural by-products (straw…)	-	-	12,5	17,3	21,7	7,9	0,8	**8,7**
Fertilizer (yearly)	**450,0**	**269,2**	**1.012,9**	**230,7**	**533,3**	**1.308,3**	**300,0**	**581,2**

Source: Survey of biogas users in 2009 (Firewood expenditure interpreted from buying)*

In order to assess the efficient of biogas plant in the fuel saving aspect, we conducted a comparison of medium income level of biogas user and non-biogas user households (income range is 40-50 million/year; number of observation of both biogas user and non-biogas users was 45).

At level of average income, a household after having biogas plant could save 132 thousand VND (reducing 26kg of wood, 1,5 kg gas, 2,44 kg coal and 151 kg of agricultural by-product)

Table 29. Comparison of fuel uses in one month of households having same level of income (Unit: 1000 VND)

No	Item	Before having biogas plant		After having biogas plant		Non-biogas users	
		Cost	Quantity	Cost	Quantity	Cost	Quantity
1	Firewood*	69,89	35 kg	8,89	4.5 kg	56,78	28,4 kg
2	Kerosene	-		-		-	
3	Gas	29,80	1,5 kg	-		33,11	1,67kg
4	Charcoal	1,11	2.44 kg	-		3,04	6,76Kg
5	Briquette	0,89	1kg	-		0,78	0,8 Kg
6	Electricity	91,47	130 kWh	89,89	128kWh	53,27	97kWh
7	Agri-by product	37,78	151 kg	-		31,00	124 kg
	Total	**230,93**	-	**98,78**	-	**177,98**	-

Source: Survey of biogas users in 2009 (Firewood expenditure interpreted from buying)*

3.1.3. Slurry use

Considering on the matter of slurry utilization of biogas users in the crop cultivation, the below table showed that on average of 12.8% of cultivation area was applied biogas slurry. Total respondents answered yes to slurry uses were 106 or occupied 50.2%. 94 cases used slurry as liquid type and 12 cases used slurry for composting or aquaculture. There were 45 households indicating that they often

use slurry from biogas plant accounting for 31.5% of total 143 household having crop cultivation. The common area applied slurry was back yard square or the cultivated land nearby. Through the survey, many household admitted that using slurry for crop was very good, however it is very difficult to apply in the large area due to liquid slurry could not be transported far away.

Table 30. Area applied slurry of biogas user

TT	Crop	Cultivated area (m2)	Area applied slurry (m2)	% of usage
1	Rice	597,880	53,410	**8.93**
2	Cash crop	117,018	6,340	**5.42**
3	Fruit	328,500	72,000	**21.92**
4	Forestry	14,440	0	**0.00**
5	Other	28,400	7,000	**24.65**
6	Total/Average	1,086,238	138,750	**12.77**

Source: BUS 2009

3.1.4. Increased Animal Husbandry

Out of economic impact gained from saving fuel wood expenditure, buying fertilizer, there were many household also gaining economic value from expanding their raising scale. According to the calculation, on average if a household expanding the raising scale to 7.3 pig heads (with stable input and output price the household may increase their income from 800,000 VND-1.2 million for one herd of pig).

Table 31. Comparison average raising scale before and after having biogas plants

Item	Number of Household (HH)	Before using biogas (Head)	After using biogas (Head)	Compared +,-
I. Pig raising				
- HH increasing scale	108	13.87	31.45	17.58
- HH decreasing scale	33	28.85	17.73	-11.12
- HH with no change scale	69	23.78	23.78	0.00
Average		19.48	26.78	7.30
II. Ruminant raising				
- HH increasing scale	9	0.22	1.67	1.44
- HH decreasing scale	15	5.27	1.40	-3.87
- HH with no change scale	33	2.12	2.18	0.06
Average		2.65	1.89	-0.75
III. Poultry raising				
- HH increasing scale	39	26.67	84.49	57.82
- HH decreasing scale	9	110.89	51.11	-59.78
- HH with no change scale	57	7688.42	7688.42	0.00
Average		4193.12	4209.48	16.35

Source: BUS 2009

When asking people the reason of changing their raising scale after constructing biogas plant, there were 68 household said that due to the improvement of sanitation condition so that they could increase their scale. 71 cases said they want to increase their income. 24 households want to use slurry for cultivation.

Table 32. Reason of changing raising production scale (opinion)

	Improving sanitation	Increasing income	Using slurry
Ruminant	9	8	2
Pig	55	57	20
Poultry	4	6	2
Total	**68**	**71**	**24**

Source: BUS 2009

3.2. ASSESSMENT OF ENVIRONMENTAL POLLUTION AND HEALTH

3.2.1. Importance of pollution

Most of households when being asked about the pollution sources in the local area, they all defined the pollution were from raising livestock activities, food processing and from livelihood activities.

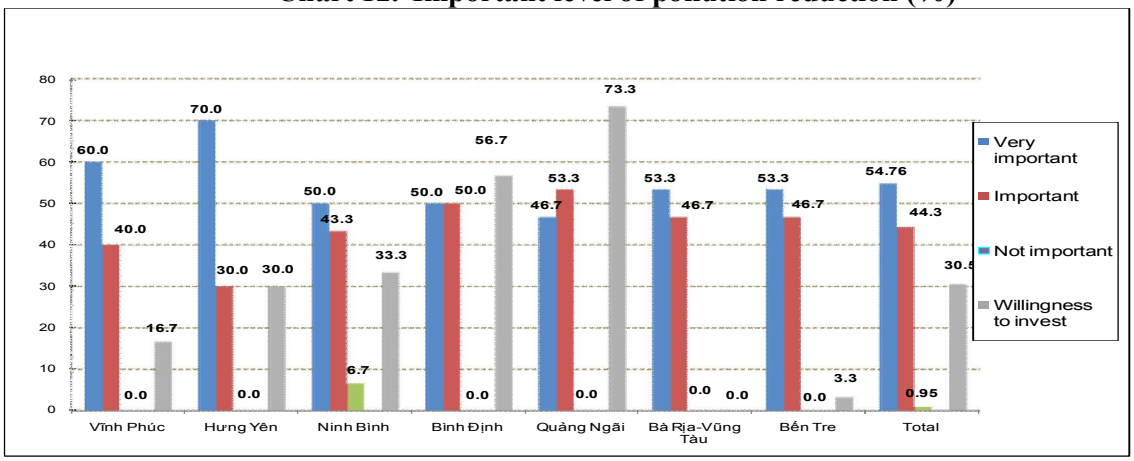
Table 33. Main polluted source in rural area

Province	Opinion on pollution source (%)				Total opinion (%)
	Raising livestock	From food processing	Livelihood activities	Other source	
Vĩnh Phúc	41.9	14.0	39.5	4.7	100.00
Hưng Yên	67.7	3.2	29.0	0.0	100.00
Ninh Bình	62.1	3.4	31.0	3.4	100.00
Bình Định	76.5	14.7	8.8	0.0	100.00
Quảng Ngãi	55.6	16.7	25.9	1.9	100.00
Bà Rịa-Vũng Tàu	54.5	10.9	34.5	0.0	100.00
Bến Tre	54.5	10.9	34.5	0.0	100.00
Total	59.8	9.6	29.2	1.4	100.00

Source: BUS 2009

Almost 100% households at surveyed province assessed that the reduction of pollution activities is important and extremely important (of which 54.7% or 115 households considered very important and 44.3% or 93 households considered important). Only 2 households in Ninh Bình considered this activity is normal. There is no household thought that dealing with pollution matter is not important. 64 household (occupied 30.5%) out of 211 households were willingness to invest for pollution reduction activity. It is very clear that the awareness on environment of livestock raisers is increasing day by day and through participating in the project.

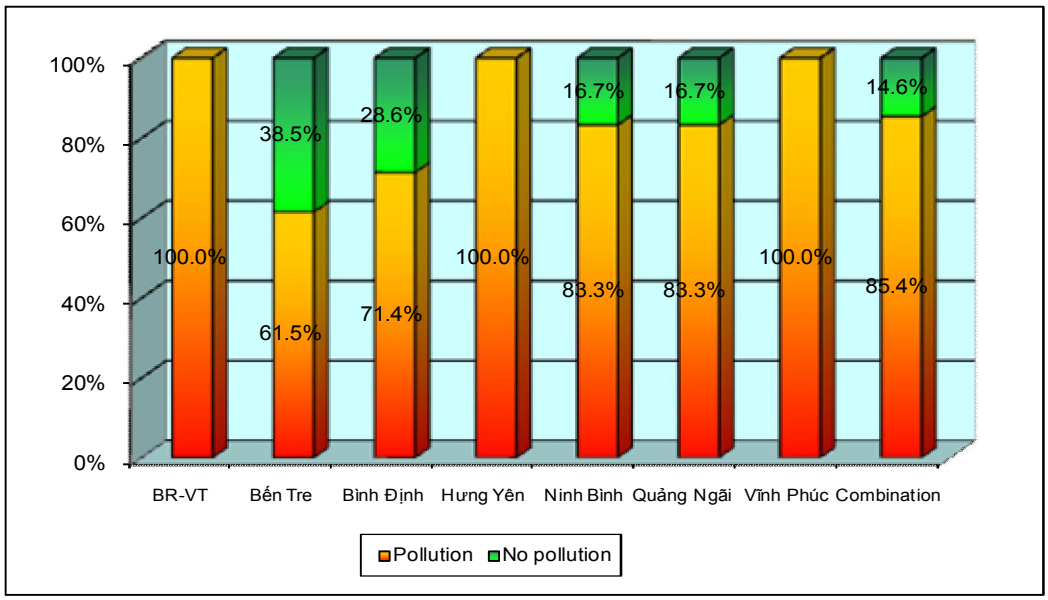
Chart 12. Important level of pollution reduction (%)



When the farmers can assess their production method, nearly 85.4% of households found that the environment is polluted and hygiene condition is not ensured, only 14.6% of households still said that making compost indoor will not pollute the environment. In Ba Ria-Vung Tau, Hung Yen and Vinh Phuc province, 100% of households found that their breeding method causes lots of pollution. Ben Tre, Ninh Binh and Quang Ngai provinces have larger area, so the households here have not been aware enough of environmental hygiene problems.

In fact, making compost inside the cages causes an unsanitary situation and air pollution and also creates living condition for mosquito and flies. Moreover, it also causes eye and respiration disease.

Chart 13. Non-biogas users assessed their treatment methods (%)



3.2.2. *Sanitation by biogas plant*

Production development and environmental preservation are two processes that against each other, especially in the livestock sector, the more livestock develops, the more environmental pollution happens. Thus, the biogas development helps to

reduce environmental pollution and also expand the scale of livestock production. 79 households (making up 37%) of total 211 households in the survey, discharged waste into the environment before the biogas plant is built. After building biogas plant, only 13 households are still discharging a part of waste into the surrounding environment accounting of 6.2%. The households that still discharging livestock waste into environment are in the province of Ninh Binh and Binh Dinh.
64% of surveyed households have found that the problem of sanitation is solved and improved, 25% of households reflected the sanitation problems solved totally, and only 5% of households stated that it is still necessary to continue to solve the problem of environmental sanitation.

When assessment and comparison the treated livestock waste method of biogas user and non-biogas user having the same living conditions (income range is 40-50 million/year; number of observation of both biogas user and non-biogas users was 45), the consultant team recognized that the biogas users before having biogas plant constructed also treated the livestock waste as similar to non-biogas user. Table below illustrates the above conclusion.

Table 34. Percentage of livestock waste being treated by biogas users and non-biogas users having the same living condition

TT	Method of waste treatment	Non biogas Users (%)	Biogas Users (%)	
			Before construction	After Construction
1	Biogas Plant			96.78
2	Burnt out	0.44	0.43	-
3	Indoor composting	27.33	31.30	0.87
4	Outdoor composting	34.11	44.57	0.87
5	Drained to public sewages	17.00	12.61	0.39
6	Direct applied for crops	12.00	4.13	0.43
7	Direct feed for aquaculture	8.44	-	-
8	Sold	0.67	-	-
9	Other (give away)	-	6.96	0.65

Source: BUS 2009

Obviously, biogas plant contributes greatly in solving livestock waste for households. The table above shows that in this sample, after using biogas system, 96.78% of breeding waste is processed by biogas plant; the remaining is used to compost or apply to crop cultivation.
Data analysis of 211 biogas user households showed that 93.4% of total livestock waste is treated by biogas plant, 6.6% remaining is used for composting or direct feed to the aquaculture. Compared to before using biogas plant, these farm households used livestock waste for inside or outdoor composting and about 13% was discharged to public sewage system. These figures are clear evident for the improvement of sanitation situation by using biogas plant. The below table shows the percentage of livestock waste being treated by biogas use households:

Table 35. Average rate of all breeding waste treatment method of a biogas user household (%)

No.	Method of treatment	Total		Vinh Phuc		Hung Yen		Ninh Binh		Binh Dinh		Quang Ngai		BR-VT		BT	
		Before using biogas	After using biogas	Before using biogas	After using biogas	Before using biogas	After using biogas	Before using biogas	After using biogas	Before using biogas	After using biogas	Before using biogas	After using biogas	Before using biogas	After using biogas	Before using biogas	After using biogas
1	For biogas plant		**93.4**		90.0		85.8		87.7		98.0		95.9		100.0		96.5
2	Burned	**1.1**				1.3		6.3									
3	Composting in door	**38.7**	**2.8**	52.0	2.7	55.3	8.2	47.0	6.0	27.2		53.3	2.3	8.0		28.4	0.6
4	Composting out door	**36.3**	**0.9**	27.5	1.3	23.0	2.0	16.0	0.7	40.8	0.7	26.3		83.3		36.8	1.9
5	Directly discharge to ditches	**12.7**	**0.4**	8.3		11.3		13.3	1.0	19.8	1.3	13.8	0.8	3.3		18.7	
6	Directly feed plant	**5.2**	**0.6**	5.3		4.0	0.7	11.3	3.3	6.5		1.2				8.1	
7	Directly feed fish	**4.1**	**1.4**	6.8	5.0	5.0	3.3	3.3	0.7			3.7		2.0		8.1	1.0
8	Sold		**0.1**										1.0				
9	Others	**1.9**	**0.3**		1.0			2.7	1.0	5.7		1.7		3.3			

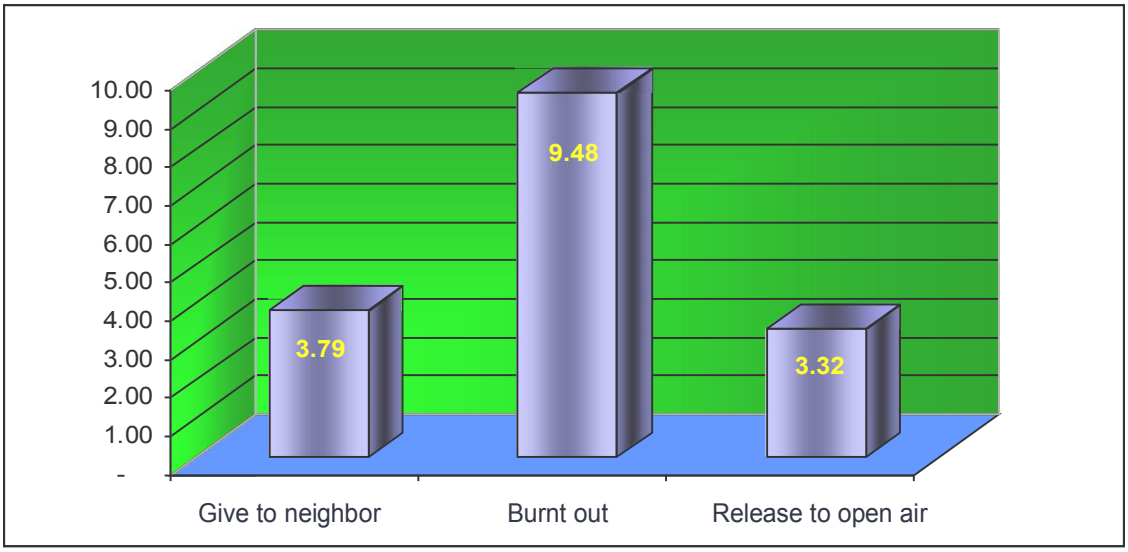
Source: Survey of biogas users in 2009

Note: Calculation from 211 biogas users household.

3.2.3. Excess gas

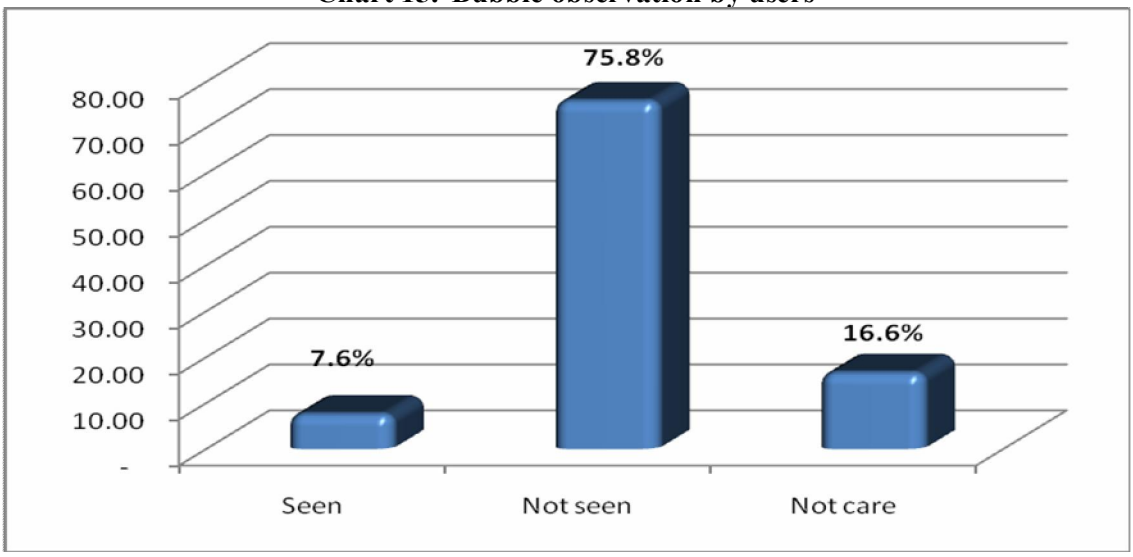
The processing of excess gas is also a concern for projects in matters related to the environment. If excess gas is discharged directly into the environment, it will cause increase greenhouse effect. In 35 cases of excess gas, it is treated as follows: 8 households let the neighbors use it for cooking, 20 households burn it, and 7 households discharge into the environment (see also table 18).

Chart 14. Treatment of abudant biogas households compared to total HH survey (%)



When asking about bubble issue, 75.8% household said that they had not seen any bubble , 16.6% did not care about this matter and only 7.6% of household indicated that they had seen bubble appearance .

Chart 15. Bubble observation by users



3.3. SOCIAL IMPACTS: GENDER, ORGANIZATION

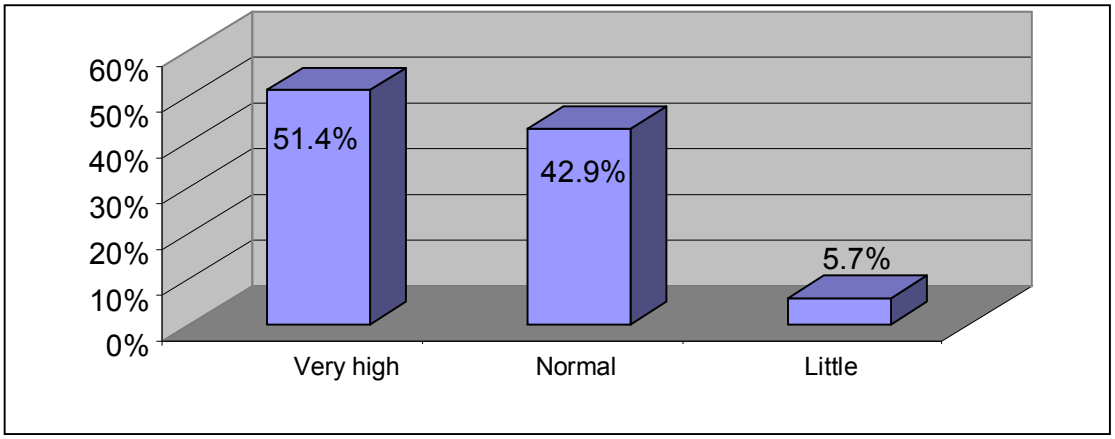
Using the biogas plant brings not only the financial and environmental benefits but also the social benefits such as improving the ability to participate in the economic sectors and social organizations and local governments Through the registration of the project, a number of organizations have involved to help households, such as women union, farmers union, Commune officials, and chief of village. Besides, technicians, masons are also the important factors for the participation in the project of the people.

4. Biogas Market development

4.1. APPLIANCES USING GAS OF HOUSEHOLDS

Most of surveyed households use biogas for cooking and lighting. There are 207 households using gas stoves; 57 households use biogas for lighting and 4 households use for electricity generators. The survey shows that households are more and more interested in the ability to use electricity generators. However, to improve the ability to use biogas and diversify uses of biogas, it takes more time and effort of all the components of society.
Through survey the mason teams and technician- the groups that directly contact with users- results show that the demand of biogas consumed appliances was great, more than 51% wanted to use more kind of appliances such as electricity generator, pumping, water heating, etc.. 43% said they satisfied with current uses and only 6% have low demand on biogas utilization.

Chart 16. Demand on the uses of biogas consumed appliances (%)



4.2. DEVELOPMENT TREND OF BIOGAS PLANT BY SIZE, GAS DEMAND AND THE EQUIPMENTS USED.

Currently, there is a technology imported from China that helps to make fuel from mixture of diesel and biogas. The mixture can be use for motors, pump…. A biogas digester with capacity of 10 m^3 will provide enough biogas for running a 1kW electricity generator for around 6 hours per day.
To use biogas for cooking, running electricity generators, the required size of

biogas digester must be considered bigger, at least over 15m^3 for a biogas digester. According to survey results, the average size of biogas digesters is between 10 to 13 m^3. With this capacity, the development of application and usage of biogas is limit. Therefore, in the future, encouraging of biogas model for producing electricity is the indirect motivation for farmer invested in appropriate biogas digester size. Furthermore, with the increasing number of farms with bigger scale livestock raising that would request more attention on environmental hygiene as well as biogas utilization for producing electricity.

In order to encourage livestock raisers to utilize the livestock waste by constructing biogas plant, the Energy Conservation Center (ECC- Department of Industry and Commerce, Hanoi) in collaboration with Institute of Energy Science has implemented the demonstration of utilization of biogas for electricity generation. In the first stage the ECC organized the demonstration model and hand over electricity generators using biogas for 2 household located in Đông Anh and Gia Lâm district. Mr. Nguyễn Minh An, deputy director of ECC said: ECC has invested in constructions and transferred the biogas plant with electricity generator at capacity of 1,500 W with total value about 30 million/household.

Evaluating efficiency of the model, Mr. Án revealed that by using the above biogas system, his family could save several hundred thousand for buying fuel that serve for cooking animal feed or daily cooking of the family. Especially, the electric generators with capacity of 1.5 kW, his family can use the electricity for pump, lighting, and be active in electricity source. The system helped his family in saving of 1/2 electricity expenditure as compared with before. The livestock waste also treated before releasing it in to public sewage system, contributing to the pollution deduction. Another beneficiary Mr. Nguyễn Văn Binh, his farm raising 40 sows in Đông Dư commune, Gia Lâm district said that on average, using electric generator run by biogas for 8hour in a day, his family could save 5kWh.

According to the Institute of Energy Science, with livestock raising scale of 10 pig/herd the farmer can be able to construct the biogas plant that produce enough gas demand for 4-5 people in the family. If the farm has a scale of 10-20 pig in a herd they can build the biogas plants that ensure the biogas amount enough for electric generators of 1.500 W.

http://sct.quangninh.gov.vn/default.aspx?page=news&do=detail&category_id=116&news_id=8911

Design of KT1, KT2 allow to construct biogas digester up to 50 m^3 while majority of biogas plants under project are with size of 9-12 m^3, if the biogas productivity increased so that there is a bigger market for appliances.

Through the survey, it is very clear to see the tendency of constructing bigger bio-digester size of farmers. The present preferable digesters sizes are 12-15m^3. Project should pay more attention on promoting of 15-20 m^3 digesters in the future. At this size of digester, the biogas user could be able to utilize biogas for electricity production as well as gas consumption.

As a result, assessment of biogas used demand could help the Project to form and establish a number of biogas system packages.

4.3. COMMENTS OF NON-BIOGAS USER HOUSEHOLDS

Considerations about sanitation, expansion of livestock scale, fuel expenditures savings, so that many households have planned to build biogas plant. In 90 non-biogas user households surveyed, 86 households wish to build biogas plant as soon as possible (accounting for 95.56% of households),

including 100% of the households Ba Ria Vung Tau, Ben Tre, Hung Yen, Ninh Binh, and Vinh Phuc province.

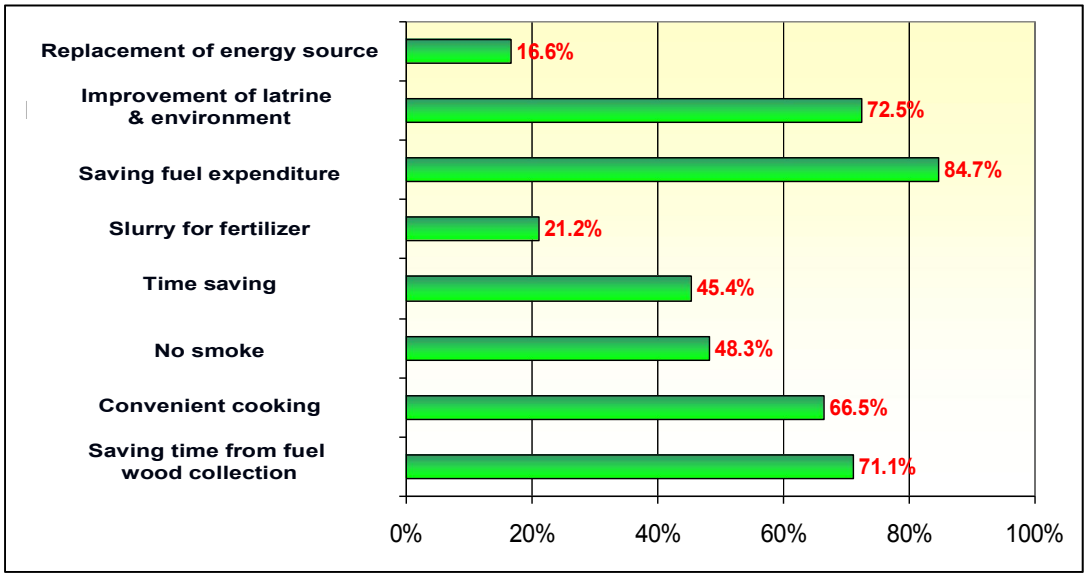
Table 36. Non –biogas household wishes to build the biogas plant

	BR-VT	Ben Tre	Binh Dinh	Hung Yen	Ninh Binh	Quang Ngai	Vĩnh Phuc	Total
Ratio (%)								
Wish to build the biogas plant	100.00	100.00	92.31	100.00	100.00	78.57	100.00	**95.56**
Do not wish to build the biogas plant	-	-	7.69	-	-	21.43	-	**4.44**
Total	100	100	100	100	100	100	100	**100**
Number of households (HH)								
Wish to build the biogas plant	12	13	12	13	12	11	13	**86**
Does not wish to build the biogas plant			1			3		**4**
Total	12	13	13	13	12	14	13	**90**

Source: Survey of biogas users in 2009

When asking farmers what would they expected from construction of a biogas plant, 84.7% said they want to save their fuel expenditure, 72.5% wanted to solve the pollution, 71.1% hoped that they could save time for collection wood; about 45% and 48% expected of no smoke and save time for cooking. The Chart below demonstrated the wishes of non-biogas users when they would construct a biogas plant.

Chart 17. Expected outcomes of non-biogas user household when having a biogas plant



According to the non-biogas user households, lack of funds is the most difficult to build biogas plant (with 81.2% of comments were made); small scale of livestock raising is the second difficulty (accounting for 31.2 % of comments made); difficult technique is the third difficulty (accounting for 20.4% of comments made). The other difficulties that they raised are the lack of labor, etc. do not make up much.

The details of the difficulties faced by non-biogas users in the surveyed province as presented in below table:

Table 37. Difficulties to build biogas plant of non-biogas users

Unit: %

	BR-VT	Ben Tre	Binh Dinh	Hung Yen	Ninh Binh	Quang Ngai	Vinh Phuc	Average
Lack of funds	44.4	100.0	77.0	87.5	85.7	77.0	100.0	**81.2**
Difficult technique	33.3		46.2			22.2	40.0	**20.4**
Lack of building area	11.1				42.9			**20.3**
Small scale of breading	11.1	23.1	84.7	12.5		44.4		**31.2**
Lack of labor	22.2			12.5				**4.7**
Others	11.1	7.7	7.7	12.5				**6.3**

Source: Survey of biogas users in 2009

4.4. ANALYSIS THE APPROACHING ABILITY OF HOUSEHOLDS TO THE PROJECT

For biogas user household, the sources of information, that they have accessed to decide to build biogas plant, is from the mass media, propaganda from the projects, friends, and neighbors. 64.6% of the ideas said that they received information from the project, 68% gets information from local officials, 31.5% of the comments received information through the media, 57% gets information from friends, neighbors, and 3.5% of the comments said that they find out themselves.

Since the biogas plant has been built with clear benefits from the biogas plant, many biogas user household have become volunteers who promote for biogas project.

The information sources that non-biogas user household has accessed is mainly from friends, neighbors (84% of comments); information from the project reaches 50% of households; information from the media reaches 50% of households. In addition, there is 54% of non-biogas user household said that the content of the project and the benefits of biogas were conveyed by the local officials

Table 38. Information resources that households have accessed to biogas

Unit: %/ total of households

No.	Item	BR-VT	Ben Tre	Binh Dinh	Hung Yen	Ninh Binh	Quang Ngai	Vinh Phuc	Total
1	**Household using biogas**								
	Mass media	30.0	41.1	14.3	35.0	30.3	36.6	33.3	**31.5**
	Project	66.7	82.4	67.8	65.0	69.5	43.2	60.0	**64.6**
	Friends, neighbors	56.6	79.0	75.0	40.0	43.3	63.2	36.7	**57.3**
	Self study	9.9	10.2	0.0	0.0	0.0	0.0	3.3	**3.5**
	Local official	90.0	75.6	28.6	65.0	69.4	66.6	80.0	**68.3**
	Others								
2	**Non-biogas user household**								
	Books, newspapers	33.3	42.9	16.6	37.5	33.4	16.7	20.0	**28.0**
	TV, radio	50.0	71.5	16.6	87.5	83.4	16.7	40.0	**50.0**
	Commune officials	33.4	71.5	33.3	62.5	50.0	83.4	60.0	**54.0**
	Project official	100.0	42.9	16.6	100.0	33.3	16.7	60.0	**50.0**
	Friends, neighbors	66.7	71.5	99.9	75.0	83.4	83.4	100.0	**84.0**
	Others								

Source: Survey of biogas users in 2009

Results of BUS in 2007-2008 also showed mostly similar results. In 2009 however, the influence of neighbors and friends is increased for both biogas and non biogas users. For biogas users households, the information related to biogas (technique, training, use, operation ...) they obtained mainly from the project. While for non-biogas users households this formation is coming from their neighbors and commune officials. Therefore, to popularize the use of biogas in the future, the projects should focus on developing the propaganda through the biogas user households and local officials.

When asking farmer households on how to get more involvement of local authorities in biogas development, the result turned out to be as follow:

- 72% of 211 surveyed households (152 HH) gave no comment as their assessment on the local authorities was that they were helpful and support for biogas development.
- The remain 28% of surveyed households or 59 households revealed that they want local authorities to i) spend more on communication on the local broadcasting system (16 comments); ii) remind those households making pollution from livestock activities (19 comments); iii) honor and reward biogas users in the local area (11 comments); iv) support from provincial and district (13 comments).

PART III. CONCLUSION & RECOMMENDATION

I. CONCLUSION

At the time of survey (October 2009), through 7 year of implementation, the project has built about 75.000 biogas plant in 36 provinces and cities in the whole country.

Result from surveyed 211 observation of biogas users in 7 selected provinces (Bà Rịa- Vũng Tàu, Bến Tre, Quảng Ngãi, Bình Định, Ninh Bình, Vĩnh Phúc and Hưng Yên) revealed that 96% biogas users gave high value on quality of the plant specifically in construction quality, biogas production, waste treatment, pollution reduction. Many of respondents answered that thank to the biogas plant so that their raising scale is increased. Beside the households recognized that training class, materials, guidance have good impact on operation and maintenance their biogas plant.

1. Strength points of biogas programme

The project has contributed positive impacts on rural development, reducing environmental pollution in livestock sector and creating job opportunities for many farmers' households in the agriculture sector.

1.1. TECHNOLOGY

With number of 75,000 biogas plant showed that construction technology of KT1, KT2 designed type obtained great confidence and trusted from user, especially for small and medium scale of livestock raising farmer (5-30 heads/herd). In summary those of KT1 and KT2 model have the following indicator:

Construction quality was ensured

High safety character

Ability of high gas producing and sustainability.

Longevity of used.

1.2. ORGANIZATION

Not only those provinces participated in previous year but also newly participated province like Bà Rịa-Vũng Tàu showed the good management scheme, unique network from central to grassroots level. Provincial agricultural extension centers or water supply and sanitation centers showed the ability of organization, monitoring, guiding and updating information timely. Most surveyed provinces achieved their 2009 plan; some provinces exceed their 2009 planning on number of built biogas plants.

The project has built up a technician and mason team with good knowledge on biogas and construction technique as well as professional skills that ensure the trust of biogas users in surveyed provinces.

2. Constraints

2.1. CONTRAINTS TO ACCESSIBILITY

During project designing stage, the counterpart fund is a key to ensure the involvement of provinces in biogas development programme. However the counterpart fund is also a constraint, especially for "poor" provinces. As a result the number of biogas plant allocated to provinces somehow not reflects the real demand of livestock raisers in those provinces.

KT1, KT2 technology might only be suitable with small and medium scale (up to $50m^3$). While the number of large scale livestock raiser such as 100-500 head/herd keeps increasingly so that more customers at this scale are looking for other biogas technology than technology developed by the project.

Selection of household participant in the project:

Non-biogas user showed their opinion on the selection process that is not fair selection in some cases. According to Mrs. Đinh Thị Tâm (Ninh Bình) her family is located in the low area (inundated area) which is easier getting pollution as compared with other located in higher part , but her family is still waiting for approval even they submitted the applications. The process was that commune will make the list of household wanted to have biogas plant, however the list somehow depending on list maker who gave priority for those households got relations with him/her or sometime the announcement from Commune People Committee reached to household not timely. However, this situation is not common and sensitive matter and need carefully studying in the next BUS.

On subsidy transfer, about 64% said is simple and 31% said is normal. However, through in-depth survey, there still several households (1.19%), indicated that the procedure of registration, guarantee, especially receipt financial support is still complicated and not fit with the education level or the wish of biogas users, especially in newly entering provinces.

In general, biogas users assessed technicians as qualified and helpful officers. However, in some provinces, especially for new provinces, the number of creative, active technician is still lacking and unsustainable due to the staff transferring. Some of technicians might need more consultancy skills on size of digester, location, maintenance and utilization of biogas and its slurry.

2.2. MANAGEMENT AND COORDINATION

At the moment, some provinces were not yet received the new designed draws from project, for instance Quảng Ngãi

Relation between implementing agencies (Extension Centers, Water Supply and Sanitation Center) and local commune authorities is weak. There was lacking of exploration ability of local mass organization or individual people (Farmer Union, Women Union, VET, village heads, and others).

Most of technicians have been assigned at least two duties rather than specializing on biogas development. Beside, the limited number of

technicians and mason teams against to the increasing number of biogas plants in most provinces that lead to the lack of manpower, weakness of technical support or new technology transfer to remote areas.

3. Challenge and issues need to be solved

3.1. MARKET DEVELOPMENT

With considered the increase of livestock raising scale at present and future, the common dosmetic biogas plant may become small. The residual left over will be treated as the same as before (composting in open air, composting in the cages, or directly feed for aquaculture) so as the positive impact of biogas plant toward environmental protection may be limited. Therefore in the next steps the programme should focus on research and develop on the larger scale greater than 50m^3 for application and fully utilization of biogas.

The market of electric generators using biogas is paid attention by biogas user household in recent years. Therefore the activities of marketing, joint venture and research on making motors, machinery fuelled by biogas at low cost, long lasting, convenience and safety is a real motivation for encouraging farmer to invest in construction of biogas plants in greater quantity and bigger in the size.

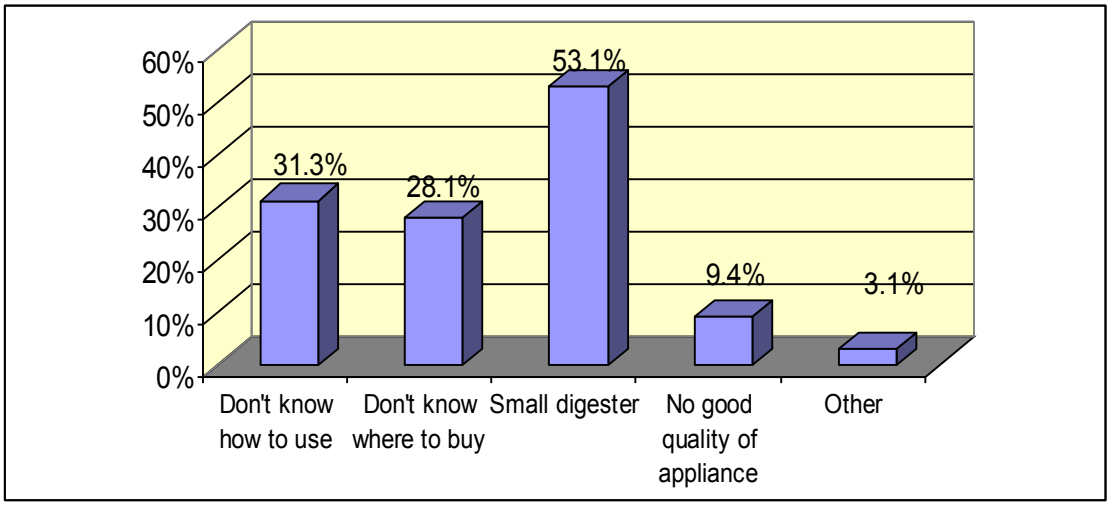
3.2. UTILIZATION AND DIVERSIFICATION THE USE OF BIOGAS

Same as assessments from BUS 2005, 2006, 2007-2008, the clear benefit of biogas plant is fuel substitution, improving sanitation, saving time and convenience. Monthly the household could save about 200 thousand VND. Biogas plant could help household to control pollution of living environment and treat almost of the livestock waste. Number of household using and applying slurry was 50.2 % of the total biogas users surveyed.

Most of surveyed households use biogas for cooking and some for lighting as a replacement of propane gas, fuel wood, coal and electricity. The benefit is clear; however the use of biogas at present is not fully utilized potential of biogas like the biogas can utilize for water heating, running combustion engine that using gasoline, diesel.

The utilization of biogas in motors needs a little innovation. For example, there are some motors or machines using fuels. Now if use biogas as a replacement fuels, there is a need to innovate the carburetor, refining system…. That is reason why many biogas user households use biogas only for cooking.

Chart 18. Reason of biogas users not using multiple appliaces



In order to improve the utilization of biogas the programme may need to develop several demonstration models on biogas utilization at full options (biogas for cooking, lighting, electric generator, pumping, water heating….) so that the household can utilize the use of biogas at their ability and wishes. At that time, the biogas plant will help not only in solving waste problem of livestock activities but also in saving energy for society and in each household as well.

3.3. IMPROVEMENT OF TECHNOLOGY

It is a need to develop research and study on biogas filtering system or equipments in order to improve the use of biogas and the durability of biogas used equipments.

Development of suitable biogas packages or biogas options based on the livestock raising scale, income levels of several groups of biogas uses is very important. For example, a farm household with raising scale from 10-20 pigs/herd so she/he may need a biogas package of 12m^3 biogas digester + slurry pit+gas pipe system+filter+gas stoves and lamp+ or water heater. If a household with raising scale greater than 50 pigs/herd, she/he may need a biogas package of 20-30m^3 biogas digester and equipped same as above household and adding with a electricity generator. It is a need to push up research and collaboration in development and setting up several biogas packages. Therefore, potential biogas user can select suitable biogas package (biogas digester => biogas providing system => utilized biogas equipments) based on their raising scale, their income, their expectation in the future.

3.4. DISSEMINATING AND TRAINING

The dissemination activities are significant mean for project implementation. Strengthening in dissemination activities with the aims of increase people awareness on biogas benefits; introduction of new biogas technology; more

advocacy through local loudspeakers system or through local officers, local mass organizations is an aspect need to be emphasized. There is a need to tight up and integrated between biogas advocacy and water supply and sanitation in rural area.

Most of households only figure out the benefit of biogas in very sole subject that is saving fuels and cooking convenient. The benefit of using biogas for electric generator, drying facilities is not yet reach to the potential users. Some farmers are still pending investment due to suspicious or even unknown the benefit of utilization.

In some extend, if farmer could be trained they may come to be a service provider in the rural area and could contribute in the economic efficiency, and living standard improvement.

Using slurry for livestock raising, cropping is still limited. That may be of insufficient information provided and farmers not yet have custom of uses.

During operation, many of biogas users were not stirring as recommended that may be affecting to biogas generation, however the biogas is still enough for home consumption. The issue is if the households follow the guidance there will be abundant of gas and farmer doesn't know how to deal with it except releasing to environment that may get harmful to the environment.

It is a need to have guidance or document materials on using biogas used equipments as well as technical standard of equipments that will help farmers easier in buying and using properly.

3.5. ISSUES THAT RELATED TO CONSTRUCTION OF BIOGAS PLANT

Competitiveness in construction: At present, numbers of trained masons at provinces are not yet meeting with the demand of the farmers (who wish to have biogas plant without registration) therefore some faked mason teams called "project mason team" were established. They have no design drawings, no technical requirements and they construct the biogas plant based on their experiences so that the quality of the biogas plants constructed by these persons is not good (many biogas plants produced no biogas or failure frequently. However their cost of construction is quite cheap due to the bricks was constructed in vertical lay (the 5cm thick is not technical requirements from project). This may harm to the trust of the true project's mason because the farmers do not know which one is real or fake. This phenomenon occurs in all surveyed provinces and need further study.

Through the survey, the consultants observed that for those digesters built in 4-5 years ago with small digester capacity but farmers are still increasing raising scale, and plus with cumulated residuals so far. Consequently, there were several biogas plant got filled and required for sucking slurry and residuals. However, the cost of sucking slurry was too high such as Bình Định was 300-600 VND/time; Quảng Ngai 1-1,2 million/time. Mr. Trần Đức Tông (Quảng Ngãi) said that: when having biogas plant, his family could save

several thousand dong (due to less cooking or collecting wood) while for single time of sucking slurry (once a year, on average) was 1 million, as a result his family was not saving money.
The scale of livestock raising is affected by output prices of livestock products and feed prices so as the consulting on the size of the biogas digester should be based on not only demand on biogas, economic ability but also be considered the livestock raising potential of the household. On the other hand, when consulting the size of biogas digester, the technician should be based on the livestock planning of the province so that avoiding of biogas plant removal after constructed. (Some provinces promote livestock production in separated and isolated from residential area. Farmers are no more allow to keep their livestock herds in the residential area. Consequently, if the biogas plants built in the residential area, sooner or later, it would be stop operation.)

3.6. SUPPORTING ACTIVITIES

1.2 million support from project to biogas users is very necessity. However, the money always be transferred after completion of construction of biogas plant for several months so that this amount of money sometimes was not meaningful as contribution to the construction cost and not being used as it supposed to be used (several household use this amount of money for celebration of the biogas plant while they still in debt).
Supporting equally one million and two hundred thousand per biogas plant may be not appropriate. For some better off household this amount of money is small but for medium or lower level of income household this amount of money have greater meaning in support and making construction decision...
In general, most of farm household's opinions show that the supporting level is considered low as compared to the increasing construction materials prices. At present some province has combined the support fund from project and loan from Policy Bank (former Ha Tay is an example) to develop biogas plant. This combination brings a good achievement, especially for medium and lower income level households. Development of credit programme toward medium and lower income level may be also a challenge for the programme, if it wanted to do so.

II. RECOMMENDATION:

1. Recommendation on policy, planning

It is a need to have a flexible planning and allocation of number of biogas plants. For provinces having enough or abundant of counterpart fund, should project allocate more number of plants. Give more number of plants to Quảng Ngãi, Bình Định…).
Improvement of accessibility of project through getting more involvement of mass organization (strong recommending Woman Union, Famer Union) in the biogas development process especially at province having enough counterpart

funds.
Development of several biogas packages such as i) biogas plant plus oven, lamp; ii) biogas plant +plus oven, lamp; iii) biogas plant +plus oven, lamp, pump and electricity generator; combining with consultancy activities that may help farmers to select suitable biogas package for their production demand and the development trend of the provinces.
Selection of participated household needs more announcing in public and has detailed selection indicators and follows participant approach such as through group consultations, village meetings. It is better if local authorities can take part in developing a priority list.
Encouragement of household investment in biogas plant by themselves in order to reduce the dependency or philosophy of waiting project. Make self-invested household to be as non-financial beneficiary but become a technical and guidance support beneficiary. Simultaneously the project also needs to provide technical support for non-project households.
Speeding up the biogas development in not yet participated provinces in the year 2010, 2011 and 2012 the provinces not yet in the program should enter to the project. Study those provinces and development plans are crucial task.
Need to be trained more for technician and the mason
Need pay more attention on selling, promoting technical work of the mason to livestock raisers. The programme office may develop a hotline number and this number should provide information on biogas, technical specification for any person from upper level or at grassroots level (i.e. leave-left or noted by commune, village)
Biogas plant developed by the programme should have a plate attached nearby the plants. On the plate should indicate name project, size of digester, finishing date and telephone number of programme or the mason team. So that potential household may contact.
Increasing collaboration of technician, mason within or outside province
Increasing information exchange and collaboration between technicians and foreign partners: Some of the technicians have joined some study tour and obtained new biogas technology. However, the technicians wish to have more chances to tap with new biogas technique or new ways of biogas utilization. It is also better if technicians can access to biogas equipments providers (through site visiting, discussion or meeting with the providers)
Facilities equipped for provincial offices are still lacking of. Some provinces requested to have support on computer, projector that serves for communication and training activities.
Support gasoline fee for technician: the increasingly number of biogas plants (average biogas plants /technician is 50) and recently the price for gasoline is going up therefore it is a need to raise the support for technician in order to sustain the control quality.
The market of electricity using biogas is starting to develop so that the project

should emphasize the communication activities and collaborate with other organization in expanding the use of biogas-electricity generator.

> According to Center for science application of Da Nang, the Toyota Vietnam company has decided the support for production cost of mini biogas- electric generator. This machine has been innovated by professor Bùi Văn Ga – Director of Da Nang University. The machine allows saving energy source as well as no affectation to the environment. Toyota has evaluated professor Ga's study having high application level, so that the company invested for producing 1,000 generators. Each machine cost valued at about 1.5 million VND.

users and the producer meeting each others.
It is recommended establishing the biogas user club in order to create the relation and collaboration among biogas users or potential biogas user and also with the mason. This will facilitate the information exchanges, communication and experience sharing.
As many as 19 households proposed to have a punishment regulation for those livestock raisers polluted environment.

2. Specific recommendation:

Development of service after construction:
Development of private organization or personal business in investing of machinery for sucking and collecting slurry from full digester is one of new service. Province may study or encourage for such of related biogas business. It is recommend to develop a group that can provide service on collecting slurry with cost ranging from 200-300 thousand VND/time and they can keep slurry for making the base for cultivation (At Binh Dinh, the investment for one sucking machine is about 4-5 million, a 50kg of basal material costs 60-100 thousand VND . However the total capital for developing this business is about 70-80 million that is too high for a household. As a result, it is a need to find the supporting sources from province, private sector, or project.
It is very common that many households got biogas plant built before taking part in the training classes. During training, the project should increase number of participant, inviting potential households to attend training course.
The adjustment of the project is very essence relating to the following issues:
Local counterpart fund – this is a main obstacle to the development scale of project;
The financial supporting amount should be based on the volume of digester size.

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