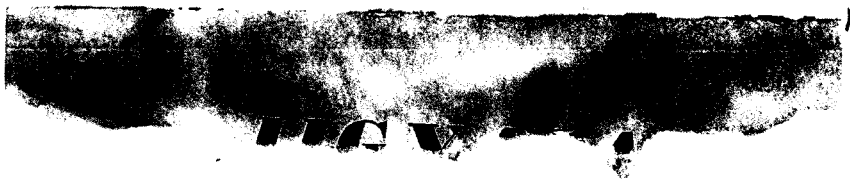

NIGHT - SOIL BASED BIOGAS PLANTS
A FIELD STUDY

by

D.K. MISHRA
T.SAMPATH KUMAR
S.V. MAPUSKAR

Edited by

REKHA BEZBORUAH

INSTITUTE OF SOCIAL STUDIES TRUST
NEW DELHI 1986

INTRODUCTION

This report is the joint effort of a team of engineers who were invited at the initiative of the Institute of Social Studies Trust (ISST) to form a study team and explore the achievements and possibilities of biogas technology in India.

Early in 1981, organisations engaged in rural development in India formed a Consortium On Rural Technology (CORT) to initiate firm measures for developing and taking appropriate technology to the rural community.

At its first meeting, held on 7th & 8th February, 1981, CORT decided to set up a number of panels, each dealing with a specific item of rural technology. The aim of these panels was the identification, development and transfer of appropriate technology.

The panels consisted of research, development and social work organisations, each with a particular focus. ISST was chosen as the focal point for the technical panel on sanitation and smokeless chulahs.* This was partly in recognition of two papers prepared by ISST as background material for the February meeting of CORT. These were (1) Rural Sanitation - A report on Village Latrines (2) Cooking with Firewood: The Burning Issue.

---

*Cook Stoves

In May 1981, ISST convened the first workshop of the panel on Rural Sanitation, facilitated by a grant from Oxfam. The workshop was attended by about forty participants from concerned organisations, both official and non-official, engaged in the field of sanitation. The specific agenda for the workshop was:

1. To review the technology available for the construction of Sanitary Latrines in different parts of the country.

2. Identification of prevalent designs of biogas plants based on night-soil for use in rural as well as urban areas and;

3. Selection of designs of models of different chulahs for implementation in rural areas was also to be discussed at the workshop.

It was observed during the proceedings of the workshop that a fair amount of expertise and literature was available on sanitary latrines and that many of the participants of the workshop were aware of the work being undertaken and implemented in other parts of the country. This was true of biogas plants as well as chulahs. The differences between the cow-dung and night-soil based gas plants were also discussed at length and it was appreciated that the propagation of night-soil based gas plants involved larger social issues, as complex as in the case of sanitary latrines and perhaps even more, and needed further probing. There was some vague information available about plants based exclusively on night-soil existing

in the country, but no systematic had been attempted hitherto.

As a follow up to the workshop it was decided that two teams of experts would separately visit the night-soil based gas plants in north and south India and submit reports on their findings. These could serve as a basis for the choice of a particular model for replication. This report is an outcome of the workshop, the proceedings of which were published by ISST in a report entitled "Rural Sanitation, Technology Options".

However, as it proved difficult to coordinate field visits for a large group of experts, eventually a team of three specialists in this field was brought together to survey identified sites. With the lapse of time, the objectives of the study were further defined as follows:

1. To study the various existing night-soil based gas plants in the country and collect technical and social information regarding use, misuse, disuse, acceptance or non-acceptance of such units.

2. To report on available technologies, and their suitability for various climatic and social conditions.

3. To assess the suitability of these technologies for use by various agencies: Government, non-government including voluntary agencies both technical and non-technical and especially for women.

4. To present a broad policy frame for Biogas development.

METHODOLOGY

A tentative list of the plants and organisations to be visited was drawn up initially, on the basis of my experience as I had earlier conducted a similar study on sanitation projects in the country. A list of projects and people contacted for this study is given at appendix I. ISST's experience of rural sanitation and smokeless chulahs' as priority issues for women's development also proved useful in identifying groups already working in this area.

It was decided to visit as many plants as possible all over the country and report on the state of their functioning. A questionnaire was framed to collect information on the projects which would help in evaluating the performance of the plants, their acceptability by the beneficiaries, and other relevant information. (Appendix II). Most of the technical questions of this questionnaire were evaded by the users as they were not aware of such implications. This was the case with the financial implications as well, and rarely was a person available who know the financial details of running a plant. All other questions elicited routine answers.

Apart from the questionnairs, interviews were conducted to assess the programme, finances and administration of the implementing agencies as well as the responses of the target population,

especially the women. Within this framework, a large number of persons were interviewed: personnel of the various Khadi Boards, Agro Industries, the KVIC*, Block offices, voluntary agencies and individual implementators, as well as a large number of end-users. Women respondents were especially interesting, and their comments were both enthusiastic as well as critical.

An important objective in interviewing a large variety of concerned people was to record the problems faced by individuals and groups struggling with implementation. It is hoped that this has extended the scope of the report beyond being a mere record of 'success' stories as models for replication.

As night-soil based biogas plants are in a nascent stage in the country as compared to gobar gas plants, the study could not be restricted to night-soil based plants alone and includes references to gobar gas. Chapter I provides the framework for the study; Chapter II describes the various models currently in use under different field conditions and by different agencies, although minute technical details are outside the scope of this report; Chapter III, IV and V record biogas policies, interviews with various people, and short case studies of some successful models, while further areas for research and recommendations for policy are suggested in Chapter VI.

---

* Khadi and Village Industries Commission.

It is hoped that the study will be useful for all those interested in promoting biogas technology as a tool of vast potential given proper implementation, towards addressing some of our energy and sanitation needs.

Our thanks to Oxfam for funding this study, and to the ISST for coordinating the project and its guidance at all stages.

Delhi, January 1986. D.K. MISHRA

CHAPTER - I

THE PERSPECTIVE

Anaerobic digestion of biologically degradable materials results in the generation of biogas which can be used as a source of energy, while the residual slurry can be utilised for farm application as manure.

As an agrarian country with a live-stock population of 491.8 million, of which 237 million are cattle and buffalo, India burns 73 million tonnes of dry dung in the form of cakes in the domestic sector. If the dung from cattle alone is passed through biogas plants, it can yield 22.424 million cu.m. of biogas every year. The Indian population of 685 millions (1981 census) has an additional potential for organic wastes to yield another 7300 million cu.m. of biogas annually. In case of human wastes, the disposal is directly linked with improved environmental sanitation and better living conditions for the masses. The manural value of human wastes is far better than the conventional composts. The available biogas from these two sources alone is sufficient to meet the energy needs for cooking for half the country's population, round the year. Use of the agricultural wastes can add further to the generation of biogas.

The emphasis in the present endeavour is on the night-soil based biogas plants in India and their related problems, and before going into the technical and social details of the programme it is worth-while analysing the situation regarding night-soil in the Indian context.

In India, there is as yet no common use of scientific method for recycling garbage and waste for utilitarian uses in aesthetically acceptable forms. However, it nevertheless provides a source of livelihood to many poor people. It is a common sight in towns and cities to see men, women and children searching garbags and sorting it out for something of value to them. These could be items of paper, glass bottles, torn cloths, metal foils, plastic, polythene bags, containers and scores of other things, and each picker has his own specialisation. What remains behind, however, has no use: we have not been able to attach a money value to the most avoided item, night-soil, which continues to be associated with filth, and which is to be handled only by traditionally appointed scavengers.

It is estimated that about one third of the Indian population in cities has no access to any kind of latrines and generously contributes to the pool of the 'never look back stuff' to be handled only by others. In rural areas, the situation is not much better, as only two percent of the population there, has access to latrines and the rest all defecate in open fields. If one can close one's eyes to the aspects of health and cleanliness, the

only good thing about our village is that there is still enough space available for open air defecation provided one sticks to pre-dawn and post-dusk sessions.

In urban areas and growing towns, however, one has to take shelter in the 'ostrich' approach which is quite paradoxical in itself. While changing clothes in public, after taking a bath, people take all sorts of precautions lest they are indecently exposed to others. The same people, however do not mind defecating in open, in full view of the passers-by. Can women afford the 'ostrich' approach in a social set-up like ours?

In villages, the approach to habitation is dotted by human excreta and the walking distance to defecate is directly proportional to the time of leaving bed. Thus the late riser walks a greater distance. Women can neither afford to rise late nor can find an out-of-sight place once the sun rises, and have to wait till it is dark again. The time and distance relationship does not apply to them. With forests and plantations receding fast, the problem is aggravated further.

Generally, certain areas near the village are marked exclusively for women and that is a prohibited zone for men. In some villages the timings are adjusted by both sexes, to enable them to share a common site. If the need develops during odd-hours, the Kanpur women will use the roof-top-latrines' to

defecate, and flush the matter down the drain; Bangladesh women will restrain themselves till the sun sets, and may even skip meals. The women in Rajasthan will go in a group to sit in a circle holding a sari around them during the day time or else use an umbrella, if no company is available. Fallen houses and the houses under construction offer defecation sites within the settlement and are a great health hazard. Generally, women sit in groups, in observable and audible distances, and the fields offer them an opportunity for chit-chat. Day to day events in the village are routinely discussed, messages are passed on to others and the newly weds get a relaxed moment free from their in-laws. This is the only platform where the village women gather for inter-action, leading to even entertainment at times. The men prefer to scatter over a large area for defecation but they also converge to a common place, be it a pond, a river bank or a village well. Thus, it is not only a question of easing oneself but also a social need in the village that the people come out of their homes at least twice a day and this is true for men and women, both. For children, the whole world is theirs, and they defecate whenever and wherever they like without being bothered about anybody. By using their prerogative, they complete the land-scape of the village with uniform dotting.

Unfortunately, our public health engineers, doctors, social scientists and researchers come in the village, if at all they do, at a time when they find filth everywhere and tend to prescribe a package of technologies for cleanliness and better health. There has always been a gap between urban and rural thinking over the same issues. According to an urbanite, sanitary latrines must be constructed in villages so that people do not defecate in the open wherever they like and this will result in a lesser incidence of soil and water transmitted diseases and hence improved health, and secondly, surroundings will be clean and the village will be more presentable.

The rural line of thinking on the problem is that it is absurd to call open defecation unhygienic. After all, fresh morning air, open fields, a calm and pleasant atmosphere are all that is the remains. Further, the Babus* from the towns, even when they talk of infections, diseases, protected water, sanitary latrines, environmental and sound health, can not hold the plough in the fields even for ten minutes nor can they contest a wrestling bout even with the weakest boy in the village, Where does the reasoning on the poor health in the villages stand then?

---

* Clerks or White Collar Workers

It is not intended at all to discourage the programme for protected water or sanitation in the villages, but the well water which can cause typhoid to an urban visitor, does little harm to an average villager since he has been using that water for years and just might have become an immune carrier of bacteria. Even if the villager is affected by the poor quality of water and sanitation, he can-not trace the effects to their root causes. On cleanliness, nothing should be judged by the urban yard stick as villagers deal with mud, earth, dung, dust, farm manure and all sorts of "dirty" things and their clothes can hardly be clean according to urban standards. On the excreta spread around - it is a part of the ground, while in the fields the pigs - nature's scavengers - are there to come to the villagers' rescue. And what of the stink? Well, that is universal, anyway.

How do we argue it with the villager then? Perhaps the answer lies in the need for the organic manure that creates enough interest in a villager to make him listen to an outsider. We now come to the stage when we have to discuss the pooling of human excreta for manural value and it is at this juncture, in the name of social justice, poor economic conditions of the rural household, people's participation, community assets and many other romentic but irrelevant phrases, a public latrine is suggested and that nullifies the entire extension work done so far. The reason is very simple as, in most cases, the

villagers' only exposure to the so-called latrines has been through public toilets at railway stations, bus stands and other similar community installations in towns. Any talk of community latrines reminds them of this hell on earth: and now it is being proposed to bring this to their village.

The village people get repulsed by the very idea but will never say so and listen patiently and end-lessly to anybody advocating the same, but without response. This is an inherent and traditional weakness of all villagers: they cannot offend a guest by saying 'No' but mean the same thing by keeping quiet. This as a rule is taken to mean acceptance. The trap is thus laid for any out side agency to walk in: and the difference in perspectives gets manifest here. The urbanites have their solution, reasonably good and workable for that matter, for what they perceive to be a problem in the villages whereas the villagers fail to appreciate the solution of a problem which never existed for them in the first place.

With this background, it has so far been difficult, if not impossible, to pool human excreta and feed it to community type biogas plants in the villages. The construction of community latrines has been a tough proposition in the existing rural set-up and this poses a challenge for social and health workers, Governments and voluntary organisations to make use of the available potential. The emphasis, in rural areas has to be laid

on the gobar-based plants where the night soil can help as secondary feed, with the help of a willing population. Also the resourceful individuals in rural areas can contruct latrines for the use of neighbours and connect them to the biogas plants. The resulting gas and the manure could be used by the owner. If this untapped potential of biogas and fertilizer from the night-soil could be put to use, together with gobar, much can be achieved on the energy front.

To spread the benefits of gobar-gas technology, it is desirable for the agencies involved to focus their attention on small sized community projects rather than go in for single large-sized units. Such smaller units will require lesser managerial skills and may result in better participation of the beneficiaries. The chances of latrines being used are also improved in such cases as the distance travelled to reach the latrine may be greatly reduced.

There is a great potential for night soil based biogas plants in large villages, urban slums and the semi-urban areas where population density is more. Pooling of night soil is easier as the people are virtually under compulsion to use the services. Statistically, this may cover around 40% of the urban population (i.e. 10% of the national population) which has had hitherto, no access to any kind of latrine. Assuming that gas available from the organic wastes of ten persons is enough to

meet the energy needs of one person, about one percent of the national population's energy needs can be met, certainly, with nightsoil alone. This however, does not include large villages where there is no local body. As the situation stands today, the rural areas seem to have 76% potential (population wise) of night soil. This can be exploited for fertilizer and biogas, with careful planning and improved technologies. However, unsewered areas of cities and towns are relatively convenient for the construction of night-soil based biogas plants.

CHAPTER - II

BIOGAS TECHNOLOGY

Organic biodegradable material, that is fermented in the absence of air, produces a gas which is inflammable and is basically methane, the simplest alkane. This is the same gas which has long been observed over marshy lands, produced by the fermentation of dead organic masses of living organisms. Also known as marsh gas, it burns in shifting flames if subject to sparking or fire, and is also called the 'dancing flame' or fools fire. The biogas is a mixture of methane and carbon dioxide and other gases in traces. The composition especially of methane and carbon dioxide depends on the nature of the raw materials. Generally the methane ranges from 55 to 70 percent. Biogas can be used as a clean gaseous fuel for cooking, lighting, running pumps and generating electricity. The generation and fertilizer separation from typical organic material is schematically shown below:

		Carbohydrates	
	Volatile solids	Fats	Biogas
		Proteins	
Organic matter		Others	
		(Lignin, Tannins etc.)	
	Ash		Sludge

Apart from its energy and enriched manural value of the sludge, the other benefit associated with the digestion is improvement in environmental sanitation. The most common organic wastes which can be used for recycling through biogas plants are animal dung, farm and kitchen wastes, night soil and aquatic plants.

India has been a pioneer in biogas research. The credit goes to Dr. S.V. Desai of the Indian Agricultural Research Institute, Delhi for using animal dung for the first time in 1939 for gas generation, followed by Dr. Jashbhai J.Patel who was the first person to c ome out with a working model of a gas plant in 1951 - a shifting drum type which he named Gram Lakshmi Gas Plant. The work which was started in 1951 on a very modest scale has led to about 2-5 lakh gas plants within the country by now. This, however, is a fraction when we look at the total potential of wastes available in the country.

Biogas is the result of micro organism activity. In other words, biogas formation involves several bio-chemical reactions in the digestor of a gas plant. Bio-chemical reactions require specific conditions and components to keep the system running continuously. These are briefly mentioned here:

Total Solids : Organic dry matter per unit volume of water is an important parameter in biogas research. The optimum range of total solids for biogas generation is found to be 9 - 12 percent. A homogeneous mixture of water and organic matter is desirable for microbial growth and activity. This aspect needs proper dilution of raw materials with water.

Volatile Solids : Biodegradable and non-biodegradable constituents together would form volatile solids. But out of biodegradable solids, only carbohydrates and fats contribute for biogas. The rest of the organic material comes out in the form of sludge along with ash content.

Carbon Nitrogen Ratio : This is one of the important parameters for biogas generation. Micro-organisms need these two vital elements for their growth and multiplication. Hence a suitable ratio is desired for optimum growth. It is generally believed that 30:1 Carbon Nitrogen ratio is needed for anaerobic digestion. This figure includes carbon from all chemical components or volatile solids. It is also known that components like lignin and others do not contribute in biogas generation. In other words the actual anaerobic digestion does not take plact at the overall estimated carbon nitrogen ratio. Few workers have mentioned lignin-free or non-lignin carbon nitrogen ratio which is some what more accurate than earlier reporting.

The carbon is also termed as microbially available carbon. According to Hills, the microbially available C:N, 25:1 was found to be optimum for biogas production. Unless the microbially available Carbon and Nitrogen ratio is specified the parameter is misleading.

The present report's emphasis is mainly on biogas from nightsoil, and human excreta has not very low C:N. ratio. If the earlier arguments were true (C/N ratio of 30:1 or 25:1) for maximum biogas generation, at what level of efficiency does the night-soil based biogas digestor work? Does the optimum C:N change for various organic raw materials? This is one thought provoking area and needs immediate research inputs for bringing out a true picture of C:N ratio.

Temperature : Biogas generation directly depend on temperature. $35^{0}C$ has been found to be the optimum temperature for mesophilic methanegenic bacteria. Below $10^{0}C$, biogas generation virtually stops.

PH : Micro-organisms work to capacity in a highly specified PH conditions. The PH range for bio-chemical activity for biogas production is 7 - 9. Too acidic or alkaline a slurry is detrimental to the system. By adding ingredients, one can bring the slurry to the required PH.

Multiple uses of Biogas Technology: Biogas technology can be utilised for different purposes as follows:

1. As a pollution control technology, by recycling wastes
2. As a source of the cleanest gareous fuel
3. As a source of enrichment of manural value
4. As a technology to improve environmental sanitation.

1. Biogas technology as a pollution control mechanism has been exploited by Maya Farms in the Phillippines. Huge amounts of pig wastes used to cause a foul smell in the farm. This technology was identified and used successfully to control air pollution and ultimately the farm has been developed into an excellent integrated system.

2. The result of the anaerobic digestion is methane (biogas) which can be used for heating in many practices: organic and kitchen wastes, weeds, fruit wastes etc. have been used for fuel. Even when the input is dung, the owner's emphasis has been on fuel value. In India the emphasis changes from state to state.

3. China has been one country which exploited this technology to improve the quality of organic manures. Much emphasis was laid on handling human excreta and pig wastes for fertiliser value through this technology.

4. Anaerobic digestion as one of the components in sewage treatment is the best example for improving the environmental quality. Human wastes and animal wastes contain numerous pathogens, parasitic eggs and weed seeds. If these wastes are not handled properly, diseases spread. When the wastes are passed through the biogas plant these harmful agents are killed and sludge is almost free from any disease causing organisms.

Integrated Farming Systems

As population in our country continues to increase, the agricultural land availability per head is gradually decreasing. Conventional agricultural practices may become unproductive and small and marginal farmers are reeling under the impact of modern mechanised agricultural methods. To this particular sector, the Integrated Farming System (IFS) approach would be beneficial. IFS has been developed on the reality of using wastes of one process as raw material for another. This system assures:

- increased resource utilisation
- enhanced yields
- maximized self sufficiency
- minimized external inputs.

In IFS the biogas digester plays a crucial role in recycling all wastes (animal, human and bird wastes, agro wastes, kitchen wastes) to convert them into fuel and fertilizer. The liquid fertilizer can be used in the fish pond and solid fertilizer on

the agricultural land. Parashakti College in Tamil Nadu has got a successfully working IFS where part of the fertiliser from a biogas plant is used for rearing fish in a pond and the rest for growing mulberry trees to rear silk worms. Farmers should be exposed to and taught IFS effectively to appreciate it.

Biogas Plants - Design Options

The sealed down laboratory models of biogas plants are essentially glass bottles with improvised inlet/outlet and gas collection arrangements which suggest that biogas can be produced with very small inputs in a device which could be as small and as cheap as a glass bottle. Eventually there have been efforts to produce more and more gas from the inputs while keeping the cost factor of the plant as low as possible and this race has led to various plant designs that are commonly and also not so very commonly in use. However, the biogas plants can be classified in two broad categories depending on the method of collection of the gas. There are two ways of collecting the gas:

(A) Floating Drum Type

The gases emerging out of the digester are collected in an inverted drum, which can be lifted up due to the gas pressure, along a guide-post. This is the basic principle of the working of Indian models. Various types of such plants have been developed and are listed below:

1. The Khadi & Village Industries Commission (KVIC) model :

This is depicted in Fig. 1 and its essential components are:-

a) Digester - This is the chamber in which the anaerobic digestion or the fermentation process takes place. This is a pit dug into the ground, part of which can be kept over ground too, lined with bricks in cement, sand, mortar and suitably plastered. The foundations are made of plain cement concrete (PCC). It is provided with a partition wall which bisects the digester and rises almost to the top of it but remains submerged in the slurry.

b) Gas Holder - This is an inverted drum dipped in the digester slurry and moves vertically along a central guide frame. When the pressure of the gas emerging out of the slurry rises, the drum get lifted up, exerting a pressure on the gas equal to its weight which is of the order of 8 to 10 cm. of water column. The drum is made of mild steel sheets (12 gauge approximately) and protected with non-corrosive paints. The frame work at the bottom of the drum helps break the scum while sliding vertically and also when rotated.

c) Inlet - It is made of R.C.C. or asbestos pipe and leads upto the partition wall towards the bottom of the plant. The top is connected to a mixing chamber where dung and other wastes are mixed with water and pushed down the inlet pipe.

d) Outlet - This also is an R.C.C. or asbestos pipe reaching the bottom of the digester on the other side of the partition wall. The top end is led to the

outlet chamber. Whenever the digester is fed through the inlet, an equal amount of digested slurry is pushed out of the outlet. It is just below the inlet level.

e) Mixing chamber - Befofe feeding the dung to the digester, it has to be mixed with water thoroughly in a ratio of 1:1. Mechanical devices can also be used for mixing.

f) Gas pipe - The gas outlet is fixed to the top of the collecting drum from where the gas could be led to the kitchen. This model has been developed by Shri Pritam Singh Bajwa of Rampur, U.P. (ASTRA*, IISC**, Bangalore) has optimized the design parameters for the Khadi & Village Industries Commission (KVIC) model which resulted in overall cost reduction. Some other materials like the fibre glass, PVC and LDPE sheets (Low density polythylene) etc. have also come up to be used as substitutes for the mild steel sheets in case of the gas holders.

2. Water Jacket Biogas Plant - This is an improvement over the KVIC model, where, with the help of offsets in the top reaches of the digester wall, twin concentric walls with a cavity in between is constructed (Fig.2). This cavity is filled with water, topped with oil. The drum slides into this cavity and at the same time it is not in contact with the slurry, as in the conventional KVIC model, and hence is less prone to corrosion. Further, the layer of oil which continuously gets sprayed over the exposed surface of the

* Application of Science and Technology for Rural Areas

** Indian Institute of Science

drum, improves its life span. Perfect anaerobic conditions are achieved and any foul smell is eliminated. Slurry and the raw night-soil is not exposed to the surroundings, and hence the animals and insects do not have access to it and faecal pollution of the environment is totally avoided. When the raw material is night-soil, water jacketing is probably the best approach.

3. Gobar Ganesh Model - This is basically a KVIC type plant with the digester consisting of a simple angle iron framework lined with 250 microns LDPE, used as replacement for the conventional brick masonry. Total elimination of cement is a distinctive feature of this model. The framework component can be sized to portable pieces and the cage can be assembled on site with the help of nuts and bolts. Once the pit is dug, the plant can be assembled within hours. The exposed surfaces of the steel drum, including its' top surface, is also insulated with similar polyethene sheets pasted with the help of coal tar. Steel plates contact with the atmosphere is thus eliminated and the chances of the drum getting rusted are greatly reduced. It is easier to paste the sheets on the drum than to paint it. The sheets also act as a thermal insulator. (Fig.3). In peak winters also the plants are reported to be working satisfactorily.

4. Gujarat Agro Industries Corporation (GAIC) Mini Plant - This is a mini gobar gas plant developed at GAIC with a capacity of 40 cu.ft. (1 Cum) which can operate on the wastes from one

to two cattle. The principle is the same as that of the KVIC except that the digester also is prefabricated (0.63 mm G.I. sheets) and the whole assembly is portable.

5. Kamadhenu Biogas Plant - This again is based on the KVIC technique where the digester and the drum both are made of burnt clay. The digester is laid over the brick foundation by placing clay rings over it and the joints filled with cement-sand mortar. The floating drum is laid carefully to rest over the haunches in the digester. Inlet and outlets are 4" dia clay pipes. This plant has been developed by Shri Balwant Ramchandra Gawade at Sangli in Maharashtra.

6. Portable models of Biogas Plants - Some models made of steel plates in different shapes and sizes of drums are being tested for their suitability by (1) Shri Arvind Pandya at Khadi Gramodyog Prayog Samiti, Ahmedabad, (2) Tamil Nadu Agricultural University, Coimbatore and (3) Andhra Pradesh Agricultural University, Hyderabad.

7. MCRC Model - This has been developed at Shri AMM Murugappa Chettiar Research Centre, Madras. The digester, inlet and the outlet are exactly similar to the KVIC type but the drum is replaced by a geodesic balloon made of P.V.C. or LDPE sheets which is kept in position by imposing a secured wooden frame over it to prevent the balloon from flying. The outlet gas pipe and the stirring mechanism are incorporated

within the digester itself. (Fig. 4).

8. Structural Engineering Research Centre (SERC) Model : This has been developed at the SERC, Roorkee. The basic principle is that of the KVIC type but the digester and the drum both are made of ferrocement. Whereas the digester is cast-in-situ, the drum is precast and needs transportation to the site. This being too heavy, there are handling problems and hence the design is not very much in use.

(B) Fixed Dome Type

In this method, the storage chamber for the gas is made as the integral part of the digester and the gases evolved are collected at the top of the unit. When the pressure rises, the digester slurry is pushed out into the inlet and outlet, which are designed to accommodate such displacements. Such plants are quite common in China and often known as Chinese Biogas Plants. With some modifications this model is becoming increasingly popular in India too. The various designs of this type are given here.

1. The Janta Biogas Plant : This was developed at the Gobar Gas Research Station, Etawah U.P. (Fig. 5). Its essential components are:

   a) Digester - This is generally an underground structure but can be partly over ground also, subject to local conditions depending on the ground water table. The

height-to-diameter ratio is of the order of 0-5 and hence it is shallow.

b) Gas Holder - This is an integral part of the digester and made into a dome shape to cover the digester and constructed of brick masonry in cement-sand mortar. The crown of the dome is provided with the gas outlet. When the gas emerges out of the slurry it starts collecting at the top of the chamber and when the pressure builds up, it pushes against the dome, the walls of the digester and the slurry, which get pushed into the inlet and the outlet tanks. When the pressure is reduced due to the usage of gas, the slurry attains its normal level. Because of the outward pressure, there is a tendency for the gas to leak out through the dome and this is why the entire structure, especially the dome has to be constructed very carefully by skilled and trained masons.

c) Inlet - This is a rectangular construction, as shown in the figure, and is preceded by a mixing chamber. The top position of the inlet is grilled with mild steel bars or covered with slabs or wooden planks to prevent people and animals from falling into it.

d) Outlet - This is similar to the inlet with a hole at the tail end to discharge slurry into the drying beds. The slurry level is maintained in such a way that no gas can escapes through the inlet and outlet.

2. Govardhan Biogas Plant : This has been developed by Shri M. Bhav Navrekar at Nasik. No drawings/details are available, but in this design, the inlet and the outlet are brought on to the same side, taking advantage of the fact that the

digested slurry is lighter than the newly fed material. The inlet pit is extended a bit sideways and a horizontal partition separates the lighter digested slurry from the new feed and the same pit can be used as an outlet.

3. Bhagyalakshmi Model : This type has been developed by Shri B.Renganna at the University of Agricultural Sciences, Bangalore and is a modification of the Janata technique. The basic differences are that it has a partition wall bisecting the digester and the dome is made of R.C.C. (Fig.6). This is quite popular in the state of Karnataka but some adverse field responses regarding leakages through the dome have been reported.

4. The Biogas Privy : This is only an air-tight septic tank where water input is limited and regulated by hand flushing. The plant runs easily on night-soil. Although the gas out-put is low because of the lesser input of a family size plant, it can be improved to mix dung. A few such Biogas privies have been constructed in Dehu near Pune.

5. Kalinga Biogas Plant : This is a gas plant whose base is a downward-curved convexity and the top dome is made of RCC with a provision of a manhole. This has been developed by the Department of Agriculture, Government of Orissa.

All the plants discussed above are the continuous feed type, i.e. the raw materials are fed regularly. However, there are plants where the feeding is done periodically, the plants emptied and fed again, afresh. This sort of digestion is resorted to when daily feeding is not possible.

Sometimes, the combination of the above two i.e. the continuous digestion and periodical digestion is also adopted and the process is termed 'semi-batch fed'. At village level, this would mean feeding the plant regularly with dung or night-soil in whatever quantities are available, and intermittently supplementing the feed with garbage, agricultural wastes and weeds etc.

Suitability of the Available Technical Options

The Khadi and Village Industries Commission has been mainly responsible for the construction of the bio-gas plants in the country almost till the end of the seventies. It was only towards the end of the last decade that the fixed dome model came to be reckoned as a possible low cost alternative to the KVIC plant.

The KVIC type plant had its own share of problems like (i) higher initial investments (ii) corrosion and hence painting/maintenance/replacement problems of the drum, (iii) adverse effect of temperature on the gas production during winter and (iv) the need for workshop facilities for fabrication and repairs. Six hefty persons are needed to lift the smallest drum (2 cu.m.plant),

for routine annual painting, for the plant of Dr.Kodanda Rama Rao in Surandai village of Tirunalveli (TN) and lifting alone costs him Rs.100/- per year.

These shortcomings are overcome in the Janata model which makes use of the local skills and materials (except cement). It also makes better use of the land as the whole plant is underground. If constructed and followed up properly, the Janata type would certainly outclass the KVIC, but if the steel drum is the problem of the KVIC, it is cement and workmanship which puts a question mark before the Janata Plant. Cement, when purchased from the open market is not as cheap as it is made out to be; the quantity per bag is invariably less than the standard, and the quality is always doubtful. With such constructional inputs, even with the best workmanship, the chances of leakages cannot entirely be eliminated. Further, the dome is always exposed to gas pressure ranging from 60 cm. of water column in a 2 cum. plant to about 150 cm. in case of a 15 cum. plant. There is always a possibility of micropores being present in the plaster and in joinery works which may get widened due to cyclic application of gas pressure, over a period of time. The plant may work well during its initial period but may cease to hold the gas later. Secondly, it is not very easy and convenient to locate the leakage points of the gas and repair the same, as the whole unit is underground and one really needs an expert to locate and rectify the faults. A similar situation appears on

the workmanship front. The list of dos' and donts' is much longer in the Janata type and the mason has to be really well trained, responsible and professional to construct such plants with confidence. The quality of supervision also has to be equally good. Can we honestly boast of the availability of such workers in our rural areas?

The technology, especially one related to the rural areas should be simple to impart, with minimum tips for dos' and donts'. As long as this does not happen, there should be a proper follow-up mechanism after the construction of the plan. Unfortunately, the follow-up programme is very slack and even non-existent in many states. But for the voluntary organisations, practically no assistance is available to the user. Only recently, Gujarat Agro Industries Corporation has set up a cell which will look into the grievances of the biogas users; other states are yet to come forward.

The choice of the type of biogas plant to be installed lies mostly with the implementing agencies, their personal likes and dislikes and also the expertise available with them. At the moment, there is a kind of undeclared hostility amongst the propagators of the KVIC model and the Janata model with the KVIC on the defensive. It is not the intention of this study to further the controversy but the fact remains that the beneficiary has to remain contenced with whatever services are available to him from a particular agency; he is neither capable nor equipped to dictate his

choice about the type of plant he wants to install. Rural Agriculture Centre, Naryangaon in Pune District. Maharashtra is probably the only institution which does not have a fancy for any particular model and would construct a plant as suggested by the clients. It is also difficult to prescribe a particular model to suit all the local climatic and geographical conditions.

When fairly competent masons and supervisors are available along with basic constructional materials like bricks, sand, cement, a Janata type plant may be an obvious choice. A KVIC model may be better in warm places with less temperature variations, and where workshop facilities are available. Where cement, bricks sand etc. is in short or no supply, the Gobar Ganesh model may be useful. The decision to use a particular model will have to be taken up at the local level. Unfortunately, the response to researches etc. amongst the executants of the biogas plants is quite sluggish and the growth of the agencies in the field of biogas is, by and large, unidirectional. Thus KVIC would not accept the Janata model as an option, and Janata enthusiasts will continue to ridicule the KVIC model and there is no counter check, as the end user is not aware of the implications of using either.

CHAPTER - III

PROGRAMMES AND POLICIES

The technology of biogas has been known in India for over forty years but there was a relative period of lull till the mid seventies when the oil crisis renewed afresh the interest in biogas. Till then it was only the KVIC doing stray jobs here and there, who somehow managed to keep the issue alive. It was around this time that the Janata model was developed and field tested and the momentum slowly picked-up. The Central Government started taking interest in such renewable sources of energy programmes and so did the state governments and other official and non-official agencies.

The number of biogas plants which stood at approximately 70,000 at the end of the fifth five-year plan has gone up to around 2.5 lakhs today. A national project on biogas development has been taken up under the Department of Non-Conventional Energy Sources and it provides for:

i) Central subsidies to the beneficiaries
ii) Core organisational support to state Governments
iii) Staff support of KVIC
iv) Training Programmes
v) Setting up of regional biogas centres

vi) Turn-key job fee to State Corporate Bodies/KVIC State Khadi Boards/State Agro Industries Corporations/ Identified trained private entrepreneurs/Voluntary Organisations etc.

vii) Incentives to village functionaries.

The biogas programme can be viewed in two ways: 1) small plants and 2) large size plants. In the first category the beneficiaries are only single family units whereas in the latter, the beneficiaries are groups of amilies or even the entire village. These two units are popularly known as family type and community type biogas plants, described in detail in Chapter III (iv). Facilities provided by the Indian Government vary for both types of plants.

The central subsidy for family size plants varies for different sizes, scheduled tribes and small and marginal farmers, (this group includes landless labour also). Those living in the North-East and Sikkim would get more subsidy than the general category. The North-East and Sikkim would get more subsidy among all groups. For example, for a 2 cum. size plant, North-East Region and Sikkim get Rs.2,640/- whereas the other two groups get Rs.1,200/- and Rs.1,000/- respectively.

Only 20 percent of the rural population has sufficient numbers of animal population for the smallest family size biogas plant. The concept of community type biogas plants

comes into biogas programmes as a demonstration scheme. The basic objectives of the scheme include:

- to ascertain how community biogas plants can best be integrated with the socio-economic life of the masses.
- to evolve suitable models and demonstrate them in different situations and locations for extension to all potential villages.
- to ascertain the possibility and potential for meeting the domestic energy requirements of a village.
- to identify and demonstrate ways and means for integrating this system with other systems for increased agricultural productivity, reducting human drudgery, improving standards of living etc.

To have a community biogas plant, the minimum number of families in the village should be 25 for which the minimum plant size should be 45 cum/day. These rules however do not apply to institutional community biogas plants since the feed material varies at the institutions. The Government of India provides 100% subsidy for community biogas plants whereas for the institutional biogas plants, 75 percent of costs are met by the Department of Non-Conventional Energy Sources and the rest by recipient organisations. Effluent and sewage based biogas plants also have subsidy assets for installations.

Though the biogas programme is one of the Prime Minister's priorities, and included in the 20 point programme, people are still not aware of it. To quote an example, a village called New Gwal Pahari - only 25 kilometers away from Delhi in Haryana had not even heard about the gobar gas plant till two years age. To the officials at district or block level, this programme has become an additional burden which demands expertise. It is not surprising that responsible officials are not even aware of "biogas" to a level that will motivate and mobilize the villagers.

Biogas technology, when properly exploited to yield its full potential, brings prosperity to village life. In order to propagate its use, demonstration units should be constructed vigorously. Care should be taken that these plants which are meant for 'demonstration' are constructed flawlessly. Otherwise the very purpose of 'demonstration' is destriyed and it may have a negative impact on villages and finally discourage them from having a biogas plant.

Voluntary agencies have a vital role to play in the execution of biogas programmes and can act as a link between the government and the beneficiaries. Unfortunately, their number is limited.

Biogas plants based partly or fully on night soil as a feed material are not only a source of fuel and manure but the entire concept of sanitation and its complexities are linked with them. This relates the matter of biogas directly to women. Sanitation is a delicate issue and although it is a felt need, at least in urban slums from the beneficiaries' viewpoint, and in rural areas for public health workers, the discussion on it is often avoided in society. Most of the extension work in the field of sanitation is done by the male workers amongst the male members of society, and women get ignored. The women are also inaccessible in most cases in the rural areas, even if some well meaning male extension workers try to approach them for putting pressure on the male head of the family for investments on sanitation/biogas which is generally considered a waste of resources. If only the extension/motivation and at later stages, follow up, was left to women, the results would be quite encouraging. This must be done at government level as well as the level of voluntary agencies. There should be freedom for interaction and dialogue. The construction part could be left to the male members of the family.

CHAPTER - IV

Individual and Community Biogas Plants

The viability of any night-soil based biogas, manuring or sanitation system depends on the collection of human excreta at one point, and the common media is through the community latrines. The only way it could be done is through a very effective local organisation committed to the overall development of the community, which can motivate people through a realisation of the need and benefits of such a scheme, involve the women to the extent possible because they are the primary beneficiaries of the programme, and pursue it in such a way that the programme runs on its own even when the external support is withdrawn from the scene.

It is not intended to draw a comparison between the individual and community-type biogas plants but to probe how best these could be made use of, depending on the local conditions, and availability of raw materials, There is a possibility of the following pattern of ownership of biogas plants:

1.	Individual biogas plants	Rural areas	
		Urban Areas	
2.	Community type biogas plants		Rural Areas
			Urban Areas

By community plants it is understood that the funds for construction of the plant will come through government sources, while the recurring expenses on the running, maintenance and staff salaries of the plant will be generated through the sales of manure and rental for using the gas. The Government may or may not retain the ownership of the plant but can pass on the running of the plant to a local body, to the community through an executive ancex body or a voluntary organisation.

The inputs and raw materials provided by the community and the resulting biogas and the manure can be given back to the community under some agreed financial arrangement with the executive.

3. Institutional biogas plants - educational, social, cultural and even commercial institutions can also construct the biogas plants, partly with the government's assistance. Inputs and the proper usage of the output is the concern of the institution and the users generally do not participate in the decision making process nor do they have to worry about the maintenance aspects.

These categories are described below in further detail:

1. Individual biogas plants

Let us first look at the possibilities in the rural areas.

Gobar is quite commonly available in rural areas and may form the bulk of input to the biogas plant. If the latrines could simultaneously be constructed and connected to the biogas plant, not only would the yield of the biogas improve and the nutrients of the manure get richer but over all sanitation would also improve. Night-soil in such individual cases becomes a secondary feed to the plant and the emphasis has to be laid on the gobar component.

In rural areas, individual biogas plants based on night soil sound absurd but we came across two specific cases, and there may be many more, where the individuals have constructed latrines for the use of others and connected them to the biogas plants, the resulting gas and the manure being used by the owner.

One such plant is located in Dehu, near Pune, in Maharashtra State. Dehu is a typical large congested Indian village with a population of 6000. If derives some religious importance by virtue of its being the birth place of Sant Tukaram, an Indian saint. The plant is owned by Smt. Kalabai Mohan Singh Pardesi, whose sons run a small business in Dehu. She has constructed two latrines outside her house, of which one latrine is used exclusively by her family and is kept locked while the other

one is open to use for about ten families, who pay Kalabai a rental of Rs.5/- p.m. for using the facility. The total number of users are around 75. Both these latrines are connected to a 6 cum. water jacket type plant with a fibre glass dome. She owns six cattle but the dung is not fed to the plant. The gas is sufficient for the sixteen member family of Kalabai. The resulting manure is sold for Rs.600/- to 700/- annually. The total cost of construction was Rs.11,000/- of which Rs.3,000/- came as subsidy. Rs.5,000/- of the loan amount has already been paid. The plant was constructed in 1979 and she also received the state's assistance for connecting the latrines to the plant. She, however, continues to prepare and sell dung cakes.

The other plant is located in the village Shirval, Dist. Satara (Maharashtra) in the premises of Dr.Joglekar's hospital. The plant was constructed in 1967 and is a water jacket type, of a capacity of 150 cft. The input is from ten latrine seats connected to the plant. Dr.Joglekar has allowed villagers to use the latrines and there are about 100 users daily. Gas is used in the hospital and his residence and the manure in his farm. Dr. Joglekar maintains the latrines and is reported to save about 70 litres of kerosene per month. It is used as a supplement to LPG in his residence. The original gas holder rusted and was replaced by a fibre glass gas holder in 1979.

As in rural areas, if the tenants and the neighbours could be encouraged to use the latrines, and if the space permits for the construction of the biogas plant, the night-soil based biggas plant is a distinct possibility in urban areas also.

One such plant belonging to Prahlad Bhai J. Patel, is located at Mahesana district in Gujarat. This plant is a KVIC model of 2 cum capacity and was constructed in 1980. Prahlad Bhai has a double storeyed housing complex of single bedroom tenements for twelve families, six on each floor. Three latrines of PRAI type pans on each floor are connected to the gas plant. One of the tenants, has been given the gas connection and is charged an extra Rs. 30/- p.m. for this additional facility. The spent slurry is applied to the kitchen garden measuring 6,000 sq. ft. belonging to Prahlad Bhai again, where vegetables are grown and sold to the tenants and also kept for personal consumption. The yield is so high that no seasonal vegetable is purchased from outside by these thirteen families. Children are allowed to play and jump over the gas holder, which is fun for them but it actually breaks the scum regularly. His own children paint the drum annually - and with pleasure. The cost of the plant was Rs. 3,000/- of which 1,400/- came as subsidy. No loan was taken and the Rs. 2,100/- invested by him has been paid back.

Should there be space available and proper guidance forthcoming, there is a possibility of commercial exploitation of a hitherto impossible proposition. Smt. Kalabai and Prahlad Bhai have shown the way.

2. Community type night-soil biogas plant (CTBP)

Any development programme concerning sanitation or biogas, that too based on night-soil, suffers from a stigma and not many people come out in its favour in the first instance. It is also devoid of the glamour which other programme possess to an extent, and is confronted with serious attitudinal problems of the target population. To organise a community is a job tougher than providing a technical package in such cases. The committed Gandhians had been very active in the field of sanitation, in the early post-Independence periods, and had constructed night-soil gas plants in rural areas when nobody else had thought of them.

The first community night-soil based biogas plant (this may as well be the first CTBP based on any input raw material) was constructed in the year 1953 in the village Kanakvali, Dist. Sindhudurg (Maharashtra) by Shri Appa Saheb Patwardhan, a disciple of Mahatma Gandhi, who took up rural sanitation as the mission of his life and had established Gopuri Ashram (at Kanakavali). A twelve seat community latrine was constructed and connected to a 500 cft capacity biogas plant with a floating gas holder and

water jacket type digester. The unit was run by the Gopuri Ashram; the gas was used for street lighting and the manure was used by the Ashram at its farm. The plant ran satisfactorily for about fifteen years, when the management and maintenance was passed on to the village Panchayat. The Panchayat neglected the job and the plant became non-functional gradually. Later, the gas-holder got corroded and the plant became totally defunct.

One more such plant has been constructed at Shigli (Dharwar) in Karnataka. Shigli, which we came across in Karnataka, South India, is quite a unique village as far as night-soil exploitation for fertilizer value is concerned. This village has really discovered the worth of night-soil. The farmers from this village go to Goa to bring night-soil manure for application in the agricultural fields. The credit goes to Shri Basavkumar Mulagundnath who has been a disciple of Gandhi and Vinoba Bhave and devoted to village development. He motivated people to have their own 'Shuchi Kunda' (sacred pits), community lattine and subsequently tapped the nutrient potential of night-soil. It is no surprise that the young farmers from this village bagged a prize for their work on organic manure in the First State Conference of Young Farmers in 1966. Praising Shri Basavakumar Mulgundnath, the man behind this 'Khad* factory' Appa Saheb Patwardhan said "Gandhiji started 'Bhangi Mukti Seva** but you yourself became a Bhangi

---

* Fertilizer

** Scavenger Liberation Service

and organised a community of dignified Bhangis and thus eliminated the social stigma of Bhangi".

One does not need to motivate villagers to use night-soil for fertilizer. Since the villagers know the worth of night-soil, this forms a favourable background to introduce technology like biogas. With funds from the State Khadi Board of Karnataka, the village had a 500 cft. biogas plant connected to a 20 seat community latrine. About 400 to 500 villagers enjoy the services. Villagers were served with the required amount of night-soil manure by taking money in advance.

Transportation of huge quantities of manure later became a problem. The farmers made a request to the State Khadi Board for a pair of bullocks which were more suitable to the village atmosphere. The authorities were very liberal and advanced an amount of Rs. 33,000/- for the purchase of a tiller.

The humble and modest village organisation was suddenly seduced by the money power, and village politics surfaced, resulting in the untimely closure of the programme. Neither the tiller nor the bullocks could be purchased. Ultimately, the biogas plant had to be abandoned. The plant had run successfully from 1968-75 and the gas used for a 50-student hostel's energy requirements. The funding agency was too liberal in giving a tiller, ignoring the request for bullocks for transportation.

During our visit we saw the torn out drum resting in the empty digester since years. The latrines are still being regularly used by villagers and the composting is done in conventional pits.

Disappointed by the new negative developments, which slowed down his further activity on night-soil, Shri Basavakumar told us "When I felt that there was no scope to work on night-soil management in this village, I onee thought of taking a leap into the pit of the night-soil and ending my life". This touching statement shows his dedication to the cause.

While appreciating the efforts of these individuals in the field of sanitation/biogas, some issues emerge for reflection.

i) A period of fifteen years in Kanakvali and eight years in Shigli could change the habits of the people so that they got used to latrines but failed to get them to organise themselves to keep the community services running.

ii) Financial requirements mar the growth and running of such plants. If the money be made available to replace the gas holders, both the plants may be revived again because the leadership still is available in some form.

iii) It needs a commitment and dedication on the part of the leadership to run such plants or similar projects.

It is not known if there are any plants in the rural areas of the country run by the Government which are based purely on night-soil. There are many dung-based plants with a provision for latrines in the countryside, which are being run as experimental plants. The maintenance and running of these plants is to be passed on to the community after a successful run of three years. Unfortunately, the state of affairs on all these CTBP is frustrating and almost all the plants are faced with some difficult or other. The much propagated Fateh Singh Ka Purwa in Etawah (U.P.) is now non-operational due to village politics and feeding has been discontinued. In Masudpur, where the dung is purchased from a dairy farm and fed to the plant, the gas distribution timings as well as the disposal of the manure are causing friction among users. In Karuthia Goundanpatti (Madurai) the beneficiaries on whose cattle strength the plant was supposed to run, sold their cattle/buffaloes in distress to meet the drought situation. An installed capacity of 51% is now backed by seven buffaloes. The picture that emerges thus with big size community plants is not very encouraging.

In urban areas, the situation is no better either. A 15 cum. Janta type night-soil biogas plant funded and guided by AFPRO for Medinipur Municipality in West Bengal is also not working for non-technical reasons. It was proposed that the scavengers would bring 120 gallons of night-soil in wheel carts

to the biogas plant in their colony and the resulting gas would be used for working and lighting by seven out of forty families to start with. The plant constructed in 1981 worked well for seven months and then the beneficiaries lost interest in the plant and the apparent reason given by them is the bad odour of the gas in burners and lamps. Crawling worms around the plant and towards their residences have also been noticed. This may be attributed to short circuiting of feed material. Lastly, they wanted to forget their profession once they were back home and did not like the wheel carts containing night-soil to be brought to the colony.

Pune Municipal Corporation failed initially when it constructed three night-soil based gas plants in the slum areas of the town. The fourth one was constructed in Santnagar with the technical guidance of Maharashtra Gandhi Smarak Nidhi. It is a complex of a 15 seat latrine visited by about 300 persons everyday. The gas connection is given to six families who do not pay anything for the services nor do they intend to.

The only positive example is that of the Sulabh International and their biogas plants at Patna and Lucknow. The Adalatganj plant (Chinese model) is fed through a 42 seat latrine complex visited by about 2,500 persons per day. The gas is used to generate electricity to light roads from Adalatganj to Rajbhawan in Patna.

The chances of survival and continuance of such programmes are better in case of voluntary organisations because of their commitment to the cause, concern for the problem and compassion for the people. Compassion is a word which is missed sadly in the official approach. Only the concern and commitment is observed in varying degrees depending on the individual in the chair. Wonderful programmes are drawn, probably by the best brains available in the country, with vast resources at their disposal, yet the results are frustrating. A half hearted and unrealistic group approach is the only way by which one could explain these disasters. Well meaning people when assisted by disinterested and indifferent persons can hardly make the programme a success.

A more realistic approach to the CTBP will be to treat it as a public utility system like water supply and sanitation etc. in urban areas. Manpower could be employed by the state to run the programmes instead of indulging in the academic exercise of seeking people's participation in smooth running of the plants, which is very difficult to realise in practice. Surprisingly, romantic phrases like people's participation etc. are advocated in case of rural areas only. Just because the urbanites are more vocal in their approach, heavily subsidised state services are made available to them and their counterparts in rural areas are ignored.

3. Institutional Biogas Plants

With institutional plants, it is understood that there exists an organisational set up behind the construction, maintenance and running of these plants, which comprises of a group of self-motivated people who are well aware of the needs and benefits of such schemes, and who look after all the aspects rights from construction, maintenance, replacement and proper use of the unit, to the follow-up. The beneficiaries participate only towards the proper utilisation of the facility for which they are often given demonstrations and proper education.

The schools in Gujarat and Maharashtra which are mostly run by trusts have done a commendable job by introducing night-soil based biogas plants in the hostels. Gandhi Gram Rural Institute at Madurai, and Parashakti College for Women, Thirunelveli (Tamil Nadu) are the other institutions which have done a lot to expose the students and their parents to such technologies. Many of these plants were constructed over twenty five years ago and still continue to work properly and are based purely on night-soil.

In addition to the above four categories, we came across two night-soil based plants in hotels at Tumkur in Karnataka. There are two hostels owned by the same person. The first one, Hotel City Woodlands, is located opposite the bus stand and has twenty three rooms, which are always occupied. It has a resident staff strength of 120. About 200 persons use the toilets regularly and the effluents are fed to a KVIC type plant which was constructed

about eleven years ago. The ensuing gas is used in the kitchen of the hotel through a 4" burner for about eight hours a day. There have been no major repairs of the plant except for routine paintings. Encouraged by the performance of this plant, the owner, Shri M.K. Ballukuraya, installed another plant in his new venture, Hotel Deluxe Woodlands on the out-skirts of Tumkur, in 1982. There are twenty four rooms at present in this hotel, with a projection for ninety and 130 permanent staff members of which 110 are residents. The average attached is 30 to 40 percent. There are twenty four toilets attached to the rooms, two toilets for staff and eight in the cafeteria. The gas is used again in the kitchen and the slurry is led to the drain. There are no arrangements to limit the amount of water nor does the owner know that the water input to the plant should be limited. All the rooms are fitted with cisterns for flushing.

Hotel Carlton at Lucknow also has a biogas plant based on dung which is purchased. This was designed by Shri Md. Ibrahim and is of the Chinese type and works satisfactoriyly. The digested slurry is used in the garden of the hotel and the gas is used in the kitchen to make tea for the guests almost throughout the day. Shri Ibrahim is also doing a wonderful job in Khurramnagar village near Luncknow on the night-soil based plants belonging to individuals but with the facility extended to the community.

CHAPTER - V

BIOGAS AND WOMEN

Biogas technology has always been given primary importance to the production of the gas as a fuel substitute, and treated the manure produced as only an incidental benefit. The manure however, has also proved to be an important component, contributing to increased agricultural production where it has been utilised. Women especially who stand to benefit on both counts have been quick to realise the advantages of biogas plants, both for providing a clean and convenient cooking fuel as well as an organic manure for increasing agricultural production. Men however, due to the greater stress on the biogas/fuel aspects do not perceive a biogas plant as a priority input since they are not directly affected, and are largely indifferent towards it.

Various aspects of women's involvement in biogas programmes emerged during the course of the study.

1. Decision Making: installing a biogas plant - Installing a plant means expenditure which is controlled by the head of the family, who, in most cases, is a male member. He alone is approached, educated, motivated and takes a decision to install or avoid the plant. The biogas plant is meant primarily for women, but they do not have much say within the family. What

is true of any other programme is true for biogas too. It was only in Tirunelveli district in Tamil Nadu in the Parashakti College for women that one came across an instance where women took a decision to have a biogas and the male head of the family was 'prevailed upon' to install a biogas plant. This has been possible because the girl students, including those who had graduated, are very active in the field of biogas, right from motivation to supervision of the construction. The college, through its' NSS programme has successfully installed over 2,000 KVIC plants in and around Courtallam and after passing out, the girls are active almost all over the State. It is quite natural for these girls to start the motivation with the woman of the house and the whole decision making process takes a different route. In other places, even installation of a smokeless chullah, which may not cost more than Rs. 60/- has to be approved of by the husband first. The women are not aware of the cost of the plant, the element of subsidy or the way the money is to be arranged. They are also not aware whether any instalments are to be paid or are being paid, or whether there is any financial liability.

2. Maintenance and running of the plant - Dung, the basic ingredient of the input to the plant, is the problem and property of the house-wife. In the absence of a biogas plant, it is her duty to collect gobar, prepare the dung cakes and store/stack them properly. When a biogas plant is installed, only she is responsible for feeding the plant, preparing the slurry, stirring,

composting and drying. When the manure has to be taken to the fields by head-loads, and if labour cannot be engageged to do the job, it is rarely taken on by the males. Even amongst the women, the job is done by the house-wife, the daughter-in-law alone. The mother-in-law will not do it on account of her status in the family, and the daughter will have to do it, anyway, after her marriage and is protected till that time. The plant feeding may shut down for the time being if the house-wife is away and hired labour is not available. Nevertheless, "it is a pleasure to run and maintain the plant" says Smt. C.R. Patel of Ashalali village near Ahmedabad, "otherwise who else will do it... and there is nothing wrong in doing your own job even if it is dirty..... you talk of dignity of labour in America - why not make it America here". Most of the women seem to enjoy the work as the traditional alternatives are seen as a greater drudgery. In community-type plants, the women are ignored at all levels except that they use the facility in case the toilets are connected to the plant and also use the end product - the gas, for cooking. The implementing agencies only perform a ritual, by conducting a meeting of the village women to educate them about using the gas, before withdrawing from the scene.

3. Advantages of the biogas

i) As a cooking fuel, it is more convenient for women. Turning a knob for fuel was thought to be an urban amenity which is now available in rural areas too.

ii) It is more healthy, as the smoke of conventional fuels is hazardous to eyes and causes respiratory diseases.

iii) The kitchen, utensils, floors and walls of other rooms, as well as clothes remain cleaner and it takes less labour, water and time to keep everything presentable.

iv) More time is available to attend to the children and other jobs.

v) Chances of children playing with fire and getting burns are eliminated.

These advantages are listed by the village women but there are other advantages too like (a) lesser dependence on outside fuel, (b) availability of good organic manure and (c) better sanitation facilities if latrines are connected to the plants.

4. Constraints in the use of biogas plants:

i) The rigour of feeding and maintaining a plant is the women's responsibility. Water at times is available at distant points and puts an additional burden of fetching on the women, especially in states like Rajasthan.

ii) Male members do not take much interest in the repairs of the plant if it develops defects. As long as they get their food prepared and served, they do not bother about repairs.

iii) Exploitation may be a harsh word to use but bullying the women in the name of improved facilities for cooking is quite common. They are expected to do more work because of the time saved.

iv) In the families where the cattle shed/farmhouse is away from the normal dwelling, i.e. where the biogas plant is away from the kitchen, the facility becomes redundant.

v) Large size chapatis *like 'Bhakari' in Maharasthra (12" to 15" dia) cannot be cooked well over the existing burners. Alternative fuel is always needed in such cases.

vi) Time regulation of gas supply in large community plants (Khoraj in Gandhi Nagar and Masudpur in Delhi) is also a deterrent and enforces the use of alternative fuel.

5. Connecting toilets to the biogas plant:

Toilet connections to the gas plants are thought to be a good means to improve sanitation, manural contents and gas production. However, except for the states of Maharashtra and Gujarat, and probably Haryana too, there is general aversion to connect latrines to the gas plants, and women's opinions in this regard reign supreme. No reasons could be given for not connecting the toilets to the gas-plants except the aesthetic aspects. The general response in the southern states was that the auspicious dishes and the dishes prepared on auspicious days could not be cooked on the gas from the night-soil, as it is offered to the Gods. In the north, it was just the psychological aversion to the idea.

---

* Unleavened Whole-Wheat bread

In the states of Gujarat and Maharashtra, however, there is no aversion to connecting the toilets to the gas plants. Many women there felt that fire is the best purifier. Some thought it to be a cheap source of fuel and suggested that people never realise the worth of the gas from the night-soil as long as the alternatives are available. If the other sources disappear, everybody will come forward to use it. It was also observed that the toilet connections have got nothing to do with the educational levels of the users. In the Terai areas of Uttar Pradesh where many well-to-do educated families with high social status are settled as farmers, the users are totally averse to the idea of connecting the toilets to the gas plants. Gujarat and Maharashtra have a long tradition of social service and reform movements and this has helped to create an environment where it is easier to propagate biogas technology. From childhood, children are conditioned to seeing biogas in use in hostels in schools and do not need to be 'educated' about it in a formal way. Voluntary agencies have also brought in this innovation in a big way. In other states however, particularly in the North, it will require a more sustained effort to motivate people to utilise human waste as a bio-resources.

In many cases, latrines existed before the biogas plant was constructed and hence not connected to the plant as it would not affect the gas production and also a disposal system did exist, anyway. " we are charged with making money

from all possible sources and not sparing even the night soil" says Smt. Vijaya Mahadevan, a Brahmin house-wife of Tenkasi - Tamil Nadu, whose toilet is connected to a 6 cum. KVIC type plant (Photo No.)

Another factor that comes in the way of toilet connections to the plant is that if the digester is to be emptied even for routine maintenance not many people are available who will do the job, once they know that the contents include night soil. although digested. A similar problem is faced in handling the composts also.

6. Biogas plants and financial security for women:

Dung cakes are quite popular as supporting fuel in the villages and fetch a good price in small towns, the peripheral areas of large towns and even in the towns themselves. Dung cakes are prepared and marketed by the women, sometimes without the knowledge of the husband and even if he is aware of the deals, there is always a possibility that the woman may save some money secretly. When the dung is fed to the gas plant, the end product is organic manure, over which the husband has the exclusive right of ownership. The woman thus loses her share of earning. Feelings becomes bitter if the plant develops defects and does not generate gas but continues to act as a manure pit. This is what happened with Shri Jwala Jatav's plant at Bhawan Bahadur Nagar, Bulandshahr, U.P.

For those women who collect firewood, agricultural wastes, etc. for sale, the construction of a biogas plant results in loss of clientele. At the moment there is a shortage of fuel and the biogas plants also are not too many. It will be of interest to know the plight of such firewood collectors in the areas where intensive biogas programmes are taken up for implementation.

7. Biogas plants as dowry gifts:

Dowry is an all-prevalent social evil and over the years biogas plants have emerged as status symbols. While looking for matches for their daughters, parents are reported to have made enquiries about the plants in the grooms homes. Rural Agricultural Central, Narayangaon in Maharashtra is toying with the idea of advocating biogas plants as dowry gifts. This approach, however, is very strongly ridiculed by Ms. S.Bhagirathy, Principal of the Parashakti College for Women, Tirunelveli who does not want that "biogas be polluted with dowry deaths."

8. The group most sensitive towards the adoption of biogas is married women upto the age of forty five, i.e. the women who are actually involved in cooking food. These women must get the motivational and educational inputs for installing the plants and this could best be done by women social extension workers.

Unfortunately, the motivators are mostly men, who contact only the male members of the family for the purpose.

Gujarat, again, has taken a lead in this matter and the Gujarat Agro Industries Corporation is in the process of appointing women workers for its maintenance and motivation cell.

CHAPTER - VI

FINDINGS AND RECOMMENDATIONS FOR POLICY

Besides the technological aspects, the biogas programme is faced with many other problems which are reflected through illustrations given in this chapter.

1. Acceptability of the biogas:- This has been discussed in detail in Chapter-I but some points deserve further consideration as the gas has varied utility and the emphasis may differ from place to place, region to region and family to family. In tribal areas of Orissa or Bihar, for instance, fuel can be obtained from the forests but it is the kerosene for lighting purposes that is in scarce supply. One has to travel over ten kilometers to get a bottle of kerosene which may last not more than a week and if the labour spent to fetch kerosene be valued at the prevailing minimum wage rate, a litre of kerosene may cost around Rs. 10/- and is more precious than fuel.

The failure of the night-soil based biogas plants at the Goraknpur Railway Station is a classic example of a methodology gone wrong. Aversion towards the use of gas from night-soil is total in the north, in areas of U.P., and without realising it, a railway catering stall was given a gas connection from a night-soil plant. The whole show started with much fan-fair and wide publicity given through news papers and photographs, which

was its undoing. People could identify the stall and the owner and carefully avoided taking tea from that shop. Not even the railway staff and the Gorakhpur Railway Police personnel took tea from there. The owner quickly disconnected the gas but not before losing most of his business and it took him quite some time to be back on the rails again. If only the toilets had been lighted with the gas first, the people might have shown interest in it and other uses could have been introduced step by step, keeping cooking at the end. The night-soil based biogas plant of Sulabh International at Adalatganj, Patna, generates electricity for street lighting from Adalatganj to the Rajbhawan, and a stream of visitors come to see the installation and are often served tea made on biogas burners, and get exposed to all the possible uses of biogas. Technically, there is nothing wrong with the Gorakhpur plant but the planners failed to feel the pulse of the people, even though it was a very good idea to collect night-soil from tracks and feed it to the gas plant.

In the Terai areas of Uttar Pradesh, the emphasis is on using the biogas as fuel to run the pumps for irrigation purposes as the cost of using diesel is prohibitive while the electric supply is erratic. The people are not interested in the lighting or cooking aspect of the bio-gas. Cooking on biogas is quite popular in Maharashtra and Gujarat, even if the source is night-soil.

There is a need to assess the necessity and acceptance level of the ensuing gas in case of the night soil based biogas plants. The use should be encouraged and not thrust on the people. Also, the peoples' acceptance in using the gas from night soil should not be taken for granted in case of community plants.

2. Financial Implications:

a) Subsidy - Besides the subsidy provided for the construction of the biogas plants, as mentioned earlier, some state Governments provide additional subsidy as in Madhya Pradesh, Gujarat, Maharashtra, Himachal Pradesh and Bihar, for the construction of the bio-gas plants. In states, like M.P., the Government bears all the costs of construction of a bio-gas plant for scheduled castes/tribes, and in some other states also, it is heavily subsidised.

The usual procedure is that the recognised agencies in the field of biogas construction approach a farmer to motivate him for installing a biogas plant. The farmer is then supposed to get a "no dues" certificate from the block office that there are no dues outstanding against him under any of the loan schemes, and the papers are forwarded to the local bank who verifies the documents, number of cattle etc., and sanction the loan and informs the block of the decision. The block

then prepares the documents for subsidy transfer to the bank and the first installment is paid to the beneficiary when he has completed digging the pit, and the work proceeds.

In practice, it is not very easy to get the "no dues" certificate from the blocks and a person is also not entitled to take loans for biogas plant if he is a loanee under a different scheme, or is a defaulter for any reason. It takes months for the bank to verify the papers and other relevant documents. Transfer of subsidies from the Government offices to banks move at such a slow speed that the interest paid by the farmer balances the subsidy, in many cases. In the states of Maharashtra and Gujarat, the procedures are simple and the time taken to clear an application is very short.

b) Financial Institutions:

There is a general suggestion that the funding of the biogas plant (including subsidy) should be from one single source to avoid delays and paper formalities at two points.

Banks claim to be understaffed because they cover on an average, forty villages which would mean that an officer can reach every village once in two months, and that too if he is processing the loan applications

for biogas only. The banks also feel shaky about the returns as the biogas is a non-commercial activity and the saving cost of fuel is an academic term. People do not "feel" the savings, as instead of paying for the fuel, they pay the amount to the bank. Delay in the reimbursement of subsidies and erratic or non-payment of loans by the beneficiaries discourages the financial institutions from being enthusiastic for ever. However, recently the Syndicate Bank has taken an out-of-the-way interest in biogas by inviting low-cost designs on a competitive basis, for adoption in rural areas.

c) Misuse of funds:

With a lot of money flowing into the biogas programme, many quacks have entered the business. The construction is done carelessly and also lesser-size plants are constructed with payment drawn for the bigger size. In the Janata type plants, cement is often diverted to house repair and other works as in most cases cement for biogas construction is made available from controlled stocks and hence is relatively cheaper. The sheet thickness in the drums of KVIC plants is also reduced resulting in a lesser life span. All this happens with the full knowledge of unscrupulous

element in business and authority and the owner stands cheated. The drum of a KVIC plant at Viswaneedham, Bangalore, got corroded within three months of its installation (photo No._____) and was never replaced by KVIC. This is when Viswaneedham wields much influence in official circles. The story of Rajla and Bardaun villages of Jhilar block in Nawadah district (Bihar) is similar, where the adivasis could not get their plants commissioned because the contractor could manage to get the payments and abandoned the site. It is suggested therefore that:

i) Liberal subsidies should be made available to connect the latrines to the biogas plants. This is already being done in the state of Maharashtra.

ii) Payments of subsidies and loans should be done through single institutions to avoid delays and duplication of formalities. At present, the block offices and the banks are both involved in the process of funding and it takes a longer time to get clearance from the two sources.

iii) Loans for the construction of biogas plants should be treated as independent of the other agricultural and crop loans and money should be advanced to the beneficiaries irrespective of their being loanees on other counts.

iv) The Government Biogas Supervisors are all ill-paid and not provided with any working facility. They are not even paid for travelling to the villages and the HQ for reporting. (Karnataka-Uttar Pradesh).

v) The implementing agency or the individuals are paid a fee of Rs. 200/- for each plant constructed after it runs successfully for one year. This is grossly inadequate, at least in case of remote areas. Gram Vikas (Berhampur, Orissa) spends not less than Rs. 800/- per plant in tribal areas under their operation. This fee should be raised accordingly.

vi) The stakes of an implementing agency and the activator are restricted to Rs. 200/- and Rs. 300/- per plant but the owner of the plant incurs a minimum expense of Rs. 3,000/-. If the plant does not work, for any reason, he stands cheated. There should be an insurance cover for proper running of the plant to the extent of thorough repairs or even replacement, till the period of repayment of loan installments is over.

vii) Loans and subsidies should also be available for the replacement of corroded drums in case of KVIC plants.

3. Training programmes - Two types of training programmes are run by the state governments and some of the voluntary organisations. One is a condensed course for supervisors of biogas programmes for a period of two weeks. There are generally the block engineers/overseers, Junior

Engineers of Government departments like Rural Engineering, Assistant Development Officers and trainees from voluntary organisations. The training is mostly technical in nature to enable supervision of the construction. The extension, motivation, economy, maintenance and follow up are side tracked and are only talked about, and there is scope to improve the training courses in these aspects. Similarly, the training programme for masons also is run normally for abou three weeks, and they are given an on-the-job training. During this period only, the trainee mason gets an opportunity to work on the construction of two plants. The quality and duration of both these courses are inadequate. " A traditional mason starts getting training at the age when he can carry only one brick; at the age of about fourteen he starts rough plastering; fine joinery and plaster at the age of eighteen, and becomes an expert around twenty" suggests Prof. Arun Sarpeshkar of the Agricultural Engineering Department of U.A.S. at Bangalore. "The finer skills can't be transferred in just twenty days". By the time the mason becomes an expert in biogas plant construction, he has already ruined many plants if the quality of supervision is poor.

Such skills are cultivated rather than learnt. Although the Government subsidises heavily the cost of training a reasonably good hand can early about Rs. 50/- per day in

Ahmedabad, Rs. 40/- per day in Bangalore and Rs. 60/- per day in Trichur and will not waste his time to get a petty stipend of Rs. 25/- per day to acquire a skill which he may not use on a regular basis. The training programme should be made more lucrative for the masons. Subsequent to the training, there is no liaison between the masons and the block officer, and they are left to fend for themselves. If they are also given some monetary incentive like the supervisor, the performance may improve. The training periods for masons could be increased for one month. In case of supervisors refresher courses should be arranged.

Training courses for the personnel, both supervisory and the masons, should be streamlined further with adequate emphasis on post-construction care and follow up. Such assistance must be available to the beneficiary at the block level, at least.

4. Conventional and alternative fuel and biogas: - The economics of biogas is projected with reference to the purchased fuels like coal, kerosene and firewood which can be correctly priced for the purpose of analysis. The farm residues, roots stumps and many other items, which are used as fuel, are not priced and a major chunk of the rural population who can afford a biogas plant also has an access to the alternatives which are available almost free for a major portion of the year. Even

when the biogas is in use, these alternative fuels find their way into the kitchen, for not all the dishes can be cooked on the biogas. If the plant develops any defect, the standby fuel takes over the biogas and the changes of repairs of the plant recede. Despite the analysis on paper, the photographs (1 & 2) amply depict the winning fuel. In the first, the biogas plant is buried under the twigs and in the other, the dung cakes are piled near the gas plant.

Two other programmes, which do not compete with the biogas and are complementary to it, need serious consideration:

a) Smokeless improved Chulah - All said and done, it is unlikely that the benefit of biogas can be taken beyond one third of the population and reliance on conventional fuel will continue. Agressive efforts will have to be made to improve the performance of chulahs in villages. Simultaneous intensive programmes on smokeless chulah will reduce the pressure on the available fuel. Academic and research institutions through NSS, and voluntary organisations could launch a massive programme for this purpose. This is cheaper, more relevant and likely to show immediate results.

b) Energy Plantation - Even with smokeless chulahs, fire wood will be needed and as a consequence, energy plantations need to be encouraged. People need to be educated about energy plantations to solve fuel problems for individuals and the community.

5. Ascertaining availability of raw materials and proper feeding of the plants:- The individual plants are not much affected because of the lesser inputs, as the owner may take personal interest in running the plants. There are many unrealised factors governing inputs. Seasonal variation in dung output, exodus of bullocks in crop season, allowing milch cattle to graze in off seasons etc. would result in irregular supply of dung.

In community type biogas plants, this issue takes on a serious proportion. Initially, every thing starts on a good note. Suddenly, something goes wrong somewhere, the feeding is suspended and the plant gets totally or nearly defunct. The worst should be anticipated in advance and the size be cut accordingly. There is always a possibility of adding one more plant if the programme picks up on a smaller scale, but nothing can be done to revive an oversize plant economically. The temptation to go in for a single large size community type biogas plant should be avoided. The initial approach should be modest, with a possibility of future extensions and multifications.

6. Maintenance mechanism and follow up: - There is a need to exphasise the maintenance mechanism which is as important as the construction. The demonstration value of a defective plant is more pronounced than a good working plant. In Kuarasi

village near Aligarh, nine Janata type biogas plants were constructed 'under AFPRO's training programme and one was repaired.

One of the trained masons constructed the elevanth plant which proved defective and was giving no gas to the owner. This plant was the main topic of discussion during our visit, and the other well functioning plants were virtually ignored. Just because it was an AFPRO programme, it might have been corrected, but what happens where no such support is available? We came across instances where the gas production was low, slurry appearing at the burners, disappearance of flame when the utensils were kept over the burners, and all this was happening over six to ten months without being attended to by anybody.

Apart from the gas, the manures also have their own problems. "The fertilizer from the biogas plant accelerates vegetative growth" report farmers of Sundarpandian Puram in Tamil Nadu. Rajendra Prasad Sharma of Chhaparawat village in Bulandshahr district applied the digested slurry from the plant to his fields. The wheat crop grew so well that it collapsed under its' own weight while it was green and the entire crop was lost. Nobody guided him that the slurry should be diluted before application, for proper results. He learnt it eventually but only after losing the crop. In the absence of proper follow up, such accidents are bound to occur.

There is a need for manpower at the block level which will look into the grievances and problems of the biogas users, and whose sole job will be to ensure the proper functioning of the plants under his jurisdiction. Most of the time of the biogas supervisor at the block level is spent in processing the applications and construction of the plant. The construction and maintenance should be separated, even if it costs the exchequer more. The extra cost would be offset by the benefits received.

Maintenance of community plants is far more complex and requires organisational skills. Collection of inputs, distribution of the gas and manure, arranging for water, maintaining accounts and attending day to day problems is a skilled job in itself. At present, no community biogas plant where people's participation in management is sought, is economically viable and these are far from being satisfactory, although highly specialised manpower and expertise is involved in maintenance. The problem will arise when these installations are passed on to the villagers after a period of time. It is too early to comment but if the people are clever they will not accept the responsibility of running a plant like Karuthaiyagoundan-Patti Khoraj village in Gandhinagar where the Gujarat Diary Development Corporation (GDDC) has constructed a KVIC type 140 cum. plant, (of which only 40 cum. is being utilised) at a cost of Rs. 4 lakhs.

The difference between the overheads and the revenue is to the tune of Rs. 2,000/- p.m. Only 144 persons (not families) are benefited by the gas, charged @ Rs. 7/- per person. The net monthly revenue from the manure is about Rs. 1,350/-. On the expense side, 2,500 Kg. of dung is purchased every day @ Rs. 0.05 per Kg. costing Rs. 3,750/- p.m. It is expected that the expenditure on maintenance of staff is Rs. 725/- p.m. It is expected that when 140 families are given connections, the installation will make some marginal profit. Obviously, the interest over the capital and the depreciation funds are not taken into account. "We are not going to take it over unless GDDC establishes that the plant runs on profit" asserts Shankar Bhai, Secretary, Khoraj Co-operative Society.

7. Biogas and the poor:- A family size biogas plant requires at least three to four cattle and the space to construct the plant to qualify for state assistance. This means that the landless peasants are out of the picture and so are the small farmers, as only about 20 percent of the Indian population possesses four or more cattle. Unless successful community type plants are run, there is little possibility that the poor will be directly benefited by the programme. In Shigli village in Dharwar District (Karnataka), there are twenty five gas plants and the poorest owner of a gas plant possesses 24 acres of land. The picture is not very different at other places.

8. Overenthusiasm also leads to trouble sometimes as has happened at the Guruvayur Devaswom in Kerala. A KVIC plant of capacity 60 cum. is installed in a temple complex which was supposed to derive inputs from 39 elephants owned by the temple, together with 24 cows. The elephants are lodged at Ponnattur fort which is at a distance of 3 Kms. from the plant site, and elephant dung slurry was supposed to have been brought to the plant in metal drums by cart loads. This has led to an added labour component and once the initial enthusiasm subsided, the Dewaswom found it too uneconomic and cumbersome to bring the slurry from Ponnattur to the plant. To top it all, the number of cows has been dwindling and stood at 6 on the day of our visit; the rest are being auctioned. The plant which was supposed to have supplied gas to 40 families on a four-hours daily basis initially, could only supply gas to 19 families to whom connections have been given so far, for one hour only in the morning. This was the current situation at the time of our visit in February, 1984.

Whereas the Devawom feels that it now owns thirty nine black elephants and a white, and blames KVIC for painting a rosy picture and thrusting the plant on to them, the KVIC blames the Devaswom administration for going back on its word and not feeding the plant properly. What is important is that it should have been realised in the beginning that carting slurry to the plant from a distance of 3 Kms. would create problems.

Technology gets blamed, unfortunately, for administrative/ managerial lapses. However, it may not be out of place to mention that the elephant dung washing mechanism at Ponnattur is too primitive, resulting in disproportionate dilution of the slurry,(Photo_____) and the gas output is bound to suffer even if the slurry could be transported to the plant. The approach towards such schemes should be realistic as these have a high demonstration effect.

9. Role of voluntary organisations:- Voluntary organisations have a great role to play in the implementation of the biogas programme and, in fact, many such organisations are quite active in this field, although no such organisation is exclusively working on biogas alone. In almost all the cases, it is a part of the overall development process which makes their job easier, because there already exists a rapport with the people on other issues and problems and the biogas or sanitation is another offshoot of development. As mentioned earlier, sanitation is not a priority in the minds of the people in villages and it is very very difficult to enter a community with a view to serving it while making a beginning with sanitation, or for that matter any programme which is material-intensive. The picture of an agency that emerged out of such material-intensive programmes is that of a group or an individual who can pump in money when needed. The whole approach gets money oriented and not programme-oriented. Thus when the money supply is withdrawn or gets

restricted, the programme crumbles under its own weight. There is more freedom to take decisions and correct oneself without being unduly bothered by others in voluntary organisations. The workers are there because of their commitment to the cause, with deep rooted sympathies for the people.

Most of the successful biogas programmes are run by voluntary groups in the country - AFPRO, Grama Siri (Andhra Pradesh), Gram Vikas (Orissa), MYRADE (Karnatake), Sulabh International, Maharashtra Gandhi Smarak Nidhi, Centre of Science for Villages, Wardha, to name a few.

Unfortunately, the official approach into a community is with a definite programme for implementation. They neither have the patience nor the time to take people with them. The beneficiaries also do not care much except to nod their heads in affirmation, when they get a hint that they need to do so; this is termed people's participation. Periodic reviews are done more as routine than to really introspect and even then, if somebody is doing a good job, he is quickly transferred to an insignificant place or pottery unit the next time and in the process, both the departments suffer.

10. Accidents and biogas:- Accidents are not very common with biogas yet a few cases have been reported of falls into the inlet/outlet of the Janata type biogas plants where the size of these components allows slipping into the digester. Adequate

precautionary arrangements are warranted in such cases. A girl is reported to have slipped into the digester of the biogas plant and died in the village Mirzapur near Kasturbagram in Indore district in 1983, and Lakshmi, daughter of Chote Lal slipped into the biogas plant in Asaraved Village (Indore) on the 8th January, 1984. She was spotted and promptly rescued. A similar accident occured with Dhondiba Bihika Hagawane of Dehu (Pune) in November 1983. He was pulled out by the women around, after raising an alarm. All this calls for immediate grilling of the inlet and outlets in case of Janata plants. No feeding should be permitted unless precautionary steps are taken. Calves, lambs, dogs etc. fall quite often into the pits and pulling them out is a tough exercise.

11. Welfare programmes for women and children: - Parashakti College for Women (Tirunelveli) conducts some mid-day-meal programme for school children through its volunteers. Each student brings a bucketful of gobar to be fed to the biogas plant, thus paying for his own fuel, and the fuel cost which at other places is a burden, is almost eliminated altogether. Similarly, in Seldo village (Wardha-Maharashtra), a twelve seat community latrine, connected to a KVIC plant used exclusively by about sixty village women, supplies gas to a Balwadi comprising sixty children. The gas is sufficient to cook the tiffin for the children once a day. The village panchayat has arranged for the water and the overall maintenance is looked after by Tanai Ashram, founded by Dr.J.C. Kumarappa. The saving on fuel is to the tune of Rs. 400/- p.m.

The two examples open avenues for savings, co-operation and comfort by making use of biogas technology; such programmes are run almost all over the country with a varying degree of magnitude and offer a unique opportunity to expose children to environmental sanitation and save women from the humiliation of finding a hideout.

12. Leadership potential in Villages: - Local leadership can play a very vital role in the process of development. Anna Saheb Hazara of Ralegan Shindi village, taluk Parner, district Ahmednagar (Maharashtra) was formerly a driver in the army. Of humble appearance but with strong commitment, he has been able to change the face of his village within a span of ten years. It was a village of illicit distillers with forty units in operation in the village. Now there are none. Thirteen check dams and eighty two wells were constructed to bring 800 acres of land under irrigation. One high school, a bank, a destitute home accommodating forty-two women and children, and an assembly hall (which is a part of the village temple) has come up during this period. Locks are not used and there have been no court cases for the past seven years. Fruit trees are planted on common land and distributed equally in the village; even children do not pluck for fun. Vegetables grown are exported to Kuwait and Muscat. Marriages are collective, costing not more than Rs. 650/- per couple. Four landless families were given land and the houses were constructed for them by collective efforts.

With this background, 28 biogas plants, of which three are community type were constructed within a span of three months in 1981 with the assistance of Maharashtra Gandhi Smarak Nidhi, and all of them are working satisfactorily.

13. Targets:- Targets have to be fixed for a programme to proceed in a planned fashion and these have to be realistic. Responsibilities of each of the functionaries have to be defined and proper facilities should be provided. In Uttar Pradesh, for example, a VDO (Village Development Officer) is responsible for achieving the targets at the field level. He is only a glorified Patwari* with no power and eventually people do not pay much attention to him. He is not entitled to any travel or daily allowances when he goes to the headquarters for consultation and is not provided with any vehicle, not even a cycle. The targets achieved in such a background can only be quantitative and at the cost of quality. Targets should be realistic and the emphasis should be on the quality of construction rather than on numbers. Out of twentyfive plants constructed in Asaravad village in Indore, the owners of four plants do not have any cattle. The owners are not aware of the cost involved nor do they know how to feed the plants. Many of these plants were constructed under 100% subsidy available for SC/ST, obviously to achieve targets.

---

*Village level accountant and clerk

14. Academic Institutions:- There is a possibility of involving the academic institutions in a big way through the National Service Scheme (NSS). The NSS volunteers can be given a thorough orientation towards sanitation and biogas to act as catalysts in their respective areas. "The NSS Programme should be taken up on a national scale for at least two years, oriented only towards biogas" feels Miss S.Bhagirathy of Parashakti College for Women and Prof. V.M. Jhala of Vivekanand College,Ahmedabad suggests that such programmes should be given proper academic credit or, at least, a good certificate at the completion of the programme may be given to students so that they get involved more deeply. Such involvement will enlighten the students and benefit the village.

a) Extension departments of agricultural universities and colleges could be given the necessary back up to spread their activities into the villages and, as far as possible, be manned with persons with concern for the people and the programme with an ability to identify themselves with the poor. Tamil Nadu Agricultural University at Coimbatore and its' adopted village Idikarai is one example of good extension work.

b) National Institutes like the IITs and leading Agricultural Universities should lend their active support to the implementation of such programmes.

c) Mass media coverage, audio-visual aids, documentaries, street plays and propagation through ratios/TVs should be launched on a massive scale to spread the message to remote areas and to cover larger populations.

d) Environmental Sanitation/Biogas etc. should be introduced in curricula at the primary school stage itself, and the students should be exposed to such technologies, through demonstration plants, at early stages.

e) Academic institutions should be provided with the gas plants and the gas could be used in the laboratories or kitchens. As it is, the buildings in academic institutions are heavily subsidised. The same support could be extended to the biogas plants also.

15. Recommended areas of research:

a) Alternative cheaper material for the floating gas holders should be researched. The work is already in progress as far as fibre-reinforced plastic (FRP) high density polyethelene (HDPE) and poly vinyl chloride (PVC) is concerned.

b) Carbon-nitrogen ratio in case of gas production from the night-soil does not conform to the present theory of gas-generation as referred to in the gobar gas plants. Even with low carbon/nitrogen ratio, the gas production is not affected in case of night-soil based gas plants. This phenomenon needs probing.

c) Water input to the night-soil based biogas plants is another field of research. It is observed that the addition of water beyond the prescribed limit does not affect the gas generation alarmingly.

d) The gas pressure is variable in case of Janata biogas plants which results in variable fuel efficiency. A suitable design for burners has to be evolved to accommodate variable pressure.

e) It is being reported from several sources that the pathogen content of the faeces is drastically reduced after anaerobic digestion for 30 days. This would mean that disposal of night-soil via biogas plants would become a significant tool for the control of communicable diseases in a a country like India where 50% morbidity results from faecal contamination of water and environment. Detailed studies need be taken on this aspect.

f) The KVIC model has lost its' popularity because of its' inherent shortcomings and the emphasis is now upon the Janata model. The time is now ripe to evaluate the performance of the Janata model on a field-responses basis before leaping into the programme in a big way.

16. Plans should be formulated to construct one biogas plant at least, in every village of the country to act as a first hand demonstration and information unit.

17. With the ongoing programme, the choice of technology should be left to the beneficiaries. It has been observed that, with most of the agencies working in the field of biogas, a particular type of model is pushed through and there is a fierce difference of opinion regarding the suitability of the models amongst various groups and individuals.

18. Jeepable roads and their fringe areas mark the limit to which official inputs can reach. This is a fact to be appreciated by all. The role of voluntary agencies starts where the official accessibility ends. Such areas should be pushed to the voluntary groups.

19. Women have a big role to play in the field of biogas. Involving more and more workers in the motivation and education process is likely to yield better results.

20. When an intensive programme is taken up in an area, the beneficiaries, especially the women, must be given courses in minor repairs and maintenance, apart from the proper use of the facility.

21. People in villages suffer from ' claustrophbia' since they are used to living in open and vast surroundings. This takes a more serious proportion when they are brought to latrines which may not measure more than 12 Sq. mtrs. This is purely a matter of habit and will take a long time to change. Infants and the old can not be brought to the closets easily.

22. Among people of some communities, there are social taboos to be overcome. For instance, the daughter-in-law will not use a latrine visited by the father-in-law and that would mean the construction of two such closets. This deters many from constructing even one.

23. Many people, including a large number of the educated have wrong notions about biogas: that all the raw materials are convertible to gas and that all energy needs can be met

with a few inputs. Such people are greatly discouraged when told about the inputs and become negative carriers of the message.

24. Plants based on migrant cattle populations often get defunct because the cattle migrate to greener pastures in far distant places. This is quite common in Rajasthan and care should be exercised in the estimate of raw materials in such areas.

25. Certain individuals and groups view the entire programme from a purely commercial angle and feel that the traditional village trader approach based on profitability may work in the villages. In towns, large villages and semi-urban areas the propagation could be based on modern management techniques, with promotion agencies involved commercially. The user, individual or community, is to be treated as a customer only. This approach may further corner the benefits of biogas to a still smaller percentage of the population comprising of traders and businessmen.