# BIOGAS FOR RURAL COMMUNITIES

TD390 Supervised learning: Study report


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# Abstract

This report presents a preliminary study of two highly successful rural biogas models wherein biogas is produced and utilized as a cooking fuel by the villagers. The two models studied are the Community Biogas plant established by SUMUL Dairy at Bhintbudrak, Gujrat and the Individual Biogas plants established by Bhagirath Pratisthan (an NGO) in south Konkan region of Maharashtra. Various aspects including design, operation, economics and benefits to the stakeholders have been described. The report ends with a comparison of the two models studied on the basis of their design, vision, performance, economics and benefits.

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*“The dream of India as a strong nation will not be realized without self reliant, self-sufficient villages, this can be achieved only through social commitment & involvement of the common man."*

- **Anna Hazare**

# 1. Introduction

## 1.1. India's energy scenario

Mahatma Gandhi, in his vision for India, envisaged a system of devolved, self-sufficient communities, sustaining their needs from the local environment, and organizing income generating ventures around co-operative structures. Sixty years on, and Gandhiji's vision of *Swadeshi* (self-sufficiency) for India is perhaps more urgent than ever. Diminishing forests and a burgeoning, mainly rural biomass-dependent population of around 70% of the total population necessitates a co-ordinated effort of rural India to supply itself with a dependable and sustained source of energy.

Biomass alone currently meets almost half of the national energy demand, yet is rarely featured in any 'official' statistics of energy use, given perhaps its scattered nature, and its low status as fuel. Fuel wood is the primary source of biomass, derived from natural forests, plantations, woodlots and trees around the homestead. Alarm regarding the state of India's forests has kick started an intense afforestation and forest regeneration scheme that attempts to share management of forest resources between the forest department and local user communities.

India's overall energy production is considerably less than its overall energy consumption. India's energy demand is increasing, and its inability to step up production to meet demand, has increased India's reliance on costly imports, the gap between consumption and production projected to widen into the next century, as demand for energy is projected to grow at an annual rate of around 5% - one of the highest in the world. Energy for developing industries, transport, and a drive towards the electrification of India over the last three decades have contributed to the energy production deficit.

TABLE 1.1 Estimated Potential of Rural Energy Sources in India (Source: MNRE, 2008)

| Source | Approx. Potential (MWs) |
|---|---|
| Biomass energy | 19,500 |
| Solar energy | 20,000 |
| Wind energy | 47,000 |
| Small hydropower | 15,000 |
| Ocean energy | 50,000 |

In an attempt to stem the projected deficit between production and consumption, particularly for the expanding rural sector, the government is pursuing alternative measures of energy provision. Renewable energy potential is high on the subcontinent. Table 1.1, above, lists the estimated potential of various renewable energy sources. Energy from solar, wind, hydro and ocean all have a significant future potential to play in a mixed energy production scenario. However, of particular interest here, in the context of providing a devolved, sustainable energy supply for the burgeoning rural sector in India, is the potential of biogas; the gas created as a product of anaerobic digestion of organic materials.

The government views biogas technology as a vehicle to reduce rural poverty, and as a tool in part of a wider drive for rural development. To promote and disseminate information about biogas technology specifically, the government has organized the National Project on Biogas Development nation-wide, and several NGO's have been active in implementing the program on the ground. Currently, there are thought to be about 2.5 million (Dutta et al., 2007) household and community biogas plants installed around India.

## 1.2 Why biogas?

The enormous potential of biogas, estimated at 19,500 MW can be seen from Table 1. The capacity was derived principally from estimated agricultural residues and dung from India's 283 million cattle (National Dairy Development Board, 2010). Biogas technology is a particularly useful system in the Indian rural economy, and can fulfill several end uses. The gas is useful as a fuel substitute for firewood, dung, agricultural residues, petrol, diesel, and electricity, depending on the nature of the task, and local supply conditions and constraints, thus supplying energy for cooking and lighting. Biogas systems also provide a residue organic waste after anaerobic digestion that has superior nutrient qualities over the usual organic fertilizer, cattle dung, as it is in the form of ammonia. Anaerobic digesters also function as a waste disposal system, particularly for human waste, and can, therefore, prevent potential sources of environmental contamination and the spread of pathogens. Small-scale industries are also made possible, from the sale of surplus gas to the provision of power for rural industries. Therefore, biogas may also provide the user with income generating opportunities. The gas can also be used to power engines, in a dual fuel mix with petrol and diesel and can aid in pumped irrigation systems.

Apart from the direct benefits gleaned from biogas systems, there are other, perhaps less tangible benefits associated with this renewable technology. By providing an alternative source of fuel, biogas can replace the traditional biomass based fuels, notably wood. Introduced on a significant scale, biogas may reduce the dependence on wood from forests.

Biogas certainly has a significant impact on rural women’s lives. A regular supply of energy piped to the home reduces, if not removes, the daily task of fuelwood gathering, which can, in areas of scarcity, be the single most time consuming task of a woman's day - taking more than three hours in some areas. Freeing up energy and time for a woman in such circumstances often allows for other activities, some of which may be income generating.

A clean and particulate-free source of energy also reduces the likelihood of chronic diseases that are associated with the indoor combustion of biomass-based fuels, such as respiratory infections, ailments of the lungs; bronchitis, asthma, lung cancer, and increased severity of coronary artery disease. Benefits can also be scaled up, when the potential environmental impacts are also taken into account; significant reductions in emissions associated with the combustion of biofuels, such as sulphur dioxide ($SO_2$), nitrogen dioxide ($NO_2$), carbon monoxide (CO), total suspended particles (TSPs), and poly-aromatic hydrocarbons (PAHs), are possible with the large-scale introduction of biogas technology.

The use of biogas systems in an agrarian community can increase agricultural productivity. All the agricultural residue, and dung generated within the community is available for anaerobic digestion, whereas previously, a portion would be combusted daily for fuel.

Therefore more is returned to the land. Moreover, as mentioned earlier, the slurry that is returned after methanogenesis is superior in terms of its nutrient content as the process of methane production serves to narrow the carbon:nitrogen ratio (C:N), while a fraction of the organic nitrogen is mineralised to ammonium ($NH_4^+$), and nitrate ($NO_3^-$), the form which is immediately available to plants.

Thus, it can be seen that biogas is the appropriate rural energy sources which matches with Mahatma Gandhi's vision of a system of devolved, self-sufficient communities.

## 1.3 Factors hindering spread of biogas plants

Although biogas is seen to be better off as a rural energy resource, the following factors have hindered its spread in rural India.

Technically, problems have arisen from installing too large a capacity plant, either by accident or design. Too large a plant was found to lead to under feeding, and eventual failure of the plants to produce gas. Under feeding was also found to occur due to the under-collection of dung, estimated typically at 30-40% of the required capacity, and principally due to cattle being worked in the field, which would also lead to a reduction in gas production. Dung may also vary in its availability: in areas of climatic instability, the occurrence of drought may reduce dung availability, by forced sale of cattle, or even death of cattle. In some areas, the plant may not be technically feasible all year round due to low winter temperatures that inhibit methanogenesis.

Sometimes the plants are faulty in their construction, or develop problems that lead to the non-functioning of the plant, due to shoddy construction (more relevant to the fixed-dome models, than the floating dome, which comes pre-cast). Often, specially trained masons in biogas plant construction were overlooked, due to their higher cost, in favor of cheaper trainees, or those with no training at all.

Economically, biogas systems have been shown to be cost-effective. Despite the positive cost-benefit of biogas technology, the 'macro-environment', may discriminate against the uptake of biogas. The macro-environment which determines price structures of conventional fuels most likely acts as a disincentive to adopt renewable technologies. Subsidized conventional fuels, such as electricity, along with free connection to the grid for farmers, will continue to make non-renewable technology the cheapest option, unless subsidies for biogas can be brought into line, or prices of conventional fuels are raised.

The system of grants and loans may hinder the correct choice of plant for different users, such as the ineligibility of community size systems, due to their size. Another point in prohibiting uptake may be the perceived unnecessary switch from the existing free source of energy, such as wood and crop residues.

Cultural practices may also hinder general uptake, due to reluctance to adopt different behavior, particularly regarding the use of latrines in biogas systems. Traditional cooking practices may also need to be altered. A common complaint about the use of gas burners for cooking is that the staple bread *chapati,* cannot be properly roasted. Further, women are not necessarily the decision makers in a household, and the men of the household may not consider benefits, which mainly accrue to women, to be of significant urgency.

Some of the problems discussed above may be overcome, through effective selection processes for the technology, and proper extension and support services. By all accounts, the government does not seem to be effectively organized to achieve such a goal, and a high number of non-operative biogas plants are likely to continue. Criticisms of National Program on Biogas Development have been widely articulated, from the lax selection process, to the arbitrary fixing of regional targets, which are then pursued. Further, when complications have arisen in the functioning of plants, a common complaint articulated is that there is a lack of available technical support. In this way, plants are allowed to fall into disrepair, when their functioning depends upon adequate maintenance skills, which should be available in every village. There is a danger that biogas may come to be thought of as a useless and inappropriate initiative, a folly imposed from policy makers and NGO's.

To overcome such organizational errors, micro-planning is essential so that genuinely appropriate biogas technology is made available to rural communities. Also it is very important to promote the participation of local people in the whole process of education, planning and monitoring, so that the renewable technology is viable and sustainable in the communities it is designed to serve.

## 1.4 Objectives of the study

In view of **the rural energy scenario in India** and **the well-suitedness of biogas as an energy source**; this project plans to study two highly successful biogas models which have **countered all the hindering factors** and stand out as ideal models which should be replicated.

The 2 models studied are:

1. Community Biogas Plant (CBP) at Bhintbudrak village (Taapi district, Gujrat) established by SUMUL
2. Individual, house-hold level plants in Sindhudurg and Ratnagiri districts of Maharashtra established by Bhagirath Gramvikas Pratisthan, Kudal

The following study report presents the various aspects of both the models including design, operation, economics and benefits to the stakeholders have been described. The report ends with a comparison of the two models studied on the basis of their design, vision, performance, economics and benefits.

# 2. Community Biogas Plant

## 2.1 Introduction

Majority of the biogas plants in India are individual, household level plants. However, since only comparatively rich villagers have adequate number of cattle, most small farmers and landless labour and artisans in the villages cannot have biogas plants. The common needs of the villagers such as organic fertilizers in large quantities, lighting and water supply cannot be met from individual plants as privately owned individual biogas plants are used mostly for cooking and the sludge for fertilizing the fields. Some of the other advantages of a community plant are listed below:

1. Sanitation: with proper management of animal and other agriculture/organic wastes/ village will be clean leading to better health and hygiene in rural areas.
2. Energy security: conversion of organic waste into methane and its use as fuel will lead to energy security because the fossil fuel is not going to last forever.
3. Pollution control: normally aerobic decay of organic waste leads to emission of green house gases like carbon dioxide or carbon monoxide. The process of methanation reduces green house gas emission and helps in arresting depletion of the ozone layer. This is likely to earn carbon credits.
4. Employment generation: Such plants can be easily set up and operated at village level and can be managed by women self help groups or local entrepreneurs with lower per capita investment. Since the product has a captive market the plant is bound to be economically viable and generate employment opportunity for a large number of people

Despite the advantages mentioned above, there are very few successful community biogas plants (CBP) in India, most of which are institutional biogas plants constructed by organizations such as the Khadi & Village Industries Commission, other commercial entities (as part of their Corporate social responsibility programs) etc. At present, the number of community biogas plants established in villages to cater to the cooking fuel, organic fertilizer or electricity requirements of the village is very small. The unpopularity of CBPs can be attributed to the following constraints:

1. Economic:
    a. High capital and interest cost of CBP compared to the smaller family biogas plant.
    b. High repair and maintenance cost.
2. Social:
    a. Women gather fuel wood for cooking while the decision making for CBP is by the men folk. Therefore, the need for construction of such plants in not dealt with urgency.
    b. Lack of awareness.
3. Technical:
    a. Inadequate dung availability.
    b. Initial gestation period of about two months of feeding.
    c. Scarcity of water.
    d. Non-availability of space.
    e. Maintenance problems.
    f. High rate of plant failures.

4. Institutional:
    a. Complex procedures to obtain loan, subsidy and repair charges.
    b. Inadequacy of funding.
    c. Lack of masons and skilled labour.

As we see, establishment and proper functioning of community biogas plants is difficult. One of the very few successful community biogas plants in India is the plant in Bhintbudrak village (Taapi district, Gujrat). This plant was constructed by Surat District Co-operative Milk Producer‘s Union Ltd, abbreviated as “SUMUL” with the support and co-operation of local villagers. The plant produces biogas which is distributed to the villagers through underground pipes. The gas supplied is used as a fuel for cooking by the villagers. The production of vermicompost from the output slurry makes this project economically viable. The Ministry of New & Renewable Energy took a note of this project and formulated a scheme which is known as BFFP (Biogas & fertilizer plant).

The following section of this report describes the Bhintbudrak Community biogas plant in detail. Various aspects such as vision of establishment, design, performance, economics, externalities etc have been discussed.

## 2.2 Background

Bhintbudrak is a village in Uchhal taluka of the Taapi district in Gujrat. Bhintbudrak is located almost on the Gujrat-Maharashtra border, very close to the town of Navapur in Maharashtra.

The village consists around 500 families (Population- around 2200), all of which are milk suppliers to the nearby Surat District Co-operative Milk Producer‘s Union Ltd (SUMUL). Majority of these 500-odd households are closely spaced in the heart of the village; the rest being considerably far and scattered. Figure 2.1 shows the satellite map of the village.

Fig. 2.1 Satellite map of Bhintbudrak showing closely spaced households (Source: Wikimapia)

Almost 90% of the total number of households possess cattle or other bovine animals, the number of cattle at each household ranges from 2-6. With this cattle population, the village is able to provide around 2400 liters of milk daily to the SUMUL dairy. The animal stalls are in the front yard/backyard/porch of the household in most of the cases. The animals are allowed to graze in the free pastures of the village or in some cases fed in the stall itself.

One cow produces around 10-12 kg cow dung per day. Before the establishment of the biogas plant, this cow dung used to be dried and processed into dung cakes which were then used to fuel *gobar chullas* or sold annually to external contractors at Rs. 800-1200 per tractor load.

Apart from the milk business, majority of the villagers are farmers. Maize, sugarcane are the major crops produced. Villagers here have always been open to newer, more beneficial technological advances. Many farmers have adopted mechanized methods for farming operations along with hybrid seeds and chemical fertilizers. Farmers have started cultivating crops like ginger, ladyfinger to achieve more economic returns.

The groundwater levels are high due to nearby Ukai dam. Therefore, the village has adequate water supply by the means of wells and bore wells.
Bhintbudrak, being in Gujrat, is connected to the grid for electricity which ensures an electricity supply at par with urban areas of the country. This has made the induction and fruitful use of modern technical advances easy. For instance, electric pumpsets are used for irrigation.

Many of the households are equipped with air coolers, television sets, satellite dishes for television which shows their economic stability.

The proximity to a town (Navapur) makes this village connected to the changes, developments in the outside world. Villagers can make use of facilities like higher secondary education/English medium schools in Navapur easily. Many developmental or other activities and changes are catalyzed by the proximity to a semi-urban town.

The village does not have toilets. People still tend to use open spaces instead of closed toilets.

Before the biogas supply, the main fuel for cooking was dried dung cakes. Wood, cut down from nearby forests was also used in some households. Use of LPG cylinders increased due to the government scheme of free cylinders to below-poverty-line families.

The main administrative structure of the village consists of the village co-operative (known as *Doodh Mandali*). This entity controls the milk accounts of each household with SUMUL which is the major revenue source of the villagers. The village co-operative here is by far a highly efficient, productive administration as compared to similar structures in India. The co-operative has completed developmental works such as RO purified drinking water, piped water supply to the households and of course the successful biogas plant. This work of the co-operative has been recognized and awarded time-to-time by various government and non-government agencies.

Bhintbudrak villagers are generally co-operative; no major quarrels amongst themselves. Moreover, they are willing to adopt new technology, new ideas. The mental resistance towards change is somewhat low compared to other Indian rural setups. Also, almost entire

village practices Christianity. Single religion of all villagers further reduces the conflicts amongst individuals.
All villagers are contributing a fixed sum of money depending on their economic status for the renovation of the village church. This shows the co-operation and sense of unity in the village community. Only this has made the biogas plant a huge success, which was, for that matter, constructed partly through funds raised by public contribution.
The village co-operative and villagers here understand the importance of public participation in the development process. This attitude makes the village highly amenable to rapid and sustainable development.

The main external agency the village interacts with apart from the government is SUMUL dairy. The basic point of contact is the supply of milk from the village to SUMUL. But, the interaction between the village and SUMUL is not limited to just the transaction of milk. SUMUL has provided and still provides many technical, social, institutional and economic inputs for the overall development of the village. The establishment of RO purification system is one such example among many others where SUMUL provided all necessary support and mentorship.

## 2.3 Birth of the idea

Idea of the biogas plant was triggered in order to have a proper disposal system for the cow dung. Before the establishment of biogas plant, the dung would be collected in households, streets, empty spaces and left there itself till it was sold to some external contractor. The contractor would collect the dung once in a year which resulted in dung being piled up in large quantities. This was an unhygienic practice and raised health concerns. The health hazard was further emphasized by subsequent outbreak of *bird flu* in Navapur.
Thus, these public health and sanitation issues were the main contributing factors for the construction and smooth functioning of the plant.

## 2.4 The promoter: SUMUL Dairy

Any development process rarely comes up on its own. It has to be induced. In our case, the development was induced and promoted by SUMUL dairy. Though the health hazards of mismanaged cow dung and the array of benefits from the biogas plant was intuitive to the villagers, it had to been reinforced by someone who had knowledge, authority and power. Sumul played this role which ultimately resulted in the establishment of the Community Biogas & Fertilizer plant.

## 2.5 Methodology & Construction of the plant

The methodology adopted by SUMUL for implementation of this idea of biogas plant included 7 main steps which are discussed on the next page.

1. Feasibility survey for selection of villages of Surat and Tapi District with the below mentioned criteria:

- Village Animal Population
- Geographical condition of village
- Optimum space for the project
- Co-operative culture of village
- Acceptance of new technology
- Easy availability of Water, Electricity facility
- Tribal population of the village
- Proximity to forest lands
- Distribution of households: should be clubbed together, not scattered
- Good past experience of Village Milk Cooperative Society

2. Based on the above criteria, Bhintbudrak was selected.

3. After selection of the village, a Project team was formed at SUMUL to study the following aspects:

- Project details ( Physical)
- Project Cost (Financial)
- Material required
- Fund management
- Collection and Analysis of village level Data
- Formation of Village level implementation Committee

4. After collection of all the information related to the concept of cow dung based Bio Gas production and Distribution in Bhintbudrak village, several programs mentioned below were conducted:

- Awareness Program for the active Leaders of village
- Awareness Program for all Animal rearing Family
- Key Objectives of the project
- Role and Responsibility of the Villagers and Structure formation for successful implementation of the project.
- Merits and Demerits of the project

5. Also, the following parameters related to the plant were finalized:

- Time frame of the implementation of the project
- Finance management of the project
- Operation and Maintenance of the project
- Accounting procedure of the project
- Fixing Prices of Dung and Gas distribution to beneficiaries
- Site selection for the plant
- Use of output (Slurry) to produce Vermicompost

6. Parallely the following programs were conducted:

- Training of employees and Committee for Operation of the Project
- Regular review of the Project and further improvement of the Project.

7. After all required paper work and discussions with the beneficiaries completed, the actual construction work started. The construction involved the following steps:

- Excavation of two Digester (85 cumt. X 2 nos.) Diameter 7.90 meter and 3.7 meter depth.
- Construction of two digesters, Input and Output tanks by brick and steel work.
- Lowering and Laying of Bio Gas Pipelines.
- Installation of Pressure Regulation system for equal pressure of Bio Gas for all beneficiaries of village.
- Work for electricity supply and Water availability.
- Construction of Slurry Drying bed.
- Construction of vermicompost shed.
- Provide all beneficiaries specially designed single Biogas burner with pressure valve.

The main construction stages are shown in figure 2.2.

Post-construction role of the promoter:

Once the construction and commissioning of the plant was completed as per the steps outlined above, the plant was handed over to the locals i.e. the village co-operative for day-to-day operations. SUMUL continues to act as the mentor to the villagers providing crucial technical, social or economic inputs as and when required. In case of any technical problem, a technician from SUMUL is called for the solution, who promptly comes and handles the problem efficiently. Apart from such occasional help, SUMUL has no active role in the operation of the plant. Entire operation is controlled by the village co-operative which also bears the recurring costs and gets all the revenue generated by the plant. Thus, SUMUL does not expect any revenue out of its initial investment for the plant. A few examples highlighting SUMUL's post construction role are listed below:

a. The plant had failed soon after its construction owing to corruption and other malpractices of the then supervisor of the plant. SUMUL provided a loan of Rs. 1,50,000 for the revival of the plant.
b. The plant faced a technical problem related to the electricity supply to the plant machinery. SUMUL sent in a technical expert to get this issue solved.
c. The vermicompost produced at the plant is marketed under SUMUL's brand name and marketing license. Although, all the revenue from the vermicompost goes to the village co-operative.

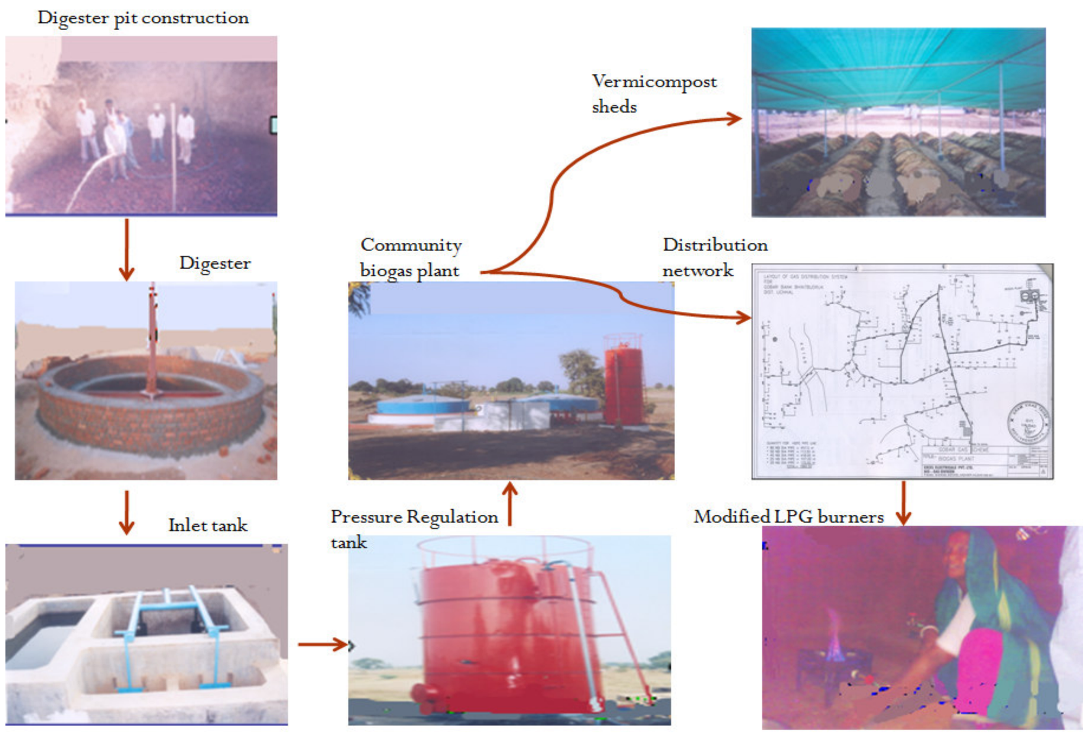



Fig. 2.2 Main stages involved in construction

## 2.6 Overview of the plant

Table 2.1 shows some of the important parameters constituting an overview of the CBP.

TABLE 2.1 Overview of the plant

| Sr. No. | Parameter | Description |
|---|---|---|
| 1 | Ownership | Village Co-operative Society |
| 2 | Number of beneficiaries | 121 |
| 3 | Operational since | 2004 |
| 4 | Feedstock | Cattle dung |
| 5 | Capacity | 4000-4500 kg per day |
| 6 | Size of digester | 2*85 $m^3$ |
| 7 | Digester type | Floating dome |
| 8 | Auxiliary systems | Mechanized mixing of dung and water, Pressure regulating tank, network of pipes for distribution, water supply from nearby tank, emergency diesel generator, vermicompost sheds |
| 9 | Input rate | 3.5 tons per day |
| 10 | Water | 1:1 |
| 11 | Slurry | Vermicompost made out of a fraction of total output slurry of 2.5 tons per day |
| 12 | Gas supply | Underground pipes from the plant to the beneficiaries |
| 13 | Gas availability | 2 hours each in the morning & the evening |

Fig. 2.3 Actual photograph of the plant

## 2.7 Design

Flawless design is the key to smooth and efficient operation of the plant. A small design error can lead to high loss of efficiency or even complete failure of the plant. This plant being a large-scale community biogas plant further emphasizes the need for accurate design. Considerably large design errors can be tolerated in the case of small, individual plants but not in the case of a community plant which is many-fold in size, operational cost, revenue etc as compared to the former.

The CBP at Bhintbudrak has two major systems viz. the biogas plant itself and the gas distribution system. Both of these systems are described below.

### 2.7.1 Design of the plant:

The design of the plant is based upon many factors. Some of the major factors imposing specific design constraints have been discussed below.

1. Location of the plant:
   The site of the plant had to be chosen in the close vicinity of the main settlement of the village. This constraint is imposed as the plant cannot be far off from the beneficiary owing to the daily transport of dung to the plant and piped pressurized gas supply to the beneficiary.
2. Sizing:
   The size of the plant was primarily decided by the number of beneficiaries that signed up for the project.
   We see that, 121 beneficiaries = 121*30 kg cow dung per day = 3630 kg per day
   Plant has a design capacity of 4500 kg per day.

As the plant operates on a very large scale (comparable to 100 individual plants!), there are many auxiliary systems associated with it. The following subsection describes the major components of the plant and the auxiliary systems.

Important Components of the CBP:

1. Mixing tank
   Water and cow dung is mixed mechanically using pressurized air in the mixing tank. This process of mixing requires electricity supply.
2. Digester
   There are 2 diesters each of size 85 $m^3$ and floating dome type. The digestion time is 40 days.
3. Pressure regulation tank
   Gas generated in the floating domes gets transferred to the pressure regulation tank which pressurizes the gas using water column. Gas pressurization is essential for its distribution through underground pipes.
4. Vermicompost sheds
   Vermicompost sheds are constructed near the plant to process the output slurry into vermicompost.

Figures 2.4 and 2.5 show the engineering drawings of the digester and the pressure regulation system respectively.

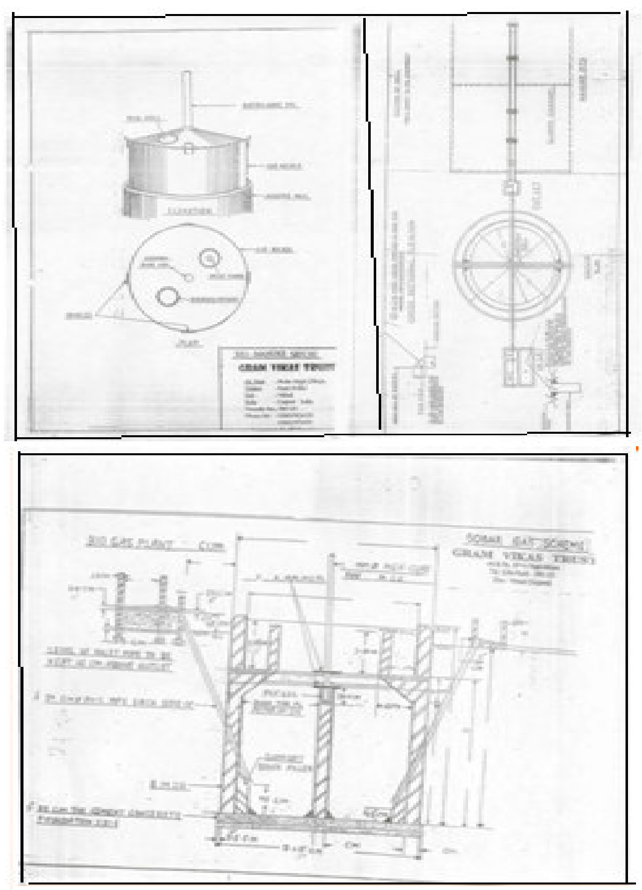


Fig. 2.4 Engineering drawing of the digester

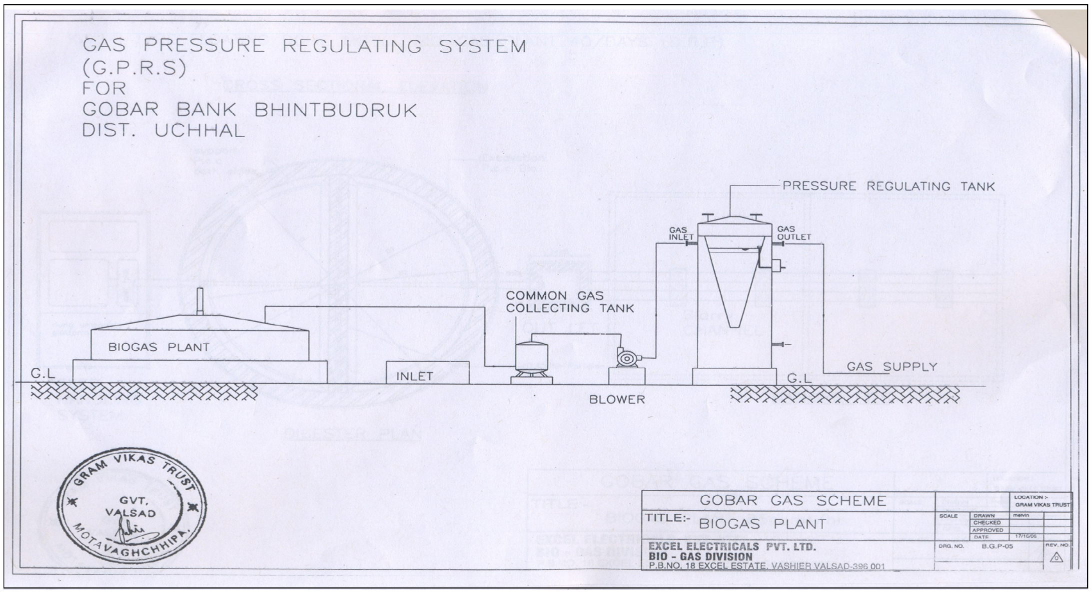



Fig 2.5 Pressure regulation system

### 2.7.2 Design of the gas distribution network

The second crucial design aspect is the design of the gas distribution system. Special care has to be taken so that gas is supplied at each household with sufficient and equal pressure, irrespective of the distance of the household from the plant. This is achieved with the help of the pressure regulation system and the robust distribution network. A detailed map of this network along with the location of plant and beneficiary households is shown in figure 2.6.

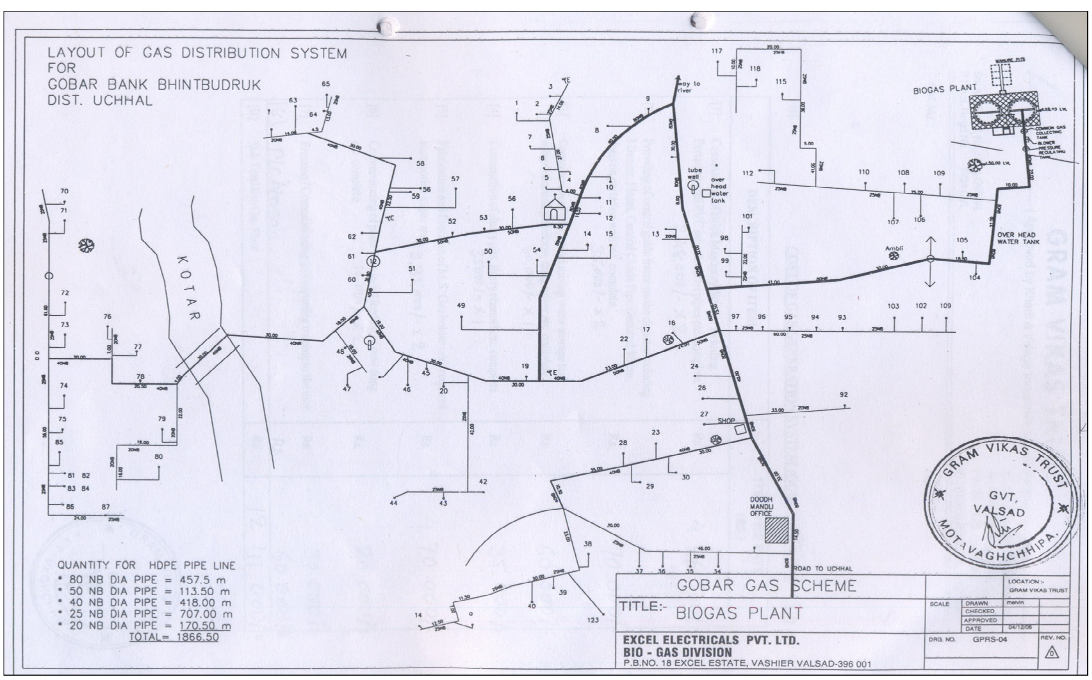



Fig. 2.6 Gas distribution network

## 2.8 Operation & Maintenance

The CBP has a fixed daily operations schedule which is outlined in this section.

### 2.8.1 Daily operations:

1. Biogas production

Every morning around 6:00 am villagers bring the dung collected during the previous day to the plant. Normally, this is carried in overhead containers (*ghamelas*) by men or women. An important point that should be stressed upon here is the involvement of men folk in carrying the dung to the plant site. Thus, this model of biogas plant reduces the efforts required to be put in by women, who in other cases are alone responsible for the operation and maintenance of biogas plants.

In case the beneficiary's stall is far from the plant, he has the option to deliver the cow dung to the plant on a weekly basis. Tractors are used to transport the cow dung in such cases.

The cow dung brought in by the villagers is weighed on an electronic balance and the amount is logged into a register. Usually, 25-30 kg cow dung is supplied by each family everyday. The weighed cow dung is then put in a mixing tank in which equal amount of water is added. Slurry of dung and water is formed as they are mixed using pressurized air. Water for the operation of the plant is procured from a nearby tank which has a bore well connected to it. The slurry thus produced passes into the two digesters where it gets decomposed anaerobically. The gas produced by this decomposition raises the floating domes. Once the dome gets fully filled, the valve connecting the dome and pressure regulation tank is opened so that gas generated is stored in the pressure regulation tank. The gas is supplied to the beneficiaries daily twice-once at 6 am and next at 6 pm. The gas generated daily is sufficient enough to give a continuous supply to all the beneficiaries for 2- 2.5 hours each in the morning and the evening. The plant supervisor and 4 workers oversee the plant operations.

2. Vermicompost production

The plant produces 2.5 tons of slurry per day out of the 3.5 tons of input cow dung per day. This slurry is left to dry as it comes out. In case of rains, it is put in heaps which are then covered. As the slurry dries, it is collected manually and put in vermicompost beds in the sheds near the plant. Local laborers are hired on a daily wage basis for this operation. The process of vermicomposting takes around 50 days to complete after which the vermicompost is sieved and packed in bags of 50 kg.

The smooth functioning of biogas and vermicompost production units is facilitated by the following dedicated staff: one supervisor and 4 workers. The skilled supervisor who has brief technical knowledge guides the unskilled workers to carry out essential operational and maintenance activities. All these staff members hail from Bhintbudrak village itself. The remuneration of the supervisor and workers is fixed at Rs. 2500 p.m. and Rs. 1000 p.m. respectively. Apart from this dedicated staff, daily wage laborers from the village itself work at the vermicompost facility. Their wages are fixed at Rs. 50 per day. These laborers are involved in the shifting of slurry to the vermicompost beds and sieving of the vermicompost.

The number of laborers available for vermicompost production depends on the alternative sources of employment available. For instance, the number of laborers in vermicompost facility goes down during the harvesting season as these local daily wagers work in the fields for harvesting crops. The availability of local laborers has a significant impact on the vermicompost production of the plant.

The CBP has a well defined administrative structure. The plant is owned and operated by the village co-operative. The plant supervisor reports to the Chairman of the village co-operative and rest of the staff which includes workers and daily laborers is guided by the supervisor.

### 2.8.2 Maintenance

Timely maintenance drills are essential for smooth functioning of a large utility throughout its entire stipulated life time. The CBP ensures least failure possibility by implementing the following maintenance scheme:
Daily checks are performed related to the crucial components. Accordingly the skilled supervisor directs the workers for the required action. In some cases where local solution of the problem is not possible, experts from SUMUL are called upon to deal with the issue.

### 2.8.3 Failure & Retrieval

The plant did not function as planned in the first 8 months after establishment. This failure was suspected to be due to the malpractices/corruption of the then supervisor. A loan of Rs. 1.5 lakh was taken from SUMUL by the co-operative to restart the plant.

Surprisingly, the CBP had no major failures in the last 3 years. A minor fault occurred due to electricity supply failure. This hampered the mechanized mixing of dung and water. Villagers were intimated about the failure (and associated non-availability of gas) in advance.
A technician was called from SUMUL to address the fault. Also other non-technical methods involving the manual mixing of dung and water were thought of to resume the plant operation at the earliest.

Figure 2.7 shows the flow sheet of the daily operations of the CBP.

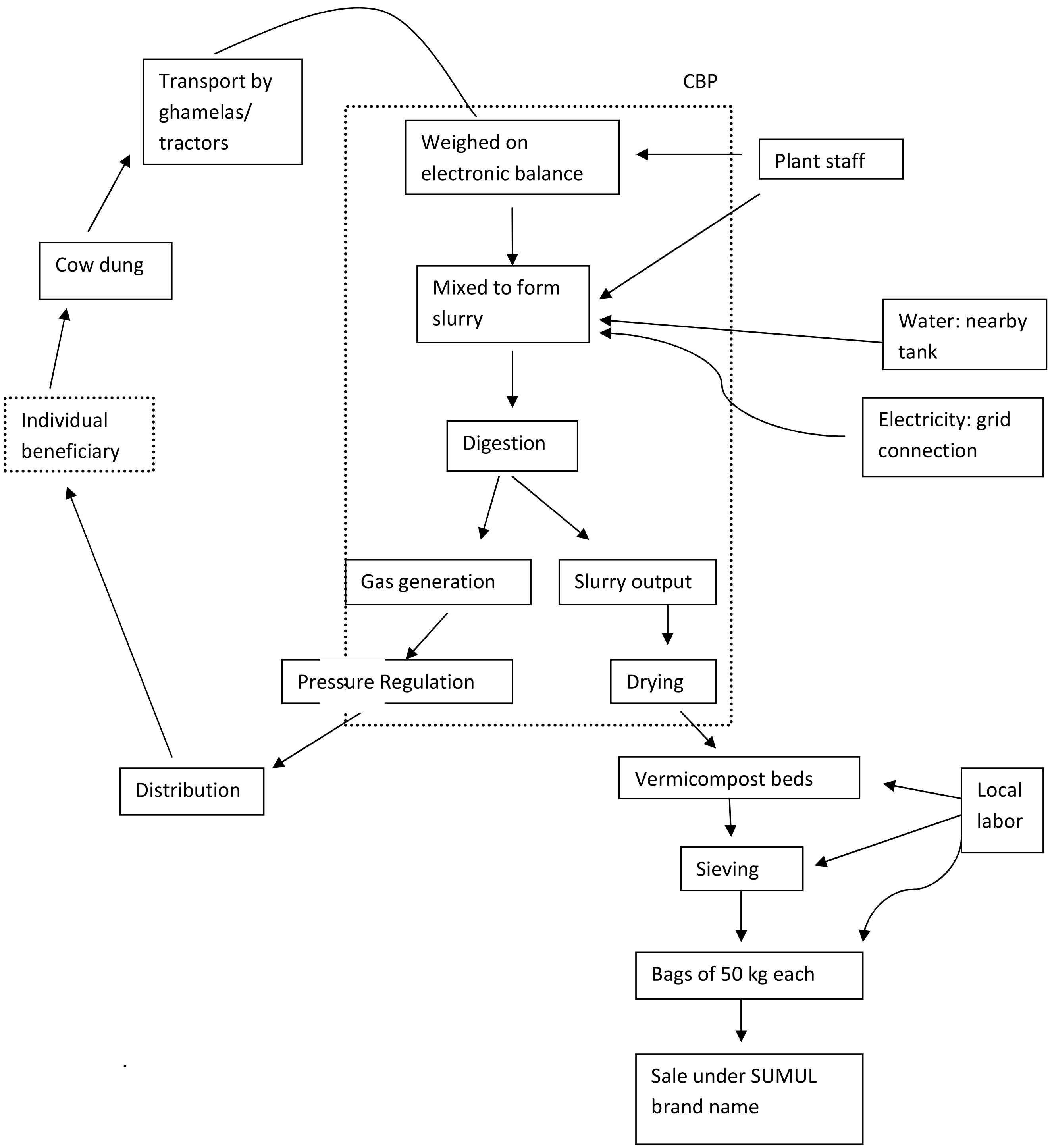



Fig 2.7 Daily operations of the CBP

## 2.9 Preliminary economic analysis

This section presents the preliminary economic analysis of the CBP. As we will see from the following tables, the economic feasibility of this model is entirely attributed to the vermicompost production. The base parameters used in the calculations are listed below:

1. Number of beneficiaries: 121
2. Cow dung at each beneficiary : 30 kg per day
3. Total cow dung input using design data: 4.5 tons per day
4. Total cow dung input using actual operations data: 3.5 tons per day
5. Rate of cow dung: Rs. 0.35 per kg
6. Cost of gas supply: Rs. 150 per month per beneficiary
7. Vermicompost production using design data: 49 tons per month if entire slurry is converted to vermicompost
8. Vermicompost produced using actual operations data : 20-35 tons per month
9. Rate of vermicompost: Rs. 3 per kg
10. Other expenses for the plant: Supervisor salary= Rs. 2500 p.m.
    Worker salary= 4* Rs. 1000 p.m.
    Laborer daily wages= Rs. 50 per day
    Electricity and maintenance= Rs. 8000 p.a.

Tables 2.2 and 2.3 show the initial cost and the source of funds for the construction of the CBP.

TABLE 2.2 Initial Cost of the CBP (One time)

| Sr No | Particulars | Amount |
|---|---|---|
| 1 | 85 Cu.Mt. two Digesters | Rs. 12,00,000 |
| 2 | Bio Gas distribution pipelines | Rs. 4,45,000 |
| 3 | Bio Gas collection Tank, Blowers, PRESSURE REGULATION SYSTEM | Rs. 3,55,000 |
| 4 | Vermicompost Unit | Rs. 1,50,000 |
| | **Total Cost** | **Rs. 21,50,000** |

TABLE 2.3 Source of funds

| Sr. No. | Source | Amount |
|---|---|---|
| **1** | Government subsidy | Rs. 10,00,000 |
| **2** | SUMUL contribution | Rs. 8,00,000 |
| **3** | Public contribution | Rest of the amount |
| | **Total** | **Rs. 21,50,000** |

Figure 2.8 shows the monthly cash and material flow to and from the CBP. Red arrows show the cash flow while black ones show the material flows. As we see in this diagram, the individual beneficiary has a net monetary gain of Rs. 165 per month and the CBP gains around Rs. 75,000 per month. Carbon credits are shown as a dotted line since the plant does not obtain these credits at present. The lion share of vermicompost in the revenue of the plant

is clear from this diagram. As stated previously, sale of vermicompost is what makes this model economically feasible.

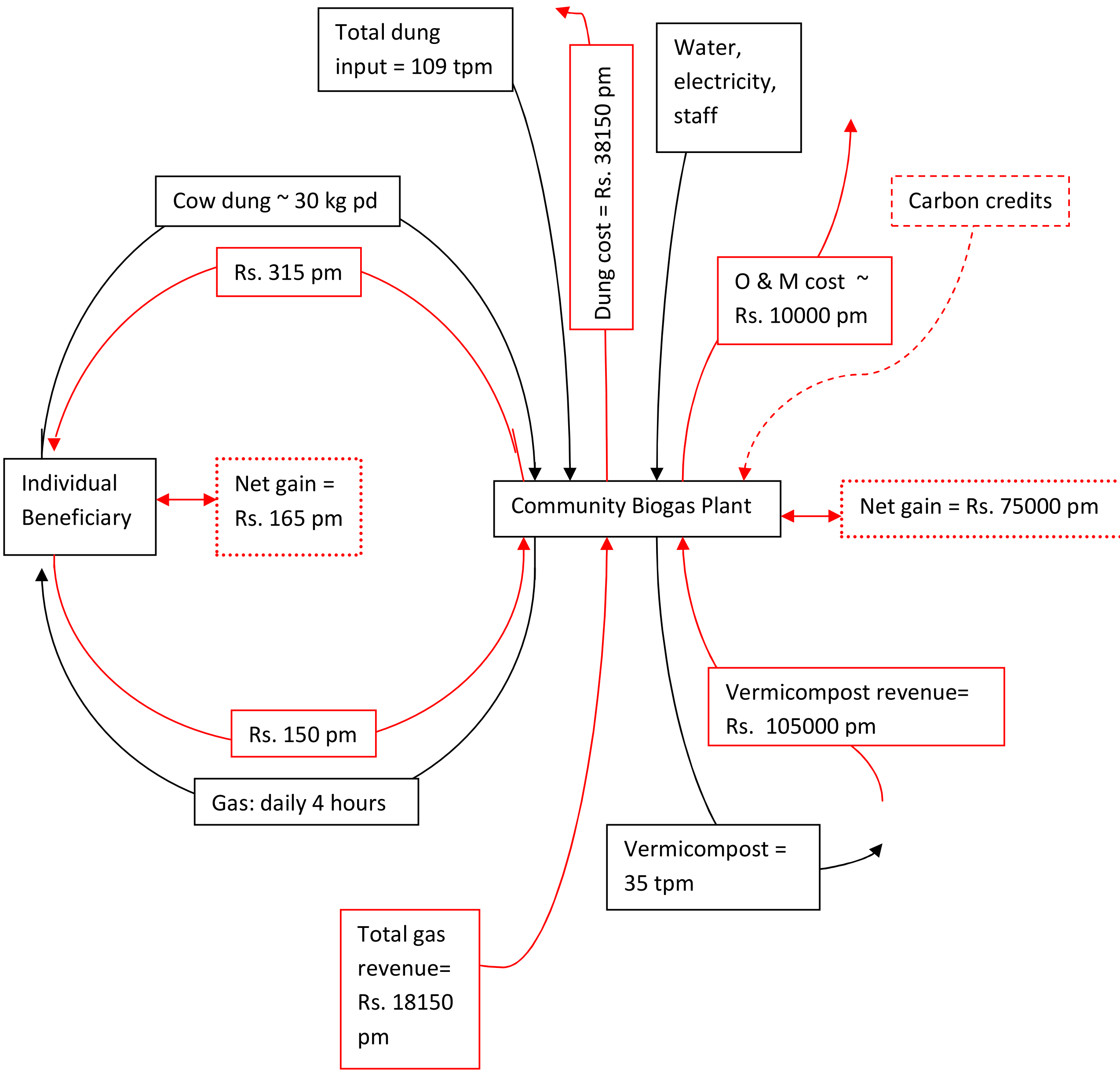


Fig. 2.8 Cash and material flows (Numbers based on operations data)

TABLE 2.4 Operational Costs of the Plant Yearly (Source: SUMUL)

| Sr No | Particulars | Amount |
|---|---|---|
| 1 | Daily 4.5 MT Dung x 365 Days = 1643 MT<br>1643 MT X Rs. 250/MT | Rs. 4,10,750 |
| 2 | Labor Cost  5 Employees | Rs. 1,37,450 |
| 3 | Maintenance ( Painting Gas Tank , oil, diesel etc) | Rs. 8,000 |
| | **Total Operational Cost** | **Rs. 5,56,200** |

TABLE 2.5 Revenue of the CBP Yearly (Source: SUMUL)

| Sr No | Particulars | Amount |
|---|---|---|
| 1 | Bio Gas Distribution<br>121 Connection X Rs.150 X 12 Month | Rs. 2,17,800 |
| 2 | Vermicompost from Slurry<br>Input dung- 1643 MT yearly from which 60 % obtained as Dry Slurry i.e. 986 MT which produces 592 MT vermicompost which is sold @ rate of Rs. 3000 /MT yearly. | Rs. 17,76,000 |
| | **Total Revenue Yearly** | **Rs. 19,93,800** |

TABLE 2.6 Net Profit (Source: SUMUL)

| Sr No | Particulars | Amount |
|---|---|---|
| 1 | Operational Cost Yearly | Rs. 5,56,200 |
| 2 | Total Revenue Generation Yearly | Rs. 19,93,800 |
| | **Net Profit from CBP Yearly** | **Rs. 14,37,600** |

TABLE 2.7 Other benefits in the terms of rupees (Source: SUMUL)

| Sr No | Particulars | Amount |
|---|---|---|
| 1 | Fuel saving<br>121 Family X 5 Person = 605 X 5 Kg of Woods for Cooking @ 2 Rs. Of Kg X 365 Days | Rs. 22,08,250 |
| 2 | After using vermicompost 25 % more income from Crops due to improved Quality and Production i.e. 121 Families get Rs. 20000.00 more per Annum. | Rs. 24,20,000 |
| 3 | Revenue Generation from Carbon Credit Yearly Rs. (Expected) | Rs. 2,66,076 |
| | **Total Other benefits in the terms of rupees.** | **Rs. 48,94,326** |

All the economic calculations done by SUMUL are based on the design data. But as the plant is not running at its full capacity, the actual operations numbers vary. The difference between these two calculations is summarized in table 2.8.

TABLE 2.8 Difference in design and operations numbers

| Sr. No. | Particulars | Design (yearly) | Operations (yearly) | Cost difference (yearly) |
|---|---|---|---|---|
| 1 | Input cowdung | 1643 MT | 1278 MT | Rs. 127750 |
| 2 | Vermicompost production | 592 MT | 420 MT | Rs. 516000 |
| 3 | Operational cost | Rs. 556200 | Rs. 428450 | Rs. 127750 |
| 4 | Revenue | Rs. 1993800 | Rs. 1477800 | Rs. 516000 |
| 5 | Net profit | Rs. 1437600 | Rs. 1049350 | Rs. 388250 |

TABLE 2.9 Various Financial indicators

| Sr. No. | Indicator | Without subsidy | With subsidy |
|---|---|---|---|
| 1 | Simple payback period | 28 months | 15 months |
| 2 | Net present value | Rs. 23,02,828 (d=20%, n=25 years) | Rs. 33,02,828 (d=20%, n=25 years) |
| 3 | IRR | 41% (n=25 years) | 78% (n=25 years) |

TABLE 2.10 Economic analysis for the individual beneficiary

| Sr. No. | Particulars | Rs. /year |
|---|---|---|
| 1 | Initial investment | Minimum 1000 (One time) |
| 2 | Cost of gas connection = 150*12 | 1800 |
| 3 | Revenue from cow dung = 30*365*0.35 | 3832 approx |
| 4 | Net monetary gain | 2032 approx |
| 5 | Revenue from previous dung disposal system | 800-1200 |

## 2.10 Benefits to the stakeholders

The establishment of CBP in Bhintbudrak has been beneficial to all the involved stakeholders. The key stakeholders and the positive impacts of the CBP on them are discussed below:

1. Individual beneficiaries:

- Health: Biogas is a smoke free fuel. The health hazards due to the smoke emitted by previous cooking fuels like wood and cow dung is eliminated.
  Also the efforts and discomforts involved in procuring firewood for burning are reduced which is an important benefit related to the health of villagers.
- Time: Use of biogas for cooking saves the time of villagers as cooking time is reduced and so is the time spent in collecting firewood.
- Convenience: Use of piped gas supply for cooking is surely more convenient than use of traditional wood or biomass *chullas*.
- Money: As seen in the economics section, each beneficiary earns around Rs. 165 per month from this scheme.

2. Village co-operative:

- Revenue: The village co-operative generates huge revenue from the CBP which can be used for many development activities in the village.

3. Village:

- Cleanliness and hygiene: The main vision behind the establishment of CBP was to have a proper cow dung disposal system. Accordingly, the CBP has contributed in increasing the cleanliness in the village. Also spread of diseases due to accumulation of cow dung is now not an issue.

- Employment generation: The CBP requires 1 supervisor, 4 workers and 10-15 daily wage laborers for its entire operation. All the staff at the plant is local. Thus, the CBP provides employment for the villagers.

4. SUMUL:

- CSR: Establishment of this plant can be seen as a corporate social responsibility initiative of SUMUL.
- Visibility: Huge success of this plant has helped SUMUL gain visibility in various spheres. The vermicompost produced here is marketed under the SUMUL brand name.

5. Environment:

– Use of clean fuel, proper waste disposal system for cow dung and the prevention of deforestation for firewood are the main benefits to the environment from the plant. It is estimated that the plant can generate carbon credits worth Rs. 2,66,000 annually.

Figure 2.9 summarizes the benefits of the CBP.

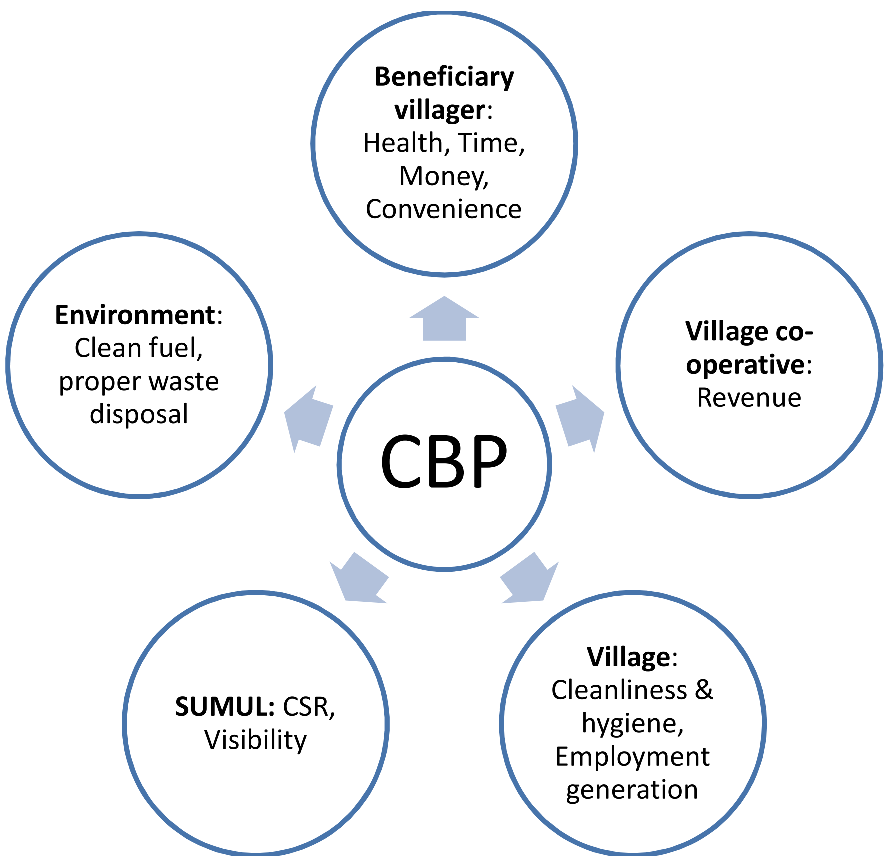



Fig. 2.9 Stakeholders and benefits of CBP

## 2.11 Reasons for success

This section lists some of the key aspects which made the CBP in Bhintbudrak a huge success in the backdrop of many examples of failed community biogas plants.

1. Involvement of villagers in the establishment and operations: This is the key factor behind the success of the Bhintbudrak plant. Villagers contributed a certain amount of money for the construction of the plant. Also they are involved in its day-to-day operation. As the villagers have invested in the plant, they feel a sense of ownership of the plant and strive to maintain its proper functioning.
   This idea also supports the observed failure of government schemes wherein 100% subsidy is provided. 2 similar plants constructed in neighboring villages failed as people there did not value the plants established out of 100% government funds and no contribution of the villagers.
   *"100% government subsidy on a development scheme is itself responsible for the failure of that scheme"* –says Mr. Rameshbhai, the chairman of the village co-operative in Bhintbudrak. This statement reinforces the above reason for the plant's success.
2. High cattle/human ratio: Primary occupation of Bhintbudrak villagers is milk supply to SUMUL. Therefore, the high cattle population here ensures sufficient cow dung for the plant's operation. The gas generated is sufficient owing to lower human population.
3. Closely packed households: The geography of Bhintbudrak is also one of the factors contributing to the success of the CBP. Households in Bhintbudrak are very close to each other. Thus it was possible to construct the plant at a location close to all the beneficiaries which made transport of dung to the plant and transport of gas from the plant feasible.

## 2.12 Shortcomings

1. Gas supplied at fixed times of the day. Therefore, villagers have to rely upon alternate fuels if food is to be cooked during those times of the day when gas is not supplied.
2. Inefficiency in operations:
   - The plant is not working in its full capacity considering the amount of gas that can be produced and the amount of vermicompost that can be produced.
   - Vermicompost produced= 400-700 bags/month<700*50=35000 kg/month
     Amount of vermicompost if entire slurry is utilized= 2.5 tpd*30*0.6= 45000 kg/month
     Production of vermicompost is limited by the availability of land and labor. There are problems (owner not willing to sell/rent the empty land near the plant which he uses as a pasture for his cattle) in acquiring land near the plant.
     Laborers are hired on daily wage basis. Therefore, there is no fixed manpower devoted to the vermicompost facility. During harvesting season, laborers (all local) are preoccupied with farming work and hence the vermicompost production goes down.

- Only 35% of the total amount of gas that can be produced from the input cow dung is produced. This may be due to a design error.

3. Non-professional outlook towards the plant operation. A proper business approach would increase the output drastically.

## 2.13 Expansion and Replication

Expansion of existing setup:
Considering that only 35% of the gas production potential of the dung is being utilized, the co-operative plans to construct 2 more digestors. Extra gas produced will be distributed to 46 new members of the scheme. As the gas has to be supplied through pipes, distance of the household from the plant is the factor limiting the expansion to 46 new households (maximum 700 meter in this case).
The vermicompost produced is already a "surplus", therefore there is no thrust regarding expansion of the vermicomposting facility to completely utilize the slurry.

Replication:
Many agencies have come forward to replicate the concept of the CBP considering its tremendous success. AMUL has decided to implement this concept in 50 more villages under its co-operative network. A newspaper clipping related to the planned replication by AMUL is shown in Appendix 1.The tribal development department of Gujrat has also followed AMUL and plans to establish 20 such plants.

# 3. Individual Biogas Plants

## 3.1 Introduction

This section of the report describes the individual, household level plantsestablished by Bhagirath Gramvikas Pratisthan in Sindhudurg and Ratnagiri districts of Maharashtra. Since last 10 years, Bhagirath Gramvikas Pratisthan (BGP) is working in this region to achieve perennial and sustainable rural development. Construction of biogas plants in households is one of the projects undertaken by BGP. Till date around 1000 such plants have been established by BGP.

Each of the 1000 odd plants established till now, is a 1-2 $m^3$ fixed dome plant which utilizes cow dung/poultry waste/human excreta as feedstock and caters to the daily cooking need of the household.

## 3.2 Background

Bhagirath Gramvikas Pratisthan works mainly in Sindhudurg and Ratnagiri districts of Maharashtra. Humras, Zarap, Pinguli, Devsu are some of the villages in this region where nearly 100 plants have been constructed by BGP. The background of Zarap village is presented here which is more or less the background of all the villages in this region.

Zarap (Kudal taluka, Sindhudurg district) is a village with a population of about 1700. Majority of the villagers here are farmers who cultivate rice as the main crop. Around 80% households possess cattle, number of animal varying from 2-5 per household. The distinct geographical feature seen in these villages is the arrangement of households. The village has clusters of households (called *wadi* ) separated from each other.

## 3.3 Birth of the idea

The pivotal person responsible for the tremendous growth of Biogas usage in sounthern Konkan today is Dr. Prasad Deodhar. Right from his childhood, Dr. Deodhar witnessed people carrying firewood through long distances for cooking purposes which led to decrease in the forest cover. Also, the traditional method of cooking had several other disadvantages which included health problems faced by women and very high cooking times. This realization led to the construction of the first biogas plant by Dr. Deodhar at his own residence. Gradually, he also understood various problems in traditional biogas construction technology. Soon he felt the need to develop team of experts and masons to develop appropriate model useful for that specific region. The Idea was that the people constructing biogas should be trained thoroughly for use, maintenance and troubleshooting. He also realised the importance of permanent support service needed. All these thoughts and related developments culminated in the establishment of Bhagirath Gramvikas Pratisthan under the leadership of Dr. Deodhar.

## 3.4 The promoter: Bhagirath Gramvikas Pratisthan

The role which SUMUL played in case of the community biogas plant discussed earlier is played by Bhagirath Gramvikas Pratisthan (BGP) in case of the individual plants in southern Konkan. Bhagirath Gramvikas Pratisthan has been ceaselessly working to achieve perennial and sustainable rural development. It believes that urbanization of a village is not the development but increase in productivity and attaining self-sufficiency is the development in the real sense. BGP has undertaken many constructive projects for achieving this goal. Some of these development initiatives include poultry breeding, computer training for village youth etc. Construction of biogas plants is one of these activities which BGP is pursuing on a very large scale.

BGP is mainly working for bringing villagers together, understanding their problems, providing various inputs needed for activities useful to them such as training support, technical support, seed capital support (if required) strictly on refundable basis without any interest. BGP helps local people to identify their problems and priorities and provides them solutions suitable to their needs. BGP's consistent efforts based on the underlying thought process of sustainable rural development has helped villagers come together and develop the roadmap of their own development. Bhagirath Pratisthan fully understands the role of a facilitator in developmental process and therefore prefers to withdraw from the village once the village has its own development vehicle created. BGP externally supports such village-based entities once they are in place.

As mentioned earlier, construction of biogas plants in households is one of the major development programs undertaken by BGP. Till date, nearly 1000 individual biogas plants have been constructed in Sindhudurg and Ratnagiri districts. The major beneficiary villages are shown in figure 3.1.

Bhagirath Gramvikas Pratisthan acts as a buffer between all stakeholders of the project: the farmer, woman in the household, mason building the plant, local authorities, bank etc. BGP facilitates the interactions involved between these stakeholders and fast tracks the steps involved in the construction and working of the plant.


Fig. 3.1 Map of Sindhudurg showing major beneficiary villages: Devsu, Wajrat, Pinguli, Humras

Each of these villages has more than 100 biogas plants constructed by BGP till date.

## 3.5 Vision

Bhagirath Gramvikas Pratisthan believes that construction of biogas plant in a household is not the end goal, but is a starting point or entry point in the household to achieve further development. Thus, the vision behind the construction of biogas plant is not limited to just the obvious benefits of this plant but incorporates the overall, sustainable development of that particular household. For instance, consider the developments BGP induces in a household once the biogas plant is constructed. After the construction, BGP provides pressure cookers so that the cooking time is further reduced. Now, the woman in the household finds more free time for herself. BGP trains that woman for poultry breeding and provides the initial requirements of the setup. Thus, the woman in our example can now generate extra income in the time available due to use of biogas and pressure cookers. Similarly, as the rapport with the household gets established, BGP initiates other secondary development activities such as computer education, primary school tuition classes for the children in that household. Figure 3.2 schematically shows the vision of BGP behind the establishment of biogas plants.

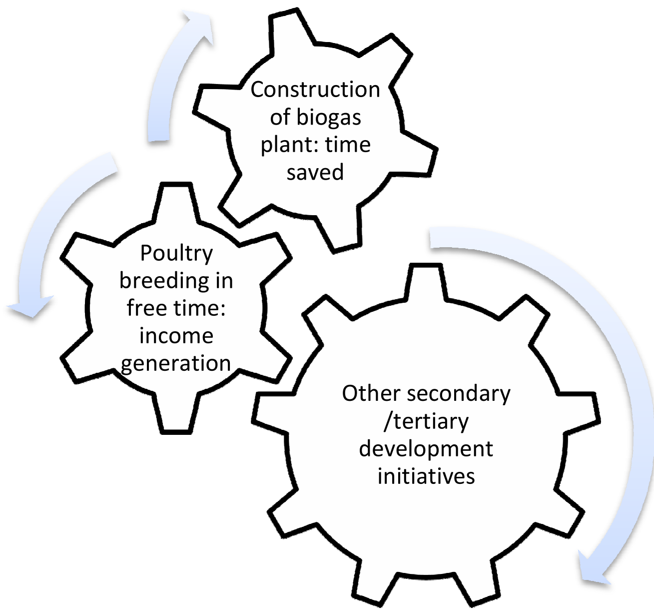



Fig. 3.2 Vision of BGP behind biogas plant construction

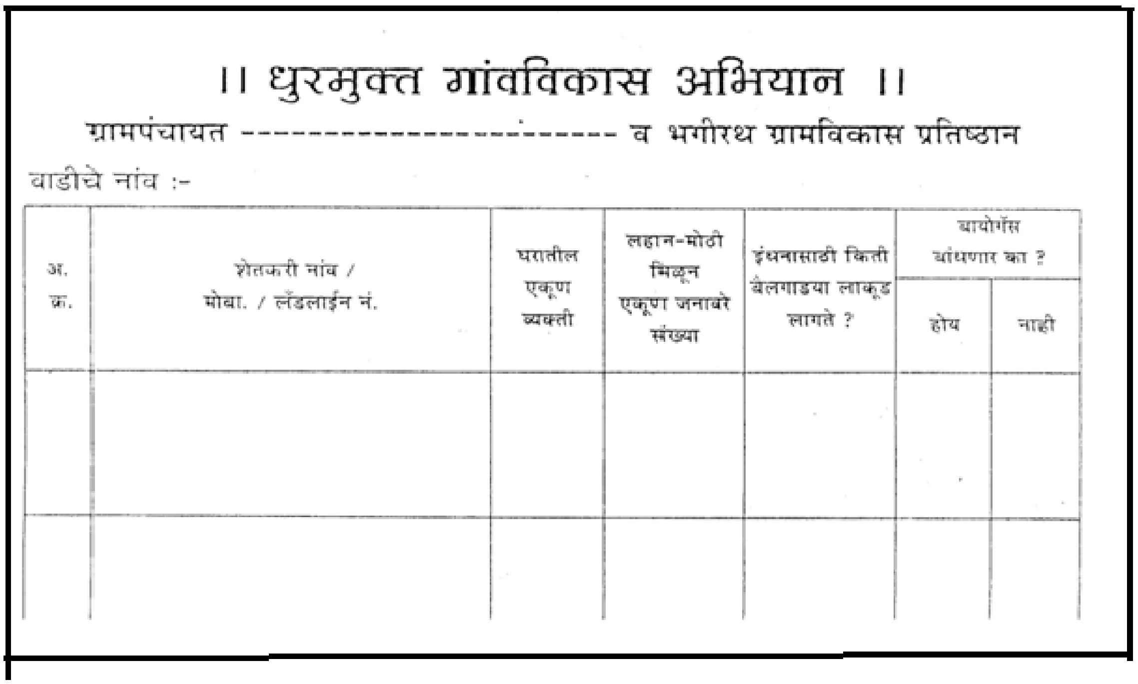
## 3.6 Methodology and construction

The primary reason behind the construction of a huge number of biogas plants is the method adopted by BGP for the implementation and replication of the individual biogas model. This section briefly describes the methodology used by BGP.
The important steps involved are:

1. Survey of the household:
   A survey of the household is conducted by BGP to evaluate its potential for caonstruction of the individual biogas plant. This survey covers the following aspects:
   - Number of persons in the household
   - Number of cattle
   - Amount of firewood required for cooking
   - Amount in Rs./month the farmer is willing to repay (as the initial cost of construction is paid through bank loan)
   - Mobile/Landline Number: indicates ease of acceptance of new technology, repaying capacity
   - Does the house have a biogas plant? Is the family willing to construct one?
   - Other observations: Overall ambience of the household
     Cleanliness
     Primary occupation of the members of the house

All these other observations give a complete picture of the household which helps BGP plan its entire further development though these observations are not exactly relevant to the biogas construction

2. Survey of the village:
   Although BGP is involved in construction of individual biogas plants, survey of the entire village level is essential as implementation is easier on larger scale owing to reduced transport and labor costs.
   A survey form used for the survey at the village level is shown in figure 3.3. This survey includes the number of people in the family, number of animals, amount of firewood required for cooking etc.



।। धुरमुक्त गांवविकास अभियान ।।

ग्रामपंचायत ---------------------------- व भगीरथ ग्रामविकास प्रतिष्ठान

वाडीचे नांव :-

| अ. क्र. | शेतकरी नांव / मोबा. / लँडलाईन नं. | घरातील एकूण व्यक्ती | लहान-मोठी मिळून एकूण जनावरे संख्या | इंधनासाठी किती बैलगाड्या लाकूड लागते ? | बायोगॅस बांधणार का ? | |
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Fig. 3.3 Survey form for the survey at village level

3. Based upon the results of the feasibility survey, the village for implementation is determined.

4. Meetings with villagers:
   A series of meetings with villagers and the local authorities (Sarpanch, Gramsevak) is taken by BGP to convince/persuade the villagers for construction of such biogas plants. BGP also displays flex boards at appropriate locations in the village for creating awareness and capacity building in the village.

5. Construction:
   BGP trains mason for the construction of biogas plants. A team of such trained masons has been developed over a period of time. In any construction activity, 2 trained and 2 untrained, local masons are involved. The construction of a biogas plant is completed in a very short time span of four days. Material required for the biogas plant such as steel rods, cement etc is procured from a central supplier which helps maintaining quality standards.

The steps involved are shown in figure 3.4.

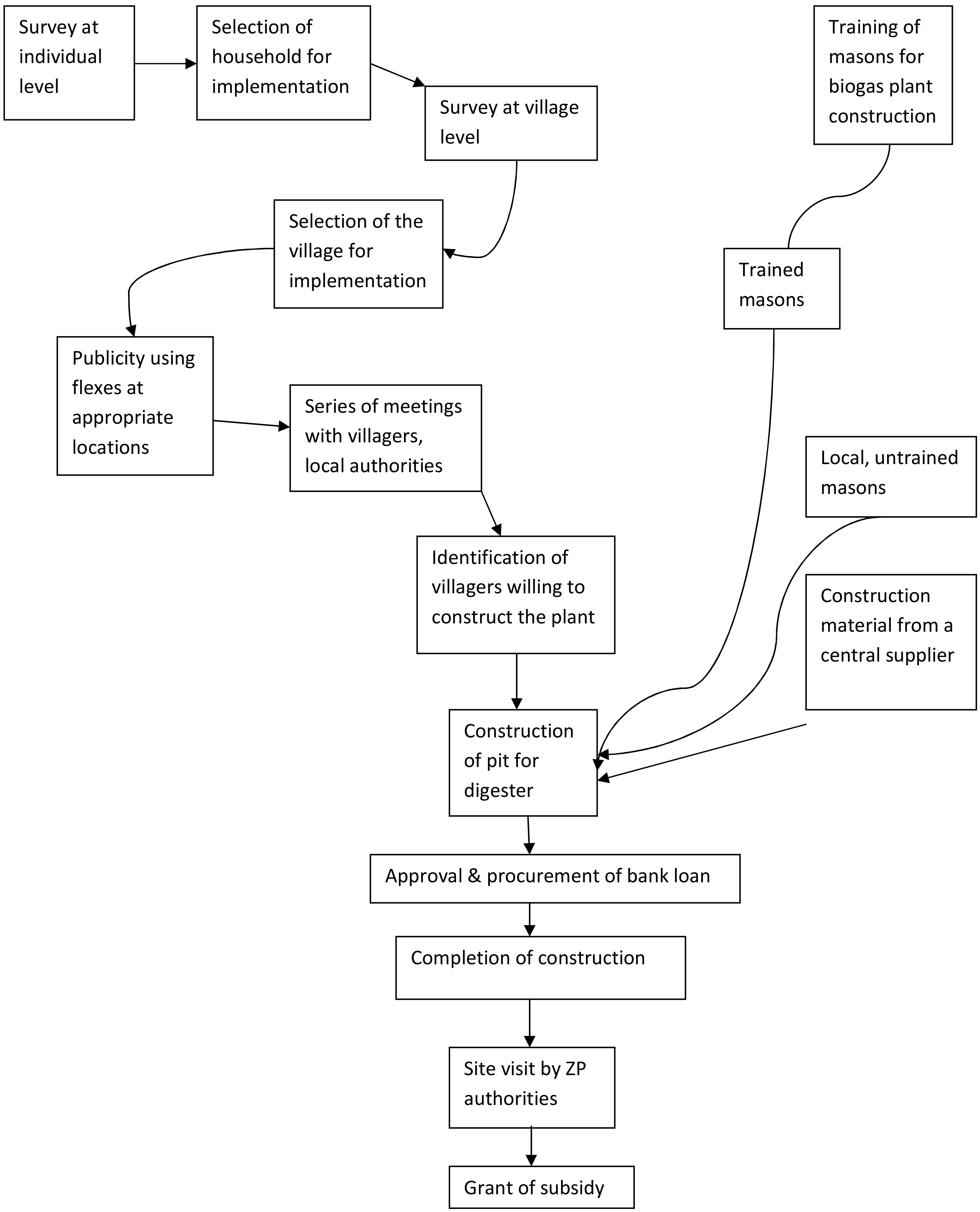



Fig. 3.4 Methodology and construction

## 3.7 Overview of the plant

Table 3.1 shows some of the important parameters constituting an overview of the CBP.

TABLE 3.1 Overview of the plant

| Sr. No. | Parameter | Description |
|---|---|---|
| 1 | Ownership | Individual Beneficiary |
| 2 | Number of beneficiaries | 1000+ |
| 3 | Operational since | Bhagirath Pratisthan has been constructing such plant since a decade; almost all are operational today |
| 4 | Feedstock | Cattle dung/ Kitchen waste/ poultry waste |
| 5 | Capacity | 40 kg per day |
| 6 | Size of digester | 2 $m^3$ |
| 7 | Digester type | Fixed dome |
| 8 | Auxiliary systems | None |
| 9 | Input rate | 30-35 kg per day |
| 10 | Water | 1:1 |
| 11 | Slurry | Dried and used as manure for the beneficiary`s farms |
| 12 | Gas supply | Direct pipe to the burner in kitchen |
| 13 | Gas availability | As and when required, provided sufficient gas has been generated in the plant dome to give required burner pressure |

## 3.8 Design

As this scheme involves construction of large number of small-size plants, the design is more or less fixed. It is not viable to design each plant separately. Minute changes can be done based on case to case differences in local conditions.

BGP has adopted the *Deenbandhu ferrocement* biogas model for this scheme. The *Deenbandhu* biogas plant is a fixed dome (underground) plant. Various design parameters of the *Deenbandhu* model are described in this section.

1. Sizing
   Table 3.2 shows various details related to the sizing of the plant.

   TABLE 3.2 Sizing of individual biogas plants

| Sr. No. | Size | Number of animals required | Daily cow dung input | Gas sufficient for |
|---|---|---|---|---|
| 1 | 1 $m^3$ | 2-3 | 25 kg | 3-4 people |
| 2 | 2 $m^3$ | 4-6 | 50 kg | 5-8 people |

2. Location
   The following factors should be considered while deciding the location of the plant
   - Distance from the kitchen: 20-30 feet
   - Maximum exposure to sunlight preferred
   - Slope towards the outlet preferred
   - The location of the plant should not be close to wells

The engineering drawings for this model are shown in figure 3.5.

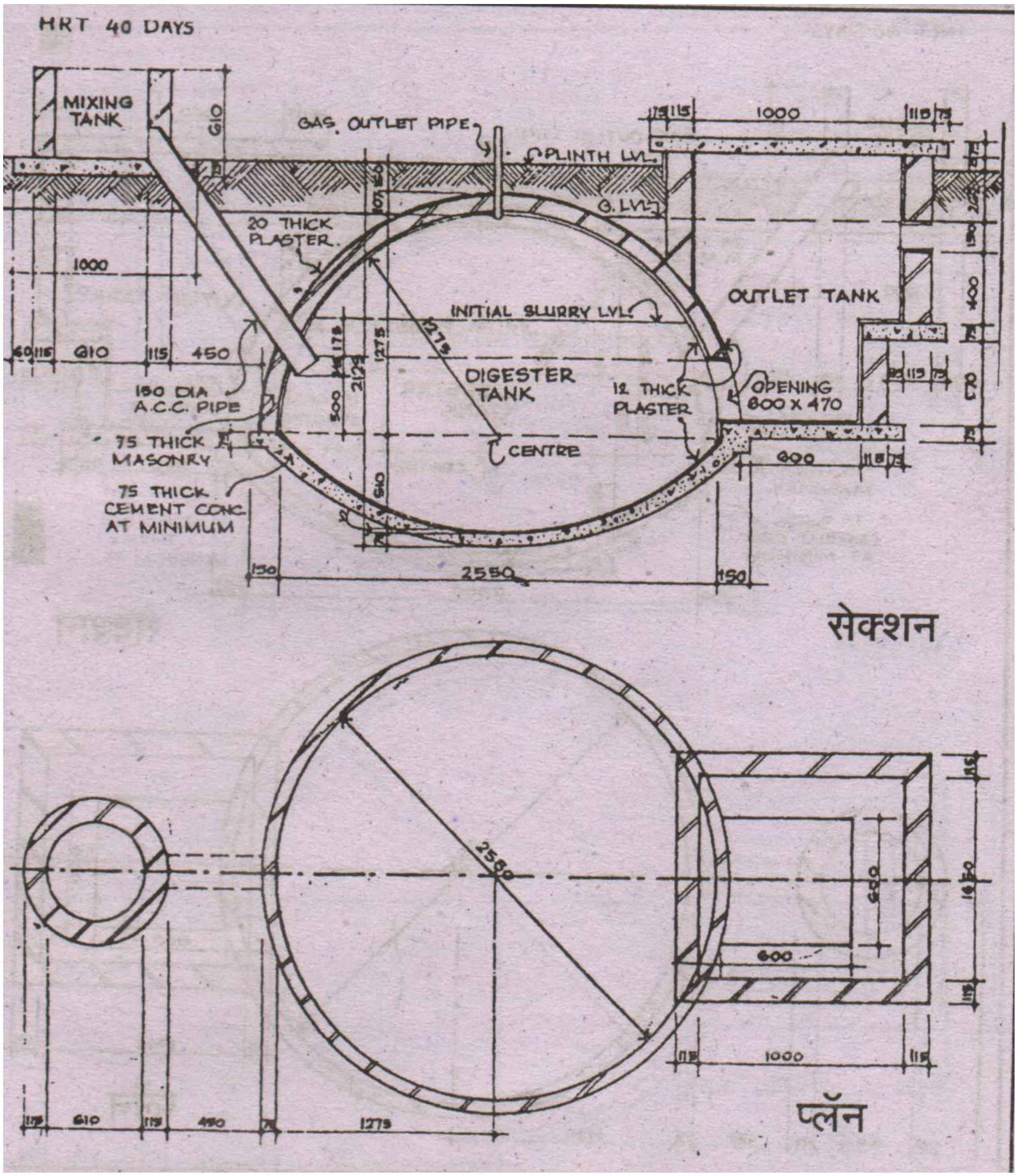



Fig. 3.5 Engineering drawing of the *Deenbandhu* biogas plant ( 2 $m^3$ )

## 3.9 Operation & Maintenance

### 3.9.1 Day to day operation:

Daily 25-30 kg cow dung is fed into the plant. The amount of cow dung fed varies with number of cattle present (10-12/animal/day). Poultry waste and kitchen waste can also be added if it is available. Equal amount of water is added in the inlet tank, mixed (manually), and let in the digester.
Water is procured manually from nearby wells (Maximum 50 feet away).The availability of water is not a problem as normally every household that has cattle has that much amount of water available.
Entire operation of biogas plant is done by the woman in the household which calls upon extra efforts to be put in by her.
The gas collected in the dome after digestion is used as and when required. The usability of gas depends on its pressure inside the dome. The output slurry is dried and used as manure in beneficiary's own farms.

### 3.9.2 Maintenance:

Specific weekly and monthly maintenance schedules need to be followed to ensure proper functioning of the plant. BGP provides the required training regarding the maintenance schedules.

### 3.9.3 Failure and retrieval:

Bhagirath Gramvikas Pratisthan has created local barefoot biogas 'doctors' which address problems and issues regarding functioning of biogas plants. It has also created a helpline where beneficiaries can report their problems. Fortunately, till now only two cases of failure have been reported!

The daily operations of the plant are schematically shown in figure 3.6.

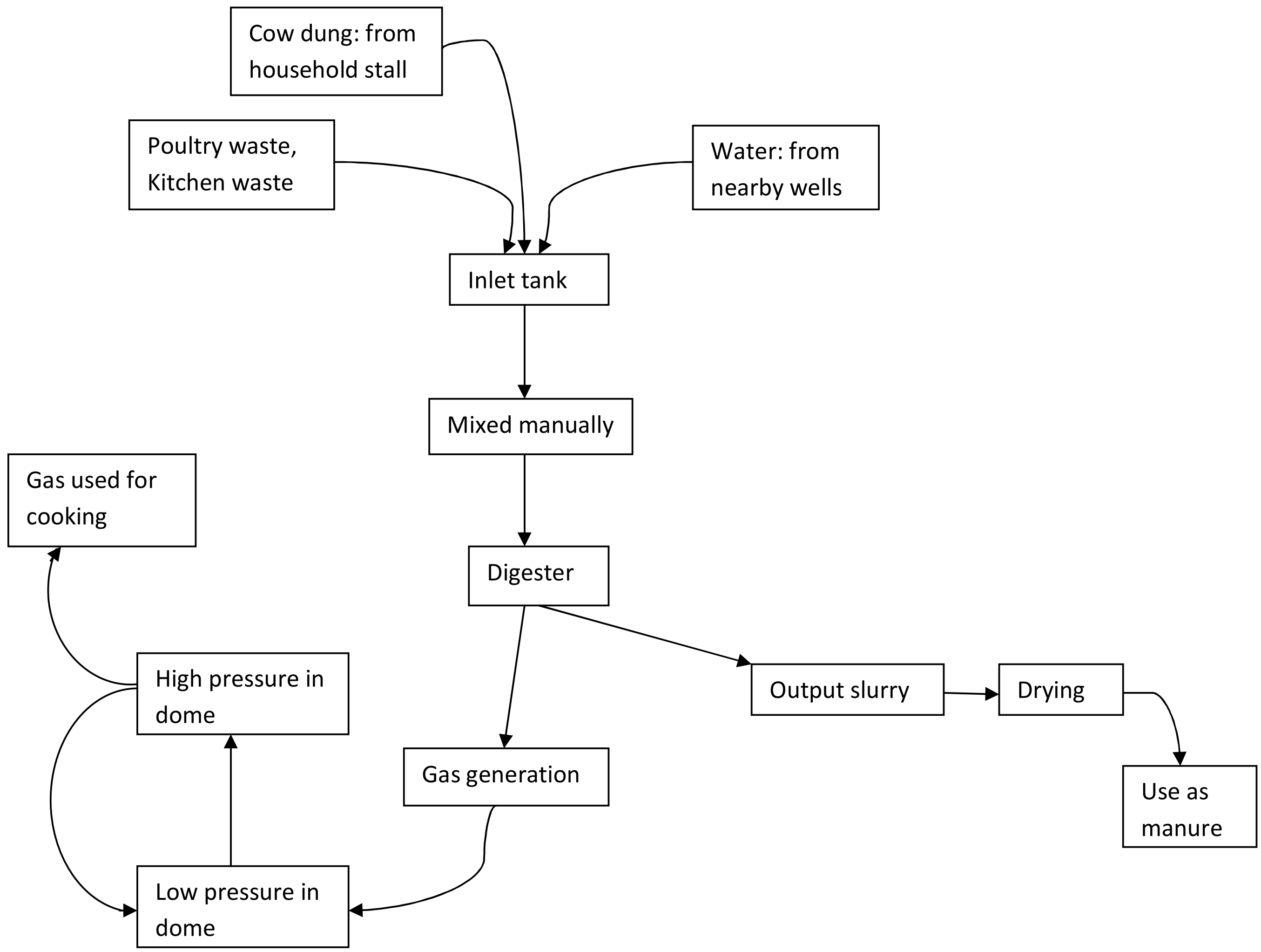



Fig. 3.6 Daily operation of the individual biogas plant

## 3.10 Preliminary economic analysis

Various economic parameters of the individual plants have been listed in this section. Tables 3.3 and 3.4 show the initial costs and the source of funds for construction of the plant.

TABLE 3.3 Initial cost of the plant

| Sr. No. | Particulars | Amount |
|---|---|---|
| 1 | Labor costs | Rs. 3300 |
| 2 | Material and incidental costs | Rs. 10000-12,000 |
| 3 | Total | Rs. 13000-15000 |

TABLE 3.4 Source of funds

| Sr. No. | Source | Amount |
|---|---|---|
| 1 | Govt. subsidy | Rs. 8000 |
| 2 | Individual contribution | Rs. 5000-7000 |
| 3 | Total | Rs. 13000-15000 |

TABLE 3.5 Various financial indicators

| Sr. No. | Indicator | Without subsidy | With subsidy |
|---|---|---|---|
| 1 | Simple payback period | 50 months | 23 months |
| 2 | Net present value | Rs. 2,811 (d=20%, n=25 years) | Rs. 10,811 |
| 3 | IRR | 24% (n=25 years) | 51% (n=25 years) |

## 3.11 Benefits to the stakeholders

Many of the advantages of an individual biogas plant are similar to those of a community one as far as the individual beneficiary is considered. Benefits to other stakeholders like the village and environment due to an individual plant are on a much smaller scale when compared to those due to a community plant.
The main stakeholders and the impacts of the individual plant on them are described below:

1. Individual beneficiaries:
    - Health: Biogas is a smoke free fuel. The health hazards due to the smoke emitted by previous cooking fuels like wood and cow dung is eliminated.
      Also the efforts and discomforts involved in procuring firewood for burning are reduced which is an important benefit related to the health of villagers.
    - Time: Use of biogas for cooking saves the time of villagers as cooking time is reduced and so is the time spent in collecting firewood.

2. Village:
    - Employment generation: Construction of individual biogas plants in a village involves local masons. Thus, this can serve as a employment generation activity.

3. Bhagirath Gramvikas Pratisthan:
    - Starting point for overall sustainable development: BGP considers the construction of biogas plant at a household to be an entry point in the household. Through this entry point it can initiate various other development activities.

4. Environment:

- Use of clean fuel, proper waste disposal system for cow dung and the prevention of deforestation for firewood are the main benefits to the environment from the plant. It is estimated that each individual plant can generate carbon credits worth Rs. 2,000 annually.

Figure 3.7 summarizes the benefits of the individual biogas plant.

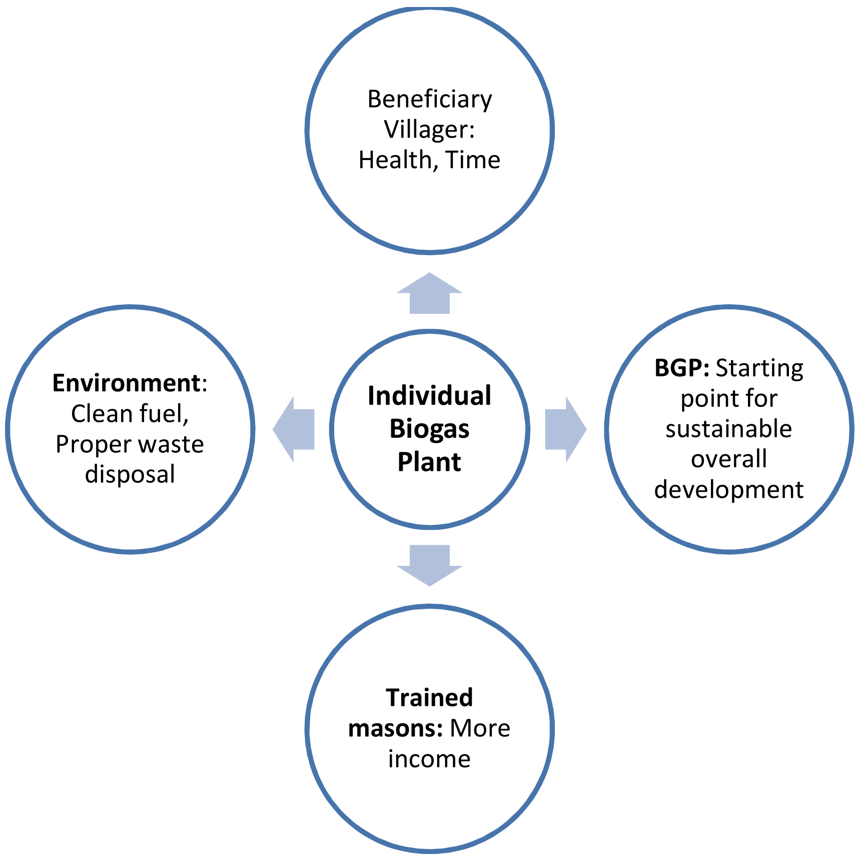



Fig 3.7 Stakeholders and benefits of an individual biogas plant

## 3.12 Reasons for success

Two primary reasons for the success of this model are:

1. Involvement of the individual beneficiary: As in the case of the CBP at Bhintbudrak, the beneficiary contributes some amount of the total required initial funding and is also involved in the daily operations. This contribution from the beneficiary is responsible for the proper functioning of the plant.
2. Role of BGP: The highly efficient and productive methodology adopted by Bhagirath Gramvikas Pratisthan has led to replication of the individual biogas plants at such high rate.

# 4. Comparison of the two models

This section of the report puts forward a comparison of the two models on the basis of different aspects discussed in the earlier parts.

| PARAMETER | | COMMUNITY | INDIVIDUAL |
|---|---|---|---|
| **GENERAL** | Ownership | Village co-operative society | Individual beneficiary villager |
| | Promoter | SUMUL Dairy | Bhagirath Pratisthan |
| | Location | Bhintbudrak Village, Taapi District, Gujrat | Sindhudurg and Ratnagiri Districts, Maharashtra |
| | Operational since | 2004 | Last decade |
| | Number of beneficiaries | 121 families (+47 in next 2 years) | 1000 families (+1500 in next 2 years) |
| | | | |
| **VILLAGE** | Population | 2500, 500-600 families | 1700 (Zarap), 400 families |
| | Cattle population | 90 % of households posses cattle<br>Number varies from 2-6 animals per family | 80 % of households posses cattle<br>Number varies from 2-5 |
| | Geography | Closely packed houses | Clusters of houses (*wadi*) separated from each other |
| | Cooking fuel | Cow dung: bio mass *chulhas* | Wood |
| | Water | No shortage, procured from bore wells | No shortage, procured from wells |
| | Primary occupation | All households milk suppliers to SUMUL<br>Farming of maize, sugarcane and vegetables like ginger, ladyfinger | Farming<br>Main crop includes rice |
| | | | |
| **VISION** | | Primarily established as a means of disposing dung properly; to increase village cleanliness and hygiene in the pretext of bird flu outbreak in nearby areas | Construction of biogas plant in a household is not the end goal, but is a means/starting point/entry point in the household to achieve further sustainable rural development |
| | | | |
| **DESIGN** | Capacity | 4000-4500 kg per day<br>( 35 kg per family per day ) | 40 kg per family (per plant) per day |
| | Size | 85*2=170 $m^3$<br>(1.4 $m^3$ per family) | 1, 1.5, 2 $m^3$<br>Majority plants of size 2 $m^3$ |
| | Area of plant | ~17000 sq.feet | 150 sq. feet |
| | Auxiliary systems | Mixing tank + Mechanized mixing apparatus<br>Electronic balance<br>Pressure regulating tank<br>Fire fighting system<br>Network of pipes, water tank | No such additional infrastructure required |

| PARAMETER | | COMMUNITY | INDIVIDUAL |
|---|---|---|---|
| **DESIGN** | Feedstock | Cow dung | Cow dung, poultry waste, human excreta |
| | Input rate | 3.5 tons cow dung per day | 40 kg cow dung per day |
| | Output rate | 2.5 tons slurry per day | |
| | Gas distribution/supply to burner | Using PRT and underground gas distribution pipeline | Direct connection to the burner |
| | Gas burner | Modified LPG burner | Normal LPG burner |
| | Water requirement | 1:1 | 1:1 |
| | Digestion time | 40 days | 40 days |
| | Digester type | Floating dome | Fixed dome |
| | Location | Land of village co-operative; Member households in 700 m radius from the plant | In the front/back yard of the household; proximity to burner site preferred |
| | Other inputs | Electricity, dedicated staff | None |
| | | | |
| **CONSTRUCTION** | | M/S Excellent Renewable, Valsad | Training of masons |
| | | | |
| **OPERATION** | Feedstock input | Members bring around 25-30 kg dung daily to the plant<br>Dung is mixed with water using pressurized air before it goes into the digester | Dung generated daily (10-12 kg per cow per day) in the stall is put into the inlet tank |
| | Water input | Procured from nearby tank through pipes<br>Tank filled by bore well attached to it | Procured from nearby wells ( maximum 50 feet away in some cases) |
| | People involved | Dedicated staff of the plant (5)<br>Daily laborers (10-15)<br>All members (121) – bring dung to the plant | All operations done by the woman in the household |
| | Maintenance | Taken care of by the dedicated staff | Fixed maintenance schedules |
| | Failure & retrieval | Skilled staff, technical help from SUMUL | No fixed scheme, case-to-case different approach |
| | Utilization of slurry | Vermicompost | Dried and used as manure |
| | | | |
| **PERFORMANCE** | Gas availability | 2 hours in the morning and evening | Anytime, subject to the pressure in the dome |
| | Seasonal variation | Low productivity in winters | Low productivity in winters |
| | Life of plant | | 25 years |
| | Replacement of alternate fuels | Potential to replace alternates fully<br>Insufficient in case of emergencies<br>Fixed time of gas supply calls upon use of alternate fuels during other times | Potential to replace alternates fully<br>Insufficient in case of emergencies |

| PARAMETER | | COMMUNITY | INDIVIDUAL |
|---|---|---|---|
| **ECONOMICS** | Initial cost | Rs. 20 lakhs | Rs. 13,000 |
| | Source of funds | Rs. 12 lakh : Govt. Subsidy<br>Rs. 6 lakh: SUMUL<br>Rs. 2 lakh: Public contribution | Rs. 8,000: Govt. subsidy<br>Rest: individual contribution |
| | Recurring costs | Cost of dung: .35*3500*30= Rs. 36,750 per month<br>Staff+Electricity+others:10000 per month | Nil apart from incidental expenses |
| | Revenue | From vermicompost =700*150=Rs. 105,000 p. m.<br>From gas supply= 150*121=Rs. 18,150 p. m. | Nil |
| | NPV | Rs. 23,02,828 (d=20%, n=25) | Rs. 2,811 (d=20%, n=25) |
| | IRR | 41% (n=25 years) | 24% (n=25 years) |
| | Payback period | 28 months | 50 months |
| | | | |
| **BENEFITS TO STAKEHOLDERS** | | | |
| **Individual Beneficiary** | Health | Smoke free cooking | Smoke free cooking<br>Discomfort, health hazards in transport of wood reduced |
| | Convenience | Piped gas | Though gas increases the comfort in cooking, entire O & M of plant can cause discomforts |
| | Time | Cooking time reduced | Cooking time reduced |
| | Money | Income of Rs. 165 p.m. | No such monetary gain |
| **Village** | Cleanliness | Improved at the village level | --- |
| | Employment generation | Staff, laborers for vermicompost | Masons for plant construction |
| **Environment** | C-credits | Rs. 2,66,000 p.a.<br>(=Rs. 2,200 per family p.a.) | Rs. 2000 per plant p.a. |
| | | | |
| **OTHERS** | Expansion | Restricted by the distance from the plant | Not needed |
| | Replication | AMUL plans to establish 30 such projects | Very easy to replicate |
| | Role of promoting agency | Sumul acts as the mentor providing necessary economic and technical inputs | Bhagirath acts as the buffer between all stake holders fastening the process of sustainable development |
| | Support from external agencies | Govt. support, appreciation from various agencies | Govt. , Bank support |
| | Possibility of electricity generation | Possible as large amount of gas is generated at the plant | Not feasible considering small scale of the plant |

# 5. Future Work

Future work on this topic is essential to fill in the loop holes of this study. Some of the key points which require more work and enquiry are listed below:

1. Design details of the community biogas plants: Major design details of the CBP are missing. A visit to Excellent Renewables in Valsad (the firm which constructed this plant) will throw more light on the design.
2. Critical economic analysis of the CBP: There are significant disagreements in the economic figures on paper and on field. A critical analysis will reveal the true numbers.
3. Interaction with SUMUL and its project team is necessary to figure out important issues in implementation/replication of the community biogas scheme.
4. Correct estimation of Carbon credits involved in both models.
5. Quantity and quality of gas produced in community as well as individual plants needs to be examined.
6. Analysis of land-use patterns, fodder availability, socio-economic condition of the village involved.

# Appendix 1

The community biogas plant and also the individual biogas plants studied here have gained much local as well as national and international media exposure. Some of the newspaper clippings about these plants are presented in this section.

## Community Biogas Plant:

લોકફાળો, સુમુલ અને જિ.પં.ના સહયોગથી બનેલો ભીંત બદૂકનો ગોબર ગેસ પ્લાન્ટ ગેસની સાથે પૈસા પણ રળી આપે છે!

લાભાર્થીઓમાં આનંદની લહેર ફરી વળી

Newspaper clipping (Gujrat Mitra, Date 24.4.2007) ststing the dual benefits of the CBP- gas and money to the tribal villagers

વેસ્ટમાંથી બેસ્ટ, હવે છાણમાંથી હજારોની કમાણી

News bulletin in Divya Bhaskar dated 21.4.2007 highlighting the huge income from waste at the Bhintbudrak plant

# કાર્બન ક્રેડિટ મેળવવા અમૂલ ૫૦ ગોબરગેસ પ્લાન્ટ્સ સ્થાપશે

## આ પ્રકારની કામગીરી કરનારી એશિયાની સૌ પ્રથમ સહકારી સંસ્થા બનશે

મિતુલ ઠક્કર
આણંદ

ખેડા જિલ્લા સહકારી દૂધ ઉત્પાદક સંઘની અમૂલ ડેરી વધુ એક ક્ષેત્રે નવી પહેલ કરી રહી છે. ઊર્જા સંરક્ષણ પગલાં દ્વારા કાર્બન ક્રેડિટ મેળવનારી કદાચ તે એશિયાની સૌ પ્રથમ સહકારી સંસ્થા બનશે.

અમૂલના ઉચ્ચ અધિકારીઓએ ૫૦ ગ્રામ્ય મંડળીઓના પ્રતિનિધિઓ સાથે રવિવારે બેઠક યોજી હતી અને તેમનાં ગામોમાં ગોબરગેસ પ્લાન્ટ સ્થાપવા બાબતે ચર્ચા કરી હતી. પ્રત્યેક પ્લાન્ટ રૂ. ૨૫ લાખથી ૩૦ લાખના ખર્ચે તૈયાર કરવામાં આવશે.

અમૂલ ડેરીના મેનેજિંગ ડિરેક્ટર રાહુલ કુમારે જણાવ્યું હતું કે, ''૯૦ ટકા કિસ્સાઓમાં મહિલાઓ જ પશુ અને ઘરની સંભાળ રાખતી હોય છે. રસોઈ માટે જરૂરી બળતણનાં લાકડાંની વ્યવસ્થા પણ મહિલાઓ જ કરતી હોય છે. જેના માટે તેણે ખેતરોમાં ફરવું પડે છે અને છેક ખેતરેથી લાકડાંનો ભારો માથે મૂકીને ઘર સુધી આવવું પડે છે. આ મહિલાઓને લાકડાં એકત્ર કરવાની કડાકૂટમાંથી મુક્તિ અપાવવા માટે અમે છાણમાંથી ઊર્જા પેદા કરીશું. અમૂલ ડેરી કાર્બન ક્રેડિટ મેળવવા માટે જરૂરી કાર્યવાહી કરવા માટે કન્સલ્ટન્ટને પસંદ કરવાની પ્રક્રિયામાં છે.''

જીસીએમએમએફના એમડી બી એમ વ્યાસે જણાવ્યું હતું કે મેનેજમેન્ટે સુરત જિલ્લામાં ભીતબુદ્રકની ગોબર બેન્ક જેવા સફળ મોડલનો અભ્યાસ કર્યો છે. વધુ કાર્બન ક્રેડિટ મેળવવા અમે મોટી સંખ્યામાં પ્લાન્ટ સ્થાપવા પ્રયાસ કરીશું. અમે મંડળીઓ મારફતે ગામડાંમાં પહેલેથી જ નેટવર્ક ધરાવીએ છીએ. આ રીતે ખેડૂત સભ્યો માટે આવકના નવા સ્રોતનો પ્રારંભ થશે.''

અમૂલ ડેરી આ વર્ષના અંત સુધીમાં ૫૦ પ્લાન્ટ્સ સ્થાપવાની યોજના ધરાવે છે. આણંદ જિલ્લાના ૧૮ તાલુકામાં પ્રત્યેકમાં ત્રણથી ચાર પ્લાન્ટ સ્થપાશે. કુલ ચાર ટન છાણ અને આશરે ૨૫૦ ઢોર ધરાવતું કોઈ પણ ગામ ગોબરગેસ પ્લાન્ટ સ્થાપવા માટે આદર્શ સ્થળ છે એવો અમૂલનો અંદાજ છે.

ધ ઈકોનોમીક ટાઈમ્સ, અમદાવાદ તા. ૧૫/૭/'૦૭

Amul to replicate this model in 30 villages to earn carbon credit

## Individual Biogas Plants:

(तरुण भारत)

# 'फेरो सिमेंट'.. केरळीयन पद्धतीचे बायोगॅस मॉडेल

## झारापला केरळीयन गवंड्यामार्फत स्थानिकांना प्रशिक्षण

▶कुडाळ / वार्ताहर

गॅस सिलिंडरचे भडकलेले दर, जळावू लाकडाची उणीव, याचा विचार केल्यास बायोगॅस हे शेतकऱ्यांच्या समृद्धीचे साधन आहे. मातीच्या विटांच्या दरामध्ये होणारे चढउतार, उपलब्धता, कामाची गती तसेच बायोगॅस बांधणीतील तंत्रज्ञानातील गांभिर्य ओळखून झारापच्या भगिरथ ग्रामप्रतिष्ठानने 'फेरो सिमेंट' या …यीस्कर केरळीयन पद्धतीच्या बायोगॅस …डेल बांधकामाला अधिक पसंती दिली आहे. या मॉडेलच्या बांधकामाचे कसब शिकण्यासाठी झाराप येथे खास केरळीयन गवंड्यामार्फत प्रशिक्षण देण्यात आले. संस्थेने २०१५ सालापर्यंत दशक्रोशीत १ हजार बायोगॅस पूर्ण करण्याचा संकल्प केला आहे.

भगिरथ संस्थेने दशक्रोशीत सामाजिक बांधिलकीतून शैक्षणिक तसेच कृषीविषयक योजना राबविताना शेतकरी स्वावलंबी होण्यासाठी इंधनासाठी झाडे तोडू नका. याला सक्षम पर्याय म्हणजे बायोगॅस या चळवळीचा प्रसार केला. गांडुळ खतासाठी बायोगॅस स्लरीचा वापर केल्यास ते लवकर तयार होते. बायोगॅसला शौचालयाची जोडणी केल्यामुळे डास निर्मूलन होते.

संस्थेने मातीच्या विटांपासून बांधण्यात येणाऱ्या दिनबंधू बायोगॅस सयंत्र पद्धतीचा वापर केला. त्यासाठी गवंड्यांनाही …क्षण देण्यात आले होते.

**फेरो सिमेंट केरळीयन पद्धत**

पारंपरिक दिनबंधू बायोगॅस बांधकामासाठी लागणारी मातीची वीट, त्याच्या दरामध्ये होणारे चढउतार, विटांची वेळेत न होणारी उपलब्धता, याचा विचार करता 'फेरो सिमेंट' ही केरळीयन पद्धत अधिक सोयीची ठरत आहे. या मॉडेलचे बांधकाम अवगत करण्यासाठी भगिरथने पुढाकार घेतला. केरळ राज्यात अशाप्रकारचे बायोगॅस बांधले जातात. माणगाव-आंबेरी येथील फादर जोबी यांनी 'रज्जी' नावाचा केरळीयन गवंडी संस्थेला उपलब्ध करून दिला.

या पद्धतीत सहा एमएम लोखंडी


सळी, चिकननेस यांचा सांगाडा तयार केला जातो. तसेच सिमेंट-रेतीच्या प्लॅस्टरचे एकुण चार थर दिले जातात.

सिमेंट, रेती व लोखंड यांचा एकत्रित वापर म्हणून फेरो सिमेंट म्हटले जाते. या पद्धतीने बांधल्यास गॅसच्या उत्पादनामध्ये साधारणपणे २५ टक्क्याने वाढ होते. बायोगॅस प्लॅंटमधील तापमान वाढीव मिळत असल्याने मिथेल तयार करणाऱ्या जंतूना पोषक वातावरण मिळते.

३८ डिग्री सेंटीग्रेडला सर्वात जास्त बायोगॅस मिळतो. बांधकामासाठी कमी वेळ तसेच एकच कामगार बांधकाम करू शकतो, ही जमेची बाजू आहे. संस्थेने काशिनाथ हरमलकर, संतोष झारापकर, बबन बिबवणेकर, जयदीश गावडे, तुकाराम धाडी अशा एकुण २० गवंड्यांना झाराप येथे प्रशिक्षण दिले. या प्रशिक्षणातून बारा फेरोसिमेंट मॉडेल्स बांधण्यात आली.

**सन २०१५ पर्यंत १ हजार बायोगॅस 'पूर्ण**

ग्रामीण भागात मुख्य अडचण पैशांची. शेतकरी गॅससाठी तयार व्हायचा. पण पैसे नसायचे. अशावेळी संस्थेने २ हजार ते १० हजारापर्यंत बिनव्याजी आर्थिक मदत केली आहे. रत्नागिरी-सिंधुदुर्ग ग्रामीण बँकेने मासिक कमी हप्त्याने कर्जपुरवठा केला आहे. भगिरथने दशक्रोशीत प्रबोधन, प्रशिक्षण, आर्थिक मदत, बँकेचे सहकार्य, कर्जप्रकरणे या माध्यमातून आतापर्यंत ३५० च्या वर दिनबंधू मॉडेल्स बांधून पूर्ण केली.

फेरोसिमेंट पद्धतीचा अवलंब केल्यास कामाची गती वाढते. सन २०१५ पर्यंत १ हजार बायोगॅस पूर्ण करण्याचा चंग संस्थेने बांधला आहे, असे भगिरथचे अध्यक्ष डॉ. प्रसाद देवधर यांनी सांगितले. गॅस सिलिंडरच्या वाढणाऱ्या किंमती पाहता बायोगॅस चळवळ अधिक व्यापक करण्याची गरज आहे. १९८२ चा राष्ट्रीय कार्यक्रमाचा भाग असूनसुद्धा याकडे पुरेशा गांभिर्याने लक्ष दिलेले नाही.

बंद पडलेले बायोगॅस या वाक्याला पुष्टी देतात. ३५० पैकी फक्त तीन बायोगॅस शेतकऱ्यांच्या असहकार्यामुळे बंद आहेत. बायोगॅस दुरुस्तीसाठी मोबाईल हेल्पलाईन सुरू केली आहे. दूरध्वनी केला, तर आमच्या संस्थेचा कार्यकर्ता संतोष तेली तात्काळ उपस्थित राहतो. कोकण कृषी विद्यापीठाचे कुलगुरू डॉ. विजय मेहता यांनी या बायोगॅस प्रकल्पाला भेट दिली. हा उपक्रम अनुकरणीय आहे, असे डॉ. देवधर यांनी सांगितले.

Newspaper article in *Tarun Bharat* about the use of ferrocement for the construction of the dome of the plant

# बायोगॅस बांधकामात आता स्टीलऐवजी बांबू

**भगिरथ प्रतिष्ठानच्या इकोफ्रेंडली प्रयोग यशस्वी : बांधकाम खर्चात दीड हजारने घट**

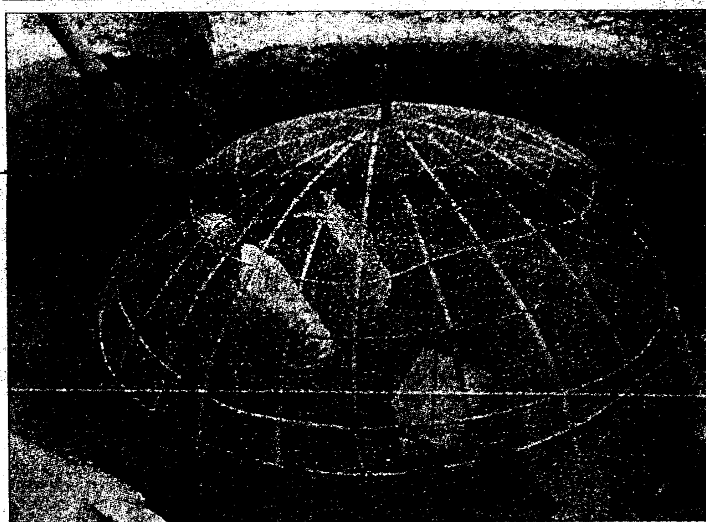
**स्थानिक गवंड्यांना प्रशिक्षण : बायोगॅस चळवळीत किर्लोस्कर कंपनी भगिरथ सोबत**

▶ **शेखर सामंत / सिंधुदुर्ग**

बायोगॅसच्या बांधकामात प्रथमच स्टील ऐवजी बांबूचा वापर करीत इको फ्रेंडली बायोगॅसचे नवे मॉडेल भगिरथ प्रतिष्ठानने विकसित केले आहे. या नव्या मॉडेलमुळे बायोगॅस बांधकाम खर्च तब्बल दीड हजार रुपयांनी कमी होणार असल्याचा दावा भगिरथने केला आहे.

जिल्हा परिषदेला दरवर्षी २०० बायोगॅस निर्मितीचे उद्दिष्ट दिलेले असते. हे उद्दिष्ट गाठत असताना जि. प.चे या नव्या मॉडेलमुळे वर्षाकाठी ३ ते ३.५ लाख रुपये निश्चितपणे वाचतील, असा दावाही भगिरथने केला आहे.

इंजिनियर धनंजय वैद्य व आजरा येथील एका आर्किटेक्टचे सहकार्य घेऊन स्थानिक गवंड्यांना हाताशी धरत हे नवे मॉडेल विकसित करण्यात आले आहे, हे विशेष होय. यापूर्वी बायोगॅस प्रकल्पासाठी दीनबंधू मॉडेलचा वापर सर्वत्र होत होता. या बायोगॅस उभारणीसाठी स्टीलचा वापर व्हायचा. स्टीलचा वापर न करता बायोगॅस उभारता येईल का? तो सामान्य लोकांना परवडेल का? सुरक्षिततेच्यादृष्टीने तो मजबूत राहील का? असे अनेक प्रश्न समोर होते. परंतु, भगिरथ प्रतिष्ठानचे अध्यक्ष डॉ. प्रसाद देवधर यांनी हे आव्हान पेलले व त्यांनी आपल्या इंजिनिअर व आर्किटेक्ट मित्राच्या कानावर ही गोष्ट घातली. त्यानंतर ही इंजिनिअर मंडळी कामाला लागली. त्यांनी बायोगॅस टाकी उभारण्यात स्टीलऐवजी बांबूचा वापर करण्याचे ठरविले. त्यासाठी प्रयोगही सुरू झाले. स्थानिक गवंड्यांचीही मदत घेण्यात आली. प्रयोग सुरू झाले. स्टील ऐवजी बांबूचा व जाळ्यांचा वापर करीत मजबूत अशा टाकीची निर्मिती करण्यात आली. तद्नंतर टाकीचे मजबूतीकरण झाल्यानंतर हे बांबू काढून घेण्यात आले. हा प्रयोग यशस्वी झाला. हमरस येथील मधुकर कांदे यांच्या निवासस्थानी हा प्रयोग करण्यात आला.



इको फ्रेंडली बायोगॅसचे नवे मॉडेल.

भगिरथ प्रतिष्ठानतर्फे बायोगॅस बांधकामाबाबत आयोजित केलेल्या प्रशिक्षणातील एक क्षण.

या प्रयोगाबद्दल बोलताना डॉ. देवधर म्हणाले, जंगल, पर्यावरण वाचविण्यासाठी आम्ही ग्रामीण भागात बायोगॅस हा पर्याय घेऊन यशस्वी वाटचाल करीत आहोत. आता गाववाल्यांना बायोगॅसचे महत्व समजायला लागले आहे. त्यामुळे मोठ्या प्रमाणात जंगलकटाई रोखण्यात आम्ही यश मिळवले आहे. आता हाच बायोगॅस जास्तीत जास्त इको फ्रेंडली करण्यासाठी आम्ही प्रयत्न सुरू केले आहेत. त्यासाठी प्रथम या बांधकामातील स्टीलचा वापर कमी करण्याचा निर्णय आम्ही घेतला व तो यशस्वीही करून दाखविला. तरीही पुढील सहा महिने या नव्या बांधकामाच्या चाचण्या सुरूच राहणार आहेत. या नव्या बांधकामाचे ट्रेनिंग हवे असेल, तर त्यांनी भगिरथशी संपर्क साधावा, असे आवाहन त्यांनी केले आहे. सध्या नेमळे, झाराप, सुकाळवाड, हडी, तुळस, गोठोस, पारपोली, हुमरस, आकेरी, पिंगुळी व पावशी अशा तब्बल १२ गावांमध्ये बायोगॅसची मोहीम पसरली असून पुढच्या १० वर्षांत १० हजार बायोगॅस अशा प्रकारे करण्याचा मानस त्यांनी व्यक्त केला. या नव्या मॉडेलची आयआयटी व किर्लोस्करकडून टेस्ट करून घेण्यात येईल, असेही त्यांनी सुचित केले. किर्लोस्कर कंपनीने भगिरथच्या या बायोगॅस मोहिमेत विशेष रुची दाखविली असून लवकरच या कंपनीच्या माध्यमातून या जिल्ह्यात बायोगॅसच्या मोहिमेवर जोर देण्यात येणार असल्याचेही डॉ. देवधर यांनी सांगितले.

Use of bamboo instead of steel to reduce cost

सकाळ — सिंधुदुर्ग जिल्हा

# घरोघरी बायोगॅस आणि गावागावांत बंधाऱ्यांसाठी प्रयत्न

झाराप (कुडाळ) : सिंधुदुर्गातील विशेषतः सरकारी बायोगॅस योजना बहुतांशी फसल्या. त्यामुळे लोकांनी खरे तर त्या उभारणाऱ्या गवंड्याला तसेच सरकारी योजनेतील त्रुटींना दोष द्यायला हवा होता; पण लोकांनी तसे न करता थेट बायोगॅस उपक्रमालाच दोष दिला. एकूणच बायोगॅसबद्दल लोकांनी वाईट मत करून घेतले. एखाद्या डॉक्टरकडील औषधोपचार घेऊनही गुण आला नाही तर आपण त्या डॉक्टरला दोष देतो, त्याच्या 'पॅथी'ला नाही, हे येथे लक्षात घेतले पाहिजे.

बंधाऱ्याचा प्रयोग यशस्वी करायचा तर त्या जोडीला बायोगॅस उभारण्याचे कामही त्याच गतीने व्हायला हवे. बायोगॅस आणि बंधारे यांचा अन्योन्य संबंध आहे. हे अत्यंत गांभीर्याने हेरून डॉ. प्रसाद देवधर यांनी बंधारे बांधण्याच्या जोडीला झाराप, साळगाव, आकेरी, हुमरस, आडेली, तेर्सेबांबार्डे परिसरात प्रत्येक घरी बायोगॅस उभारले जावेत, म्हणून एक चळवळ उभारली आहे.

आजच्या घडीला एका हाताच्या बोटावर मोजता येतील इतक्याच घरी असे बायोगॅस प्रकल्प उभारण्यात यश आले आहे, हे खर असले तरी सुरुवात महत्त्वाची आहे.

घाटमाथ्यावर म्हणे पहिल्यांदा बायोगॅस कसा बांधायचा याचा विचार करतात, मगच घराचा. पण कोकणात तसे नाही. येथल्या माणसाकडे गुरे की किती असणार? त्यामुळे येथे बहुतांश ठिकाणी बायोगॅस माहितीही नाही. घराच्या शौचालयाच्या सेप्टिक टँकला जोडून बायोगॅस उभारण्याची कल्पना तर येथे अनेकांना शिसारी आणणारी वाटते. "संडासच्या गॅसवर जेवण बनवायचे?" असा प्रश्न विचित्र चेहरा करून लोक अनेक ठिकाणी विचारतात.

झारापमधील बंधाऱ्याच्या कामाची पाहणी करताना कुडाळचे डॉक्टर नंदन सामंत, डॉ. रमेश परब, डॉ. सुधीर रेडकर.

दोन-चार गुरे असलेल्या आणि संडासच्या टाकीला जोडूनच बायोगॅस उभारून घरातला पेटता गॅस अभिमानाने दाखविणाऱ्या बांबार्डे येथीले विलास डिचवलकरच्या घरी आम्ही गेलो तेव्हा त्यांनी सांगितले, "देवाक स्मरून सांगतंय, जेव्हा डॉक्टर देवधरांनी संडासच्या टाकीक जोडून बायोगॅस बसविण्यासाठी कल्पना आमका सांगितल्यांनी, तेवा आमका पहिल्यांदा कसासांच वाटलां. त्या गॅसवरचा जेवण जेवायचा ही कल्पनाच आमका कशीशी वाटली. पण आज जेव्हा खरोखरच आम्ही ह्यो प्रकल्प डॉक्टरांच्या शब्दाखातर सुरू केलो, तेव्हा तर डॉक्टरांचे पाय घरानसारखे वाटले. डॉक्टर देवधरांनी चमत्कार घडवलो हा!"

डॉ. देवधर यांनी प्रायोगिक तत्त्वावर विलास डिचोलकर (बांबार्डे), अमित बाणे (धुमळवाडी), किशोर बागवे (आकेरी) आदी ठिकाणी संडासच्या

**त्यांचे 'समृद्धी'चे प्रयोग**

■ विजय शेट्टी ■ भाग - ३

टाकीला जोडून बायोगॅस युनिट उभारली आहेत. आप्पासाहेब पटवर्धन, पं. दीनदयाळ उपाध्याय, संत गाडगेबाबा या महापुरुषांची नावे या बायोगॅस युनिटला देण्यात आली आहेत.

डॉ. देवधर यांच्या प्रेरणेतून ज्यांनी बायोगॅस उभारले, तेच लोक आता या बायोगॅस युनिटचे प्रचारक झाले आहेत, हे डॉ. देवधर यांचे मोठेच यश मानावे लागेल.

डॉक्टर देवधर म्हणतात, "येथला माणूस नाणीजच्या भोंदू महाराजाच्या पायावर माथा टेकवतो, यात त्याचा दोष नाही. येथल्या व्यवस्थेने फार मोठा मानसिक 'स्ट्रेस' येथे भरला आहे. 'स्ट्रेस'ने फुरफुरणाऱ्या या कुकरची शिट्टी उडवायची, तर पंढरपूरला जाणे खर्चिक वाटत असल्याने तो नाणीजला पोहचतो. येथली 'स्ट्रेस' नाहीसा करायचा तर मुळावर शस्त्रक्रिया हवी. बंधारे घालून पाणी अडविल्याने येथे पाणी टिकेल. सोने पिकेल. नुसते बंधारे बांधून उपयोगाचे नाही. त्याच्या जोडीला बायोगॅस युनिट घरोघरी उभारली जायला हवीत. बायोगॅसमुळे इंधनासाठी लाकूड तोडले जात नाही. प्रत्येक कुटुंब इंधनासाठी काही किलो लाकूड वापरते. या हिशेबाने वर्षाची आकडेवारी काढा. किती झाडे तोडली जात असतील? पर्यावरणाच्या या हानीने झाडे नाहीत आणि झाडे नसल्याने पाणी नाही, असे हे दुष्टचक्र आहे. या दृष्टीने बायोगॅस युनिटची अपरिहार्यता लक्षात घ्या. झाराप, साळगाव, आकेरी, हुमरस, आडेली, तेर्सेबांबार्डे परिसरातील प्रत्येक घरात बायोगॅस युनिट सुरू करणे हे माझे स्वप्न आहे आणि मी ते पूर्ण करणारच." डॉ. देवधर भरभरून सांगत होते. 'ग्रामीण विकासा'चे एक नवे बीज झाराप पंचक्रोशीत रुजू लागले आहे, याची खात्री डॉ. देवधरांच्या बोलण्यातून पटत होती.

बंधारा आणि बायोगॅस यांचा अन्योन्य संबंध आहे.

Appreciation of BGP's work for household biogas plants in Sindhudurg district

# Appendix 2

The contact details for the two models studied are listed below:

**Community Biogas Plant:**

Bhintbudrak Village, Ucchhal Taluka, Taapi District, GUJRAT

Contact person: Mr. Rameshbhai

(Chairman, Village co-operative society- *doodh mandali*)

Mr. Kundan

(Supervisor, Community biogas plant)

**Individual Biogas plants:**

Bhagirath Gramvikas Pratisthan

At post Zarap, Kudal Taluka, Sindhudurg District, MAHARASHTRA

Website: www.bhagirathgram.org

Email: bhagirathgram@gmail.com

Contact person: Dr. Prasad Deodhar

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