

**EVALUATION  
OF  
ADAPTATION OF BIOGAS  
TECHNOLOGY TO MITIGATE THE  
ENERGY CRISES (PILOT PROJECT)**



**(Draft Report)**

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## **PREFACE**

Energy has become an essential parameter for production for development process, whereas, the cost of conventional sources of energy such as petroleum and natural gas are gradually increasing manifold. The increasing cost of fuel and importance of animal dung as a manure has stimulated the developing countries like Pakistan to search for alternate source of energy especially in rural areas. In rural areas of Pakistan, energy requirements are partially met by burning animal dung for cooking food.

The ideal use of animal dung and other crop wastes at the farm is production of biogas and at the same time using slurry from the biogas units as manure. The installation of biogas plants at / near farms will utilize animal dung and crop waste for production of biogas. Biogas plant is a device that converts fermentable organic matter (Cattle dung, poultry drops etc.) into combustible gas (Biogas) and digested organic fertilizer.

There are about 65 million animals (cows, buffaloes, goats, houses etc.) in the country beside about 69 million tons per year of crop residue and about 6 million birds in poultry estates across the country. The animals and birds produce about 325 million tone of collectable dung per year. This could yield 20 million cubic meter of biogas per day. In terms of fuel substitution, this would be equivalent to 12.4 million liters of kerosene oil daily. Thus biogas production from agricultural wastes is deemed fit for fulfilling energy needs at the farms.

Keeping in view the importance of biogas as fuel, “**Adaption of Biogas Technology to mitigate the energy crisis project**” has been prepared by the Director General Agriculture (Field) and was implemented in 19 districts of Punjab. Under this project 50 family size biogas plants was installed. These plants produced energy which is sufficient for one gas stove and a gas lamp. All the biogas plants are working/ functioning properly. Respondent farmers in all districts have adopted this technology with great interest and observe the procedures/ methods for smooth functioning of biogas plant.

**Chief  
Planning & Evaluation Cell**

## SUMMARY

The Bio-Gas technology in Pakistan has been adopted from Chinese technology. During 1975, 100 biogas plants were built and there was growing interest in the biogas industry. Keeping in view growing interest in biogas industry. 100 biogas plants were developed/ installed during 1975.

2. It is safe to say that cost of fuel and importance of animal dung as manure has stimulated the developing country like Pakistan to search for alternate source of energy in rural areas such as Methane Gas from Biogas Plant. Keeping in view its importance, a project titled “**Adaptation of Biogas Technology to Mitigate the Energy Crises (Pilot Project)**” was implemented in three district, Faisalabad, Sargodha and Jhang. As per PC-I requirement before extension of the project in 19 districts of Punjab, a survey was conducted for evaluation of this project by Planning & Evaluation Cell, Agriculture Department, Lahore. A sample of 24- beneficiaries was selected to assess its feasibility. The findings of the survey reveal that this project has created awareness & interest among the farming community to adopt this technology. It is observed that the farmers in all the three districts have adopted this technology with great interest and observe the procedures/ methods for smooth functioning of biogas plant. The farmers in all the three districts were filing dung to the fermentation chamber on daily basis as per PC-I requirement and were getting continuous supply of gas as per their family requirement.

3. The findings as per results reached upon after the analysis of collected data. It is observed that majority of the farmers availing this facility in the three districts belongs to large farmers. The completed bio-gas plants in all the three districts were producing gas continuously with normal gas pressure. Similarly average number of hours of biogas use per day was 5.2, 7.5 & 4.375 in district Sargodha, Faisalabad and Jhang respectively. The results also show that after the use of biogas, the respondents were saving Rs. 2924, 2491 & 2101 per month in districts Sargodha, Faisalabad and Jhang respectively. The survey team also collected views of non-respondent farmers and concluded that almost 100% farmers have knowledge of benefits of the biogas plants and are interested in installation of this technology.

4. In short, as per results of the survey conducted it does stand to reason to say that the project seems to be feasible and will give a better chance to mitigate the energy crisis with some improvement in its implementation and supervision procedures.

## CHAPTER 1

### INTRODUCTION

Rural communities traditionally use fuel-wood and cow-dung cakes as a source of energy in Pakistan. It has been reported that the annual per capita fuel-wood requirement is 0.52 m<sup>3</sup> that implies a consumption of 5.20 M<sup>3</sup> of fuel wood for a family of 10 per year. Thus, a single family may cut three to four fully grown trees in a year just to meet its domestic energy needs. Over the years, this has been leading to degradation of natural forests, besides depriving the agricultural fields from decomposed organic manure.

2 Almost in all the big and small cities, natural gas is meeting the deficiency of fuel wood to sufficient extent whereas in the villages, the people are using wood, animal dung and agriculture residues as a fuel. There is no other alternate source of energy, however, it is supplemented with LPG from the nearby selling point. Due to scarcity of fuel wood, people also use timber as fuel wood causing a great loss to the nation.

3 The need of animal dung and timber/ fuel wood as manure is widely recognized. It's application increases the productivity of the soil. Burning away of dung as fuel is thus a national loss. It has been estimated that about 25% cattle dung is wasted by burning as kitchen fuel in irrigated areas whereas in rain fed areas about 50% dung is burnt away.

4 The increasing cost of fuel and importance of animal dung as manure has stimulated the developing countries like Pakistan to search for alternate source of energy in rural areas such as methane generation from biogas. It is produced by fermentation of organic matter like animal dung, chicken droppings, straw and manure etc. The main component of biogas is Methane (CH<sub>4</sub>) which is about 60- 70%. The other contents being Carbon – Dioxide (CO<sub>2</sub>) alongwith traces of Hydrogen (H<sub>2</sub>) and Carbon Monoxide (CO).

5 Biogas plant is a device that converts fermentable organic matter (Cattle dung, poultry drops etc.) into combustible gas (Biogas) and digested organic fertilizer. A typical biogas plant consists of a digester where the fermentation with an-aerobic bacteria take place, a gasholder for collecting biogas, and input output units for feeding the dung, storing the effluent and the gas distribution system.

6 Keeping in view the importance of biogas as fuel, project has been prepared by the Director General Agriculture (Field) and will be implemented in 19 districts of Punjab. The project was approved by PDWP in its meeting held on 31.07.2009 with one of the condition that:-

**“In the first phase only 50 biogas plants would be installed within shortest possible time and further up scaling would be considered only after quick evaluation/ resultant adjustment”**

7 Planning & Evaluation Cell, Agriculture Department has been assigned to conduct evaluation of the pilot project to be forwarded to Planning & Development Department before starting the 2<sup>nd</sup> phase in the next financial year.

8 As directed, this office conducted evaluation of the project. The following team was constituted, which visited the project area from 16.06.2010 to 22.06.2010.

- i. Mr. Ishtiaq Ahmad, Assistant Director of Agriculture.
- ii. Mr. Abdul Majeed Nadeem, Assistant Research Officer.

### **1.1 Mode of Implementation**

9 The proposed project is being implemented through beneficiary farmers on cost sharing basis. Department is providing technical advisory services to the farmers to ensure accurate installation, proper use and maintenance of biogas plants. The farmers construct the fermentation chamber, feeding tank, slurry tank and fix drum supports on the site selected by the inspection committee under the close supervision of the Departmental Technical Expert. Government of Punjab provide 50% subsidy not exceeding Rs. 30000/- per plant to the manufactures with whom the allottee have booked their order for gas holder, gas piping, gas stove and gas lamp. The subsidy amount is given to the manufacturer after the inspection of the items by inspection committee and delivery of gas holder and its allied items to the beneficiary farmers.

10 As per provision in PC-I, 10, 20 & 20 biogas plants were to be installed under the project in districts Sargodha, Jhang and Faisalabad respectively and the priority to be given to the farmers residing on Dera Location having no electricity and gas, whereas the actual plants installed/ being installed were 18,20 & 12 respectively as shown in table-1.

### **1.2 BIO-GAS PLANTS INSTALLED AGAINST PROVISION IN PC-I**

**Table -1 NUMBER OF BIOGAS PLANTS INSTALLED**

| #  | District       | Provision in PC-I | Actual    |
|----|----------------|-------------------|-----------|
| 1. | Sargodha       | 10                | 18        |
| 2. | Jhang          | 20                | 20        |
| 3. | Faisalabad     | 20                | 12        |
|    | <b>Total:-</b> | <b>50</b>         | <b>50</b> |



11 A meeting of the monitoring team was held with the Agricultural Engineer Faisalabad, Assistant Agricultural Engineer, Faisalabad, Assistant Agricultural Engineer, Sargodha on 16.06.2010 at Sargodha. In the meeting they informed that the respondents of 8 villages in Faisalabad after balloting refused to install these plants on the plea that Government is going to provide natural gas facility in their villages, therefore, they will not install biogas plants. As there were less number of plants allotted to the district Sargodha, therefore, 8 biogas plants were shifted to Sargodha. These plants were allotted to the farmers from waiting list on merit basis.

12 Status of the biogas plants to be installed before the survey is given in the following table 2

**Table 2 PROGRESS OF PROJECT WITH RESPECT TO NSTALLATION OF BIOGAS PLANTS**

| <b>District</b> | <b>Functioning properly</b> | <b>Completed but not gas producing</b> | <b>Civil Works completed</b> | <b>Total</b> |
|-----------------|-----------------------------|--|------------------------------|--------------|
| Sargodha        | 10                          | 7                                      | 1                            | 18           |
| Jhang           | 5                           | 9                                      | 6                            | 20           |
| Faisalabad      | 11                          | 1                                      | -                            | 12           |
| <b>Total:-</b>  | <b>26</b>                   | <b>17</b>                              | <b>7</b>                     | <b>50</b>    |

13 The above table shows that out of the total 18 biogas plants installed in district Sargodha, 10 were functioning properly, 7 were completed but not producing gas and the civil works of one was completed. Similarly in Jhang district 5, 9 & 6 plants were functioning properly, completed but not yet producing gas and only civil works completed, respectively. In Faisalabad district only 12 plants were installed, out of 12 plants 11 plants were functioning properly, one plant was completed but not yet producing gas.

### 1.3 Objective

- To promote the use of Biogas Technology for enhancing income by reducing expenditure on the purchase of different energy sources like LPG, fire firewood etc.
- To convert waste material and dung into a more convenient and high value fertilizer (biogas slurry).
- To protect natural forests, minimize adverse environmental and ecological impacts by reducing the demand of wood as fuel.
- To provide employment opportunities in rural areas.

## **CHAPTER 2**

### **METHODOLOGY**

14. A questionnaire was developed for collection of data from the field keeping in view the following parameters:-

- i. Status of working of the biogas plants.
- ii. Cost sharing of the Government and Farmers.
- iii. Status of allottee/ farmers.
- iv. Status of the gas production in summer/ winter.
- v. Nature of dung feeding.
- vi. Material i.e. gas stove and gas lamp provided under the project and their daily use.
- vii. The use of slurry and its impact on crop yield.
- viii. Impact of biogas plants on fuel consumption.
- ix. To get the views of non respondent farmers.
- x. Evaluators' own opinion.

15. For the survey, 50% of the beneficiaries from each of the categories of functioning properly, completed but not gas producing, civil works completed only in each district were covered. District wise sample drawn from Sargodha, Jhang and Faisalabad is 9, 9 & 6 respectively, as revealed in the table 3.

#### **2.1 SAMPLE SIZE**

**Table 3 RESPONDENTS TAKEN FOR DETAILED SURVEY (NOs.)**

| #  | Categories                       | District wise Biogas Plants Inspected |          |            |           |
|----|----------------------------------|---------------------------------------|----------|------------|-----------|
|    |                                  | Sargodha                              | Jhang    | Faisalabad | Overall   |
| 1. | Functioning properly             | 5                                     | 4        | 4          | 13        |
| 2. | Completed but not producing gas. | 3                                     | 3        | 2          | 8         |
| 3. | Civil works completed only       | 1                                     | 2        | -          | 3         |
|    | <b>Total sample:-</b>            | <b>9</b>                              | <b>9</b> | <b>6</b>   | <b>24</b> |

## **CHAPTER 3**

### **RESULTS AND DISCUSSION**

16. The information was gathered from the respondent farmers with the help of a well designed questionnaire. Category-wise results of the monitoring survey are discussed in the following paras.

17. A person having minimum of 5-8 animals could apply for the biogas plant whether he is landless or cultivator. The below table 4 shows that no sampled respondent was from landless farmer's category. The reason is that mostly the landless have less animals than the required number for biogas plant due to the non availability of their own fodder. The high cost of fodder also restricted them from keeping animals as per requirement of the project. Resultantly, the land less could not apply and did not become part of the sample.

#### **3.1 SIZE OF LAND HOLDING OF RESPONDENT FARMERS**

**Table 4 DISTRIBUTION OF RESPONDENT BY FARM SIZE (% age)**

| #  | District   | Upto 5 acres | 5 to 12.5 acres | 12.5 to 25 acres | Above 25 acres |
|----|------------|--------------|-----------------|------------------|----------------|
| 1. | Sargodha   | 11.11        | 11.11           | 22.22            | 55.56          |
| 2. | Jhang      | 22.22        | 11.11           | 33.33            | 33.34          |
| 3. | Faisalabad | 0            | 50              | 16.67            | 33.33          |

18. District wise comparison regarding the size of holding of the respondent farmers shows that in Sargodha district 55.56% of the sampled farmers (above 25 acres). In Faisalabad district, 33.34% farmers belong to medium farmer (12.5 to 25 acres) and 33.33% big farmers (above 25 acres). Similarly, in Jhang district also majority of the farmers i.e. 33.33% big farmers' category (above 25 acres). On an overall basis 45.83% sampled farmers fall in the category of big farmers (above 25 acres).

19. The above results indicate that majority of the sampled farmers belongs to big farmers. As the project has been designed for the rural poor, therefore, it is suggested that in the remaining districts an appropriate criteria should be designed so that proportional representation be given to all the categories including the landless and small farmers.

#### **3.2 AVAILABILITY OF LIVESTOCK PER HOUSEHOLD**

**Table 5 AVERAGE HOLDING OF FARM ANIMALS OF RESPONDENTS**

| #  | Districts    | Cows        | Buffalos     | Young Stocks | Goats       | Average household |
|----|--------------|-------------|--------------|--------------|-------------|-------------------|
| 1. | Sargodha     | 2.83        | 9.86         | 17.8         | 1.98        | 14.67             |
| 2. | Jhang        | 2.33        | 10.83        | 17.6         | 1.95        | 15.12             |
| 3. | Faisalabad   | 1.87        | 13.75        | 10.8         | 1.80        | 17.42             |
|    | <b>Total</b> | <b>2.41</b> | <b>11.20</b> | <b>46.2</b>  | <b>1.92</b> | <b>15.53</b>      |

20. Results given in the above table show that the average adult animals per household in Sargodha, Jhang and Faisalabad was 14.67, 15.12 & 17.42 respectively. Due to economical size of holding, big farmers keep more animals as compared to the other categories of farmers. The higher average number of livestock therefore shown is due to the fact that majority of the farmers belonged to big farmers category.

Note: **Animals available with the household were converted into the standard unit. The conversion ration applied is as follow:-**

**Buffalo = 1.25 units, Cow = 0.70 units, 5 Young stocks = 1.00 unit & 5 Goats = 1.00 unit.**

### 3.3 APPLIANCES PROVIDED TO THE FARMER'S (WORKING PLANTS)

**Table 6. % AGE HOLDING OF APPLIANCE OF RESPONDENTS**

| #  | District   | Gas Stove |    | Gas Lamp |    |
|----|------------|-----------|----|----------|----|
|    |            | Yes       | No | Yes      | No |
| 1. | Sargodha   | 100       | 0  | 100      | 0  |
| 2. | Jhang      | 100       | 0  | 100      | 0  |
| 3. | Faisalabad | 100       | 0  | 100      | 0  |

21. Under this project one gas stove and one gas lamp was to be provided free of cost to the beneficiary farmer by the Government. Results given in the above table shows that 100% of the farmers in all the three districts of Sargodha, Jhang and Faisalabad reported that the said appliances were provided to them free of costs as per provision in the PC-I.

### 3.4 MONTH WISE COMPLETION (WORKING PLANTS)

**Table 7 MONTH WISE BIOGAS INSTALLATION**

| District   | Month ( % age) |       |     |      |
|------------|----------------|-------|-----|------|
|            | March          | April | May | June |
| Sargodha   | 0              | 0     | 100 | 0    |
| Jhang      | 0              | 67    | 0   | 33   |
| Faisalabad | 80             | 20    | 0   | 3    |

22. Balloting was held in November 2009 and the balloted farmers were required to complete the biogas plants by 31.12.2009. Results given in the table- 7. shows that in district Sargodha, 100% of the sampled biogas plants completed in May 2010. In Jhang district, 67% and 33% completed in April and June 2010 respectively. As regards the Faisalabad district, 80% and 20% of the biogas plants completed in March and April 2010 respectively. None of the biogas plants were completed in January and February 2010 in the sampled districts.

23. As the bio-gas plants were completed very late therefore, it is suggested that in the remaining districts there should be an agreement between the stakeholders under certain terms and conditions so that the bio-gas plants may be completed in time. Detail about installation of biogas plant is given in **Annex-I**.

### **3.5 STATUS OF GAS SUPPLY (WORKING PLANTS)**

**Table 8 RESPONDENT VIEWS ABOUT GAS SUPPLY (% age)**

| #  | District   | Gas Supply continuous |
|----|------------|-----------------------|
| 1. | Sargodha   | 100                   |
| 2. | Jhang      | 100                   |
| 3. | Faisalabad | 83                    |

24. The above table shows that 100% of working plants were daily producing gas continuously i.e. (as and when required), in Sargodha and Jhang Districts and the volume of gas was normal. In Faisalabad district, 5 plants out of 6 plants (83%) were supplying gas continuously whereas the remaining one working plant was out of order as observed on the day of visit due to leakage in the fermentation chamber. The beneficiary farmer took out the digester and got it repaired and again installed it in the fermentation chamber. Now he is planning to refill the fermentation chamber again. The leakage in the fermentation chamber is the technical fault, therefore, it is suggested that there should be close coordination between farmers and the project staff to provide technical services as and when needed by the farmers so that faults may not occur in future.

### 3.6

### COST SHARING IN THE BIOGAS PLANT (WORKING PLANTS)

**Table 9 AVERAGE COST OF INSTALLATION OF BIOGAS PLANTS**

| #  | District   | Farmer Share |       | Govt. Share |       | Total (Rs.) |
|----|------------|--------------|-------|-------------|-------|-------------|
|    |            | Avg. (Rs.)   | %     | Avg. (Rs.)  | %     |             |
| 1. | Sargodha   | 34920        | 53.79 | 30,000      | 46.21 | 64920       |
| 2. | Jhang      | 29172        | 49.30 | 30,000      | 50.70 | 59172       |
| 3. | Faisalabad | 32354        | 51.89 | 30,000      | 48.11 | 62354       |

25. As per project documents total cost of the Biogas plant is Rs. 60,000. Rs. 30,000 (50% subsidy) is to be borne by the Government, whereas the remaining Rs. 30,000 (50%) is the farmer's (beneficiary) share. The data in table 9 reveals that due to high material cost in Sargodha and Faisalabad districts the cost of farmer's share has been raised from Rs. 30,000 indicated in PC-I to Rs. 34920/- and Rs. 32354/- respectively. In Jhang district, the material cost is less i.e. Rs. 29172/- against the cost of Rs. 30,000/- indicated in PC-I. The less cost in Jhang district is due to the fact that the bricks are cheaper in Jhang district as compared to Sargodha and Faisalabad. The farmers share mentioned in Sargodha, Jhang and Faisalabad 53.79%, 49.30% and 51.89% respectively against the farmers/ Government cost sharing of 50:50.

26. Regarding the Government share of Rs. 30,000/- the project staff informed that the manufacturers are not ready to supply accessories to the farmers as at the current rate fixed Rs. 30,000/- as the material cost is increased. The project staff is therefore, facing difficulties in arranging accessories from the firms. It is, therefore, suggested to revise the cost of accessories keeping in view the market rates for the smooth running of project, so that an agreement with the farm for the accessories may be made for in time and easy availability of accessories.

### 3.7 KNOWLEDGE ABOUT THE ENHANCEMENT OF VOLUME OF GAS SUPPLY (WORKING PLANTS)

**Table-10 TECHNICAL KNOWLEDGE OF FARMERS ABOUT EFFICIENCY OF BIOGAS PLANTS**

| #  | District   | Season |    |        |    |
|----|------------|--------|----|--------|----|
|    |            | Summer |    | Winter |    |
|    |            | Yes    | No | Yes    | No |
| 1. | Sargodha   | 80     | 20 | 80     | 20 |
| 2. | Jhang      | 67     | 33 | 67     | 33 |
| 3. | Faisalabad | 67     | 33 | 50     | 50 |

27. The season effects on the volume of gas supply. In summer season the high temperature speedup the activities of anaerobic bacteria to produce gas and the gas volume is increased. However, in winter, due to low temperature the volume of gas supply is decreased therefore, some measures are needed to enhance the supply of gas in winter. In the winter season it is advised to lay the plastic sheets on the digester to make it warm so that anaerobic activities of bacteria may be increased. There may be some more measures to enhance gas supply in winter.

28. The project staff is desired to educate the farmers about the various measures to be adopted in different seasons to enhance the gas supply. About 80%, 67% and 67% farmers in district Sargodha, Jhang and Faisalabad respectively have knowledge about effect of summer season on the supply of gas and about 80%, 67% and 50% farmers respectively have knowledge how to enhance the gas volume in winter season as shown in table 10.

### **3.8 USE OF APPLIANCES (WORKING PLANTS)**

**Table 11 CONSUMPTION OF BIOGAS**

| #  | District   | Gas Stove Users |                     | Gas Lamp Users |                     |
|----|------------|-----------------|---------------------|----------------|---------------------|
|    |            | Users (%)       | Use per day (Hours) | Users (%)      | Use per day (Hours) |
| 1. | Sargodha   | 100             | 5.2                 | 40             | 1.5                 |
| 2. | Jhang      | 100             | 7.5                 | 0              | 0                   |
| 3. | Faisalabad | 80              | 4.37                | 0              | 0                   |

29 The data given in above table 11 reveals that 100% of the gas stove in district Sargodha and Jhang and 80% Faisalabad were working on the day of visit and their average use was 5.2 hours, 7.5 hours and 4.37 hours per day respectively. In district Sargodha 40% farmers are using gas lamp and average per day use of gas lamp is 1.5 hours.

30. The main reason of more use of biogas in district Jhang is that, after the start of working of biogas plants, the farmers are not using any other fuel and are totally dependent on biogas. In Sargodha district, the daily use of biogas is more than in Faisalabad because the farmers are still spending more money on the purchase of fuel wood as compared to Faisalabad i.e. Rs. 380 and 267 per month respectively.

### 3.9 USE OF SLURRY (WORKING PLANTS)

**Table 12 VIEWS OF RESPONDENTS FOR USE OF SLURRY**

| #  | District   | Used |     | If yes, used for  |
|----|------------|------|-----|---|
|    |            | Yes  | No  |   |
| 1. | Sargodha   | -    | 100 | -   |
| 2. | Jhang      | 33   | 67  | Sugarcane, Vegetable  |
| 3. | Faisalabad | 25   | 75  | The out let of slurry connected with the water irrigation crops/ field. |

31 The above table 12 shows that in Sargodha, Jhang and Faisalabad districts 100% ,67% and 75% of the farmers respectively reported that they did not use slurry. Some of them connected with outlet of village drain, while other was unaware about its use. As regards the slurry users in Jhang district, 33% farmers reported only that it was used for sugarcane crop and vegetables. Similarly, in Faisalabad district 25% reported that they open the out let of slurry in water course to mix it with the canal water at the time of irrigating the fields.

### 3.10 %AGE OF MICRO NUTRIENTS IN SLURRY

**Table 13 CHEMICAL COMPOSITION OF SLURRY**

| Plant Nutrient                              | Digested Slurry (%) | Farmyard Manure (%) |
|---|---------------------|---------------------|
| Nitrogen (N)                                | 1.5 - 2.0           | 0.5 – 1.0           |
| Phosphorus (P <sub>2</sub> O <sub>5</sub> ) | 1.0                 | 0.5 – 0.8           |
| Potash (K <sub>2</sub> O)                   | 1.0                 | 0.5 – 0.8           |

32. Macro nutrients such as nitrogen, phosphorous and potash are present in double quantity in slurry than F.Y.M. It is therefore, more useful for the crops than F.Y.M and artificial fertilizer. The comparison of plant nutrients in digested slurry (DS) and farm yard manure is shown in table 13.

33. As the use of slurry is very low due to no knowledge about its importance. It is suggested that there is a need to educate the farmers about its importance / use on various crops so that the crop yield and income of the farmers may be increased.



### 3.11 FUEL CONSUMPTION AND SAVING PER MONTH (WORKING PLANTS)

**Table 14 ESTIMATED ECONOMIC BENEFIT OF BIOGAS**

| # | District   | Before Biogas             |                     |                                      | After Biogas              |                     |                                      | Saving<br>Rs./<br>month |
|---|------------|---------------------------|---------------------|--------------------------------------|---------------------------|---------------------|--------------------------------------|-------------------------|
|   |            | LPG +<br>Fuel<br>wood (%) | Fuel<br>wood<br>(%) | Total<br>average cost<br>month (Rs.) | LPG +<br>Fuel<br>wood (%) | Fuel<br>wood<br>(%) | Total<br>average cost<br>month (Rs.) |                         |
| 1 | Sargodha   | 60                        | 40                  | 3191                                 | -                         | 40                  | 267                                  | 2924                    |
| 2 | Jhang      | 67                        | 33                  | 2491                                 | -                         | -                   | -                                    | 2491                    |
| 3 | Faisalabad | 100                       | 0                   | 4283                                 | -                         | 33                  | 380                                  | 2103                    |

34. One of the objectives of the project was to decrease the use of both LPG and Fuel wood. Before the project, in Sargodha, Jhang and Faisalabad districts, 60%, 67% and 100% farmers were using LPG along with fuel wood respectively and 40% and 33% of the farmers were using only fuel wood in the Sargodha and Jhang districts, respectively. The total average cost from on the sampled farmers on LPG + fuel wood and fuel woods were Rs.3191, 2491 and 4283 in district Sargodha, Jhang and Faisalabad respectively, where as in Faisalabad district no farmer was using fuel wood. After the availability of biogas, in Jhang districts no farmer using LPG and fuel wood, whereas in districts Sargodha and Faisalabad, 40% and 33% were using fuel wood and no farmer was using LPG. Results further show that after the use of biogas. The above results are very encouraging the farmers are saving Rs.2924, 2491 and 2103 per month on fuel in district Sargodha, Jhang and Faisalabad, respectively as shown in table 14.

### 3.12 VIEW'S OF THE NON-RESPONDENT FARMERS ABOUT BIO-GAS PLANT

**Table 15. RESPONSE OF OTHER FARMERS ABOUT BIOGAS**

| # | District   | Knowledge about<br>biogas plant |    | If yes             |    |  |    | Biogas owner's<br>motivation |    |
|---|------------|---------------------------------|----|--------------------|----|--|----|------------------------------|----|
|   |            | Yes                             | No | Good<br>Technology |    | Farmer interested to<br>install biogas plant |    | Yes                          | No |
|   |            |                                 |    | Yes                | No | Yes  | No |                              |    |
| 1 | Sargodha   | 58                              | 42 | 100                | -  | 100  | -  | 75                           | 25 |
| 2 | Jhang      | 55                              | 45 | 100                | -  | 95   | 5  | 61                           | 39 |
| 3 | Faisalabad | 58                              | 42 | 92                 | 8  | 83   | 17 | 58                           | 42 |

35. During the field visit, non-respondent farmers were also interviewed to get their views about Bio-gas plants. For this purpose 12,18 and 12 non-respondent farmers were interviewed in Sargodha, Jhang and Faisalabad districts respectively. Among these farmers, about 58%, 55% and 58% farmers have knowledge about bio-gas plants, in the sampled districts

respectively. Similarly, 100% non-respondent farmer each in district Sargodha and Jhang and 92% in district Faisalabad have reported that it is a good project.

36. About 100%, 95% and 83% people are interested to install biogas plants in Sargodha, Jhang and Faisalabad district respectively. About 75%, 61% and 58% of the non-respondent farmers were motivated by the bio-gas owners in Sargodha, Jhang and Faisalabad respectively.

### **3.13 INDIVIDUAL FARMERS PERSPECTIVES ABOUT NON-WORKING BIOGAS PLANTS**

#### **Sargodha District:**

Allottee No

#### **SG-4**

The construction work from the farmer side was completed. The digester was installed in the fermentation chamber. He got made it locally with the permission of project staff instead of getting it from the pre-qualified firm.

The size and design of the plant was not as prescribed, in the PC=-I. the iron sheet of the digester was also torn. The staff advised the farmer on the spot to replace it with the new digester from any pre-qualified firm.

The above exercise by the farmer caused wastage of his time and staff and resources and effects the implementation of project at right time. It is therefore, suggested to ask the farmer to strictly follow PC-I in future to avoid the wastage of time and resources.

#### **SG-8**

The Biogas plant was completed in all respect, except minor connections of gas delivery pipes. The owner of the bio-gas plant is the lady school teacher. On the completion of the plant and before filling of the fermentation chamber, she was transferred to Bhalwal. The plant is waiting for filling for the last two months.

It is suggested that this issue should be solved at Govt. level to give responsibility to do the needful for his own benefit.

## **JG-9**

On the day of visit, the farmer on the water tap and was going on mixing water in the dung without taking into account the desired ratio of water and dung. Due to imbalanced ratio of water and dung affects the efficiency of the plant. It is therefore, suggested that the project staff should regularly monitor all the activities and guide the farmers so that they may strictly follow the recommended procedure in doing the project activities.

## **SG-12**

Civil work of the fermentation chamber was not completed on the day of the visit dated 17-06-2010. All the accessories including the digester were provided by the Government. The respondent farmer reported that the delay in work was on his behalf. He remained busy in his private assignments and could not give time to the construction/ completion of the bio-gas plant.

## **Faisalabad Districts:**

### **FS-1**

The working of plant was out of order as observed on the day of visit due to leakage in the fermentation chamber. The leakage in the fermentation chamber is the technical fault. Therefore, it is suggested that the project staff should have close co-ordination with the farmers to provide technical services as and when needed by the farmer so that such faults may not occur in future.

### **FS-17**

Fermentation chamber was filled with dry matter (dung) due to which process of gas producing was not observed. Later on the technical staff visited the plant and farmer was informed that fresh material should be used for filling of chamber. It is suggested that the farmers should be trained properly for smooth functioning of biogas plant to avoid any problem.

## **In SG-16, JG-11, JG-13, JG-14**

All the required material and technical guidance was provided to the farmers but they remained busy in their other private assignments and did not take interest and did not complete their work in time.

### **3.14 GENERAL OBSERVATIONS OF THE SURVEY TEAM**

The visiting team has the following observations: -

- i. Under the project there is no provision of vehicle in PC-I at district level to the project staff. A vehicle, however, for the project staff in Jhang and Faisalabad has been arranged, whereas, in Sargodha no vehicle is available with the Assistant Agriculture Engineer (AAE). He and his project staff are facing great difficulty in visiting the project sites. In Sargodha, to visit the project area they can hardly arrange Government vehicles therefore; mostly they make the private arrangements to visit the project sites. It is suggested that a vehicle for the project staff may be provided for the smooth and effective implementation of project activities.
- ii. Under this project digester, gas stove and gas lamp costing Rs.30, 000 are provided to the farmer by the Government free of cost and are purchased for the pre-qualified firms. As per report of the project staff, the firms are now hesitating in supply the digester and other accessories at the above said/ existing rates, resulting in the delaying / non-availability of the accessories from the pre-qualified firms.
- iii. Balloting was held in November, 2009. The balloted farmers were asked to complete the construction work by 31-12-2009. Non of the farmer could complete the work within the stipulated time. Many requests were made by the project staff to complete the work in time. Only 55% , 33% and 83% biogas plants could be completed in Sargodha, Jhang and Faisalabad districts, respectively.
- iv. Presently, gas holders and other accessories are obtained by the farmers individually from the pre-qualified firms of the concerning district. The firms were using delaying tactics i.e. in March/ April. The firms were remained busy in making wheat threshers, trollies etc. and did not take interest in making the digester and other accessories, which caused delay in the project activities. Due to monopolistic behavior of the firms of the concerned districts, the farmers were forced to purchase accessories form the firms of other district, causing wastage of time and resources.
- v. Under this project family size biogas plants are being installed. These plants produce gas for one gas stove and a gas-lamp. As the household bills of electricity have gone very high due to costly electricity and crises in the country, therefore, the farmers are now demanding for the big/ community plants to operate generator to meet the energy crises.
- vi. It was observed that the each member of the field staff visited the sites 3-4 times. TA/DA provided in the PC-I is too less than the requirement.
- vii. Currently the farmers book the gasholder and other accessories with the firms and then they do not follow it for its acquisition. It is suggested that the farmers should be bound to deposit some advance money to the firm at the time of booking. Doing this the farmers will take interest in getting the accessories as early as possible.
- viii. Budget for the stationary and other utilities seems to be less under this project.
- ix. There was quite variation of gas pressure among the plants i.e. from low pressure to high pressure. It is suggested to sort out the reasons of variation in pressure among the plants, as all the plants are of the same size and make amendments/ adjustments the gas supply system if needed.

- x. Some farmer fill the fermentation chamber in few days i.e. 3-5 days, other, take 3 weeks i.e. 20-25 days to fill it. This aspect was discussed with the project staff. They informed that quickly filled plants start working within 4-5 days after its filling, as against the slowly filled plants which take many days to start working. It is suggested that the farmer should be advised about the benefit of quickly filling so that the farmers may quickly fill the fermentation chamber for the early availability of gas.
  
- xi. In SG-6, Yasin Engineering Workshop produced the digester to the farmer three months after the construction of fermentation chamber. The farmer made a complaint to the project staff. The matter was enquired and it was found that the company has sublet this assignment to the other company, due to which it was delayed. There should certain condition in an agreement so that the firm may not unnecessary delay the consignment. It is also suggested that this type of firm should be blacklisted.

## **CHAPTER 4**

### **CONCLUSIONS AND WAY FORWARD**

The survey results are summarized below: -

1. District wise comparison among the various categories of farmers show that majority of the farmers in Sargodha, Jhang and Faisalabad were big farmers i.e. 55.55%, 33.33% and 33.33% respectively. On an overall, 45.83% sampled farmers fall in the farmers category (above 25 acres).
2. Due to economy of size of holding, big farmers keep more animals than the other categories of farmers. As stated above high percentage of sampled farmers belong to big farmers therefore, the level of average number adult units per household in Sargodha, Jhang and Faisalabad districts were quite high i.e. 14.67, 15.12 and 17.42 respectively. As the project has been designed for the rural poor, therefore, it is suggested that in future proportional representation be given to all the categories of farmers including the landless.
3. As per PC-I farmers share in the total cost as material cost is 50%. The farmers share monitored in Sargodha, Jhang and Faisalabad as material cost is 53.79%, 49.30% and 51.89% respectively. The high cost of material monitored in due to inflation.
4. 100% of working plants in Sargodha and Jhang districts were producing gas continuously and the volume of gas was normal. In Faisalabad district 5 out of 6 working plants (83%) were supplying gas continuously where as the remaining one working plant was out of order as observed on the day of visit due to leakage in the fermentation chamber. The leakage in the fermentation chamber is the technical fault, therefore, it is suggested that the project staff should have close co-ordination with the farmers to provide technical services as and when needed by the farmer so that such faults may not occur in future.
5. In summer season, the high temperature speedup the activities of anaerobic bacteria and there is sufficient gas supply and no remedial measure are required to increase the gas supply. In winter season the temperature is quite low therefore, it is desire to lay plastic sheets on the digester to make it warm to activate anaerobic bacteria to produce more gas. About 80%, 67% and 67% farmers in district Sargodha, Jhang and Faisalabad has knowledge about effect of summer season on the supply of gas and about 80%, 67% and 50% farmers had knowledge how to enhance the gas volume in winter in the said districts, respectively.
6. 100% farmers of district Sargodha, Jhang and Faisalabad fed dung to fermentation chamber daily as required in the PC-I.
7. 100% of the farmers in all the three districts of Sargodha, Jhang and Faisalabad reported that the appliances like gas stove and gas lamp were provided to them free of cost as per provision in the PC-I.
8. 100%, 100% and 80% of the gas stove in districts Sargodha, Jhang and Faisalabad respectively were in use on the day of visit. Similarly, 40% of the respondent farmers were using gas lamp in district Sargodha and no sampled farmer was using it in districts Jhang and Faisalabad.

9. Average numbers of hours of biogas use per day were 5.2, 7.5 and 4.375 hours in district Sargodha, Jhang and Faisalabad respectively. The main reason of more use of biogas in district Jhang is that, after the start of working of biogas plants, the farmers are not using any other fuel and are totally dependent on biogas. In Sargodha district, the daily use of biogas is more than Faisalabad because the farmers are still spending more money on the purchase of fuel wood as compared to Faisalabad i.e. Rs.380 and 267 per month respectively.
10. In Sargodha, Jhang and Faisalabad districts, 100%, 67% and 80% of the farmers respectively reported that they did not use slurry. As slurry is the high value input therefore, it is suggested to transfer the knowledge to the farmers about its importance and use on various crops so that the crop yield and income of the farmers may be increased.
11. Before the project the farmers were using fuel wood and LPG. After the availability of biogas, in Jhang districts no farmer was using LPG and fuel wood, whereas in district Sargodha and Faisalabad, 40% and 33% were using fuel wood and no farmer was using LPG. Results further show that after the use of biogas the farmers were saving Rs.2924, 2491 and 2101 per month on fuel in district Sargodha, Jhang and Faisalabad respectively. The above results are very encouraging.
12. 12, 18 and 12 non-respondent farmers were interviewed in Sargodha, Jhang and Faisalabad district respectively. Among these farmers, about 58%, 55% and 58% farmers have knowledge about biogas plants, respectively. Similarly, 100% non-respondent farmer each in district Sargodha and Jhang and 92% in district Faisalabad who have knowledge about it reported to be a good project. About 100%, 95% and 83% people were interested in having biogas plants in Sargodha, Jhang and Faisalabad districts respectively. About 75%, 61% and 58% of the non-respondent farmers were motivated by the biogas owners in Sargodha, Jhang and Faisalabad respectively.

#### **4.1 Lesson learnt for future**

1. Majority of the farmers i.e. 55.55%, 33.33% and 33.33% in Sargodha, Jhang and Faisalabad districts were big farmers. As the project has been designed for the rural poor, therefore, it is suggested that in future proportional representation shall be given all the categories of farmers. Landless should also be given their due share.
2. In Sargodha, Jhang and Faisalabad district, 100%, 67% and 80% of the farmers respectively reported that they did not use slurry. As slurry is the high value input therefore, it is suggested to transfer the knowledge to the farmers about its importance and use on various crops so that the crop yield and income of the farmers may be increased.
3. There is no provision of vehicle at district level in the PC-I. The project staff is facing great difficulty in visiting the project sites. It is suggested that one vehicle at district level should be arranged along with the sufficient P.O.L for the smooth working of the project.
4. The digester and other accessories costing Rs. 30,000/- are purchased from the pre-qualified firm. Now they are hesitating in supplying the material at the existing rates, resulting in delaying due to non-availability of the material. It is suggested

that the cost estimates of the material should be revised and increased up to the reasonable level so that these can be made available from the firm early and in time.

5. Only 55%, 33% and 83% biogas plants could be completed in Sargodha, Jhang and Faisalabad respectively. One of the reasons of delay of construction work was that there were no terms and conditions settled with the beneficiary farmers to complete the work in time. Resultantly, the farmers went on delaying the work unnecessarily. It is proposed that the biogas plants should be allotted to the farmers under certain terms and conditions i.e. if the farmers without any reason go on delaying the construction work he may be fined or his allotment may be cancelled and the plant may be allotted to the next farmer in the waiting list.
6. The firms use delaying tactics in providing the digester and other accessories. In March/ April, the firms remain busy in making wheat threshers, trollies etc. It is suggested that an agreement should be made with the pre-qualified firms so that the accessories should be easily/ in time available and also from the home district. The Government should also take active part to ensure easy availability of accessories to the farmers.
7. Under this project family size biogas plants are being installed. These plants produce gas for one gas stove and a gas lamp. As the household bills of electricity have gone very high due to electricity crises in the country, therefore, the farmers are now demanding for the big/ community plants, to operate generator to meet the energy crises. It is, therefore, suggested to also consider their demand if is feasible.
8. It was observed that 3 – 4 visits are paid by the each member of the field staff. TA/DA provided in the PC-I is less than the requirement. It is suggested to provide reasonable TA/DA for the field staff so that they may make more visits and monitor the activities very well.
9. Currently the farmers book the gasholder and other accessories with the firms and then do not follow it. They should be bound to deposit some advance money at the time of booking to get back the advance money deposited they will try to get accessories as early as possible.

#### **4.2 CONCLUSIONS AND RECOMMENDATION**

1. It is observed that majority of the sampled farmers availing this facility were to large farmers. The completed bio-gas plants in all the three districts were producing gas continuously with normal gas pressure. Similarly average number of hours of biogas use per day was 5.2, 7.5 & 4.37 in district Sargodha, Faisalabad and Jhang respectively and the farmers were satisfied. After the use of biogas, the respondent were saving Rs. 2924, 2491 & 2101 per month in districts Sargodha, Faisalabad and Jhang respectively.

2. All the working plants are working/ functioning properly. Respondent farmers in all the three districts have adopted this technology with great interest and observe the procedures/



methods for smooth functioning of biogas plant. The farmers are happy as it is very simple technology and cheap source of energy. There is no extra operational cost to be faced by the farmers during plant operation. The farmers were satisfied/ agreed with their 50% share in the project. The survey team also collected views of non-respondent farmers and came to find that almost 100% farmers have acknowledge of the biogas plants and are interested in installation of biogas plant.

However, the major constrains hindering the smooth function of the project along with the remedial measures are suggested here under: -

- There is no provision of vehicle at district level in the PC-I. The project staff is facing great difficulty in visiting the project sites. It is suggested that one vehicle at district level should be arranged alongwith the sufficient P.O.L and TA/ DA for the smooth working of the project.
- The pre-qualified firms are hesitating in supplying the material at the existing rates, resulting in delaying/ non-availability of the material. It is suggested that the cost estimates of the material should be revised and increased upto the reasonable level so that these can be made available from the firm early and in time and the project activities may not be suffered.
- Only 55%, 33%, 83% biogas plants could be completed in Sargodha, Jhang and Faisalabad, on the day of visit, respectively. The farmers went on delaying the work unnecessarily. It is proposed that the biogas plants should be allotted to the farmers under certain terms and conditions so that they may not delay the construction/ project work.

It is suggested to implement in the remaining districts of the project after doing the remedial measures suggested in the report.

**COMPLETION DATES OF WORKING PLANTS**

| Identification Code | Name & Address                                       | 1-3-10 | 15-3-10 | 31-3-10 | 15-4-10 | 30-4-10 | 15-5-10 | 31-5-10 | 15-6-10 |
|---------------------|--|--------|---------|---------|---------|---------|---------|---------|---------|
| SG-3                | M. Khan S/o Bhan Khan Farooqabad old Bhalwal.        |        |         |         |         |         | ✓       |         |         |
| SG-6                | Mr. Riaz S/O Faize Muhammad Bhujikot Bhera.          |        |         |         |         |         |         | ✓       |         |
| SG-11               | Ramzan S/O M. Khan Moza Kudlathi Dherosial           |        |         |         |         |         | ✓       |         |         |
| SG-13               | Syed Sirajul Haq Lakhiwal                            |        |         |         |         |         |         | ✓       |         |
| SG-17               | M. Riaz Chak NO.91-A Sargodha                        |        |         |         |         |         |         | ✓       |         |
| JG-2                | All Ditta S/O Sultan Muhammad Chak Noon              |        |         |         | ✓       |         |         |         |         |
| JG-18               | Mr. Hanif S/O M. Ramzan Moza Gagrana                 |        |         |         |         | ✓       |         |         |         |
| JG-20               | Gul Ashgar S/O Mr. Ramzan Chak No. 160 Magsi Sial    |        |         |         |         |         |         |         | ✓       |
| JG-15               | Umer Daras S/O Haji Jewan Khan Haraili Bahahadq Shah |        |         |         |         |         | ✓       |         |         |
| FS-2                | Waqas S/O Faiz Ahmad 2 Chak Ramdowali                | ✓      |         |         |         |         |         |         |         |
| FS-9                | M. Usman S/O Nasrullah Chak No. 443/GB               |        |         | ✓       |         |         |         |         |         |
| FS-15               | Rana Muhammad Anwar S/O Ghulam Chak No. 206 R.B      |        | ✓       |         |         |         |         |         |         |
| FS-19               | Mr. Rasheed Ahmad S/) Abdullah Chak No. 202 G.B      |        |         | ✓       |         |         |         |         |         |