CHAPTER - II

INTRODUCTION

(A) Bio-gas Technology and Indian Rural Life

1.0 BACKGROUND ANALYSUS :

The most common problems faced by the average Indian farmer are the shortage of fertilizer on the agricultural front and prohibitive cost of fuel on the domestic front. Quantitative shortage of fertilizers is not the only problem, quality of the fertilizers, i.e., their ability to enrich the soil-mass with organic matter is also an important consideration. Regarding domestic fuel the important considerations are economic, ease of availability and hyganic safety.

In this context cattle dung is found to be of great advantage. Cattle dung contains a rich source of energy which can be extracted and used as a fuel. The cow dung contains a gas called methane which has very high calorific value. This gas is called as the 'Bio-gas'. After extracting the biogas from cattle dung, the remnants are natural manures of rich organic content.

1.1. NEED OF BIOGAS TECHNOLOGY :

The first and foremost objective of the biogas technique is to obtain fuel and mannure at as low cost as possible, using as simple machinery as possible. Excreta of cattles can

be used, for this purpose, with advantage. Anaerobic fermentation of the above excreta is a biological process and if the same is carried out in a controlled manner, it would give an unending source of energy.

To do this, the excreta should pass through, what is called as "Bio Gas Plant". The Biogas plant will take away from the excreta methane gas which can be stored in a gas holder and leave remnants as a slurry which is very rich in nitrogen and humus. Thus fuel and manure are obtained at a low cost.

1.2. PROBLEMS OF THE INDIAN AGRICULTURAL AND RURAL LIFE :

Following are the main problems faced by the Indian agriculturist :-

i) Poor yield per hectare.
ii) Inadequate irrigation facilities.
iii) Insufficient application of organic manure.
iv) Power shortage e.g. frequent power failures.
v) Shortage of cooking gas and kerosene.
vi) Inadequacy and high cost of chemical fertilizers.
vii) Unhygenic village environment.
viii) Time consuming cooking methods.

Desirability of finding out alternative source of energy, preferably renewable type and also of a low cost fertilizer, is quite obvious. Amongst the several alternatives so far biogas may prove to be one of the principal alternatives.

1.3. IMPORTANCE OF BIOGAS TECHNOLOGY :

Biogas is one of the important forms of non-conventional and renewable source of energy. Biogas is a colourless, imflamable gas, produced by the decomposition of organic waste and biomass fermentation. Biogas can be produced from animal and human excreta, plant waste, weeds, grasses, leaves, aquatic plants and crop residues. Use of biogas technology gives valuable manure besides providing clean and hygenic environment.

Coming to the fuel angle of the problem in India today the average consumption of domestic fuel in India is estimated at about 0.25 tonnes of coal equipment. Of this, the actual supply, according to Khadi and Village Indistries Commission (henceforth called "KVIC") comes roughly from -

Coal	25%
Oil	5.6%
Cattle dung	32%
Agricultural residues like wood, dry leaves etc.	34.4%

In vilages oil and coal are not available sufficiently. Naturally the pressure is mainly on fire-wood, dung cakes and agricultural residues. Today out of the total estimated 980 million tonnes of cattle dung produced in the country over 30% is burnt in the form of cattle dung cakes. If all this could be converted to biogas and manure, the country's supply of

organic manure will increase by 114 million tonnes. Besides this it will give enough fuel for the kitchen of 27 million families in villages.

One of the important causes for which an alternative must be found is insufficient application of organic manure to the soil. While the immediate result of application of chemical fertilizers is easily seen, its harmful effects come to notice rather at a later stage. As years pass a stage of diminishing returns sets in soil and it does not respond to the fertilizers unless more and more fertilizers are used. It is feared that as more fertilizers are used year after year, the soil may perhaps be damaged permanently. Rising prices is another important factor against the use of chemical fertilizers. This is the main reason why organic manure is found to be a better alternative to chemical fertilizers.

Persistant power failure during the eighties has totally disturbed the industrial life and adversely affected the agricultural activity. This is the second important reason for an intensive search for alternative form of energy.

Third important reason for finding alternative energy sources is increasing shortage of cooking gas and kerosene.

Against this background, biogas technology is found to be very useful as an alternative. It was introduced by KVIC from the days of world oil crisis. Gandhiji's followers

persued it after Independence for adoption by the rural as well as urban population in India.

1.4. BIOGAS TECHNOLOGY AND RURAL LIFE :

In Indian village, the most common traditional instrument for cooking is the mud stroves or "Chulla" (made of "Mud") using fire-wood, cattle dung-cake and occasionally kerosene, as fuel sources. Apart from the faut that this "Chulla" has low effeciency in respect of energy due to undirected wavering flame and excessive fuel feed), what was most complained of by women was the physical hazard and the time consuming nature of the exercise under unhealthy and difficult situations. All the smoke from this inefficient stove or chulla attacks the eyes of woman, throat and lungs. The woman complaints that her eyes get burned and watered due to smoke. Almost all the women using the traditional method of cooking complained recurrent cough, respiratory infections and some even complained chronic bronctitis. When cooking is done inside not only the smoke density is unbearable but the heat produced is more intense and stiffing. Often when the woman stops to rub her eyes for a moment, the fire in the chulla extinguishes and she has to start the process all over again.

The pipe that was used to blow air in to the fire was another botheration. As the woman blows into the fire through the pipe, the smoke and ash comes back into her eyes and

mouth. Often the index finger of the woman gets burnt while feeding fire wood and can even burn her clothes. The woman has to sit close beside the 'Chulla' during the whole process. The woman also complains about the blackening of the walls and utensils cleaning more of their cleaning time.

1.5. BENEFITS OF BIO-GAS PLANT :

A) Social Benefits : Biogas plants have changed the situation dramatically for the woman in the following ways -

1) It brought the woman indoor for cooking.
2) As there is no blackening of walls and utensils, the ardous of job of cleaning is done away with.
3) Because of the readymade fuel like biogas, almost 50 to 75% of the cooking time is saved.
4) The woman seems to be happy about having banished the traditional chulla which has improved her health and saved medical expenses.

B) Economical Benefits : The house hold decision-making as far as investment or any other matter related to income and expenditure is still dominated by the man, particularly in Indian villages. But the man feels happy when he finds the woman at home (his wife/mother etc) happy with biogas plant. The economic benefits that accure may be summrised thus -

i) Savings in medical expenses.
ii) Reduction in fuel cost.

iii) Saving in cost of fertilizers.

1.6. SCIENTIFIC BASIS OF BIO-GAS PRODUCTION :

Biogas plant is a device for conversion of fermentable organic matter, in particular cattle dung, into combustible gas and fully matured organic manure. This is achieved \subjecting the material to anaerobic fermentation.

In biogas plant the whole system is based on continuous operation. The fermentation, if it is to proceed in the best possible manner, has to be arranged under certain specific conditions. Before all these factors are discussed it would be advisable first to see what happens during fermentation.

Cattle dung, night soil, poultry or piggery droppings and such other fermentable materials when confined in a place, out of contact with oxygen, give rise to a large number of bacteria. Broadly, these bacteria can be divided in to two groups :-

A) Acid forming Bacteria : It converts carbo-hydrates protens, fats into volatile acid and in this process produces carbondioxide. Without this phase the subsequent gasification will not be possible. Liquification is brought about by a set of saprophyic bacteria by means of extracellular enzime. These bacteria are not very sensitive and they thrive in wide range of circumstances.

B) Gasifying Bacteria : When first set of bacteria leave the work, the second set of bacteria takes over. These are called methane bacteria. They work upon this material with the help of intracellular enzime and convert it into methane and carbondioxide. These bactria are rather very sensitive to temperature. As a matter of fact the entire process is governed by a set of factors.

1.7. TEMPERATURE :

It is found that the process of the digestion and gasfication proceeds at the highest rate when the temperature is around 35°C. When the temperature falls the process of digestion is retarded and below 15°C it is reduced so much that the gas plant produces very little gas. That it is experienced that in winter gas production is considerably depressed.

As India is placed in the tropical region, the optimum temperature of 35°C at which best fermentation could be derived is achieved without special efforts or additional expenditure.

1.8. RETENTION PERIOD :

The retention period is the time for which fermentable material resides inside the digester. This period ranges from 35 to 40 days depending upon the climatic conditions. Ordinarily it is observed that maximum gas production takes

place within the first 4 weeks and then it tapers off gradully.

It may be noted that the retention period could be considerably reduced, if the temperature could be raised or contents of the digester are augmented. The retention period for night soil need not be more than 30 days because of the high nutritional value of the matter.

1.9. TOXIC SUBSTANCE :

As regards the amount of gas that may be expected per animal, it should be borne in mind that it is a very difficult proposition to exactly mention the amount of gas. Similarly the composition of cattledung or animal dung may vary according to the feed given to it. Nevertheless some broad concepts can be given and an attempt is made in the following table.

Table-1.1. : Statement showing Gas obtainable from Various Sources.

Source Animal	Availability per day	Gas per Kg. Kg. (Cft)	Gas per animal per day (Cft)
Cattle	10 Kgs	1.3	13
Night Soil	400 Gms	2.5	1
Pig (40 Kg.wt.)	2.25 Kg	2.8	6.3
Poultry (2 Kg.wt.)	0.18 Kg	2.2	0.4
Spent deep litter (from poultry) dry		5.3	

Source : Bio-Gas : Retrospect & Prospets (KVIC Publication)

The amount of gas available from kitchen waste or flaying waste will depend on the composition and concentration.

1.10. CONSTRUCTION OF BIOGAS PLANT :

Biogas plant consists of two main parts -

i) Digester and

ii) Gas holder.

i) Digester : It is a sort of well, of a masonary work, dug and built below the ground level. Depth of the well is about 3.5 meters to 6 meters and its diameter varies between 1.35 meters to 6 meters depending upon the quantity of materials to be fed in. This well has a partition wall in the middle dividing it into two semi-circular compartments. Two slanting cement pipes reach the bottom of the well on either side of the partition wall and have their openings on the surface of the ground by the side of the top of the well. One pipe serves as inlet and other as outlet. Cattledung is mixed with water in the proportion of 4.5. This mixture is led down in the inlet pipe and as the well gets filled up, equal quantity of dung slurry flows out through the oulet pipe, the outlet opening being lower than inlet and thus it remains submerged in the dung slurry. It may be noted that the well is so designed that it can hold 30 to 50 days material. Initially it is filled up so that whenever any material is put

in from one side, equal quantity goes out from the other.

ii) Gas-holder : Gas holder is a structure like drum, constructed of mild steel sheets. It fits like a cap on the mouth of digester where it dips in the slurry and rests on a ledge provided inside the digester for this purpose. The drum collects gas which bubbles out from the cattle-dung-slurry put in the digester. The drum rises as the gas is collected in the gas holder. The gas so accumulated flows out through the pipe. This gas can be led to the kitchen or can be used for gas lamps whenever required. In its up and down movement, the drum is guided by a central guide pipe; gas formed is otherwise sealed from all sides except at the bottom. The gas which accumulates inside the drum is under pressure equivalent to the weight of the drum.

1.11. BIO-GAS PLANT : PRODUCTS AND THEIR USE :

Biogas plant produces (i) Gas and (ii) Manure.

i) Gas : The gas that is produced through biogas plant can be used as fuel for heating or lighting or for motive power. Biogas consists of approximately 55% methane and 45% carbondioxide. As the composition of this gas is different from the coal gas or burshane gas, the appliences like burners or lamps to be used have also to be of special design. The biogas cannot be filled into cylinders. The bigas can also be used for running oil engines. For this the quantity of gas

available must be sufficient. On an average 425 liters of gas is required per Horse Power per hour. Water pump or a generator can be connected to the engine.

For converting internal combustion engines (diesel/petrol/kerosene type) to the gas engines, a special attachement has to be fixed up. The engines suitable to run an duel fuel. (Diesel and Biogas) are being manufactured by M/s Kirloskar Oil Engine Ltd. Pune. In such engine the use of diesel and gas is informed to be in 20:80 proportion approximately.

ii) Manure : As regards utilisation of the manure, it can be done in various ways.

The outlet slurry as it comes out is quite rich both in nitrogen and humus. It can most profitably be applied to the farm directly by mixing with irrigation water. This way maximum benefit is derived from the manure because nitrogen content of fresh slurry is over 2% and it is in a condition to mix with soil very well. When the slurry cannot be used with irrigation water it can be used for rapid fermentation of compost.

The Biogas manure can also form a good organic base for enriched manure, i.e., by enriching the manure with chemical fertilizer like ammonium sulphate, superphosphate etc., a very fine organic base manure mixture could be produced.

1.12. ROLE OF SHIVSADAN SOCIETY IN IMPLEMENTATION OF BIOGAS TECHNOLOGY :

Shivsadan Grihanirman Sahakari Society Ltd., Sangli (henceforth called "Shivsadan Society") has played a positive role in implementation of biogas technology in Sangli and the surrounding districts like Kolhapur, Satara and Belgaum, Pune and Solapur.

Started in the year 1969, Shivsadan Society has, up to 30th June, 1989, constructed more than 9,000 biogas plants in the six districts mentioned above. It comes to more than 600 biogas plants every year on an average. This is in addition to the work done by Shivsadan Society in respect of construction of perfabricated houses, latrine and bathroom units, compost pits, water storage tanks etc.

Shivsadan Society's construction in spreading the biogas technology in the rural area of Sangli, Kolhapur, Satara and Belgaum districts, on the face of it, was found to be positive. The Researcher, therefore, thought it appropriate to study the work done by Shivsadan Society in this respect and its impact on improvement of rural life.

(B) Methodology :

Scope and Objectives of the Study :

Scope of this research study extends to the work done by Shivsadan Society in respect of improving rural life by adoption and implementation of Bio-gas Technology. Production

of gober-gas plants and their installation at the site of the customers is an important activity of Shivsadan Society. The Society has done this work in the districts of Satara, Sangli, Kolhapur, Solapur, Belgaum and Pune. Work done by Shivsadan Society in respect of bio-gas plants in Satara, Sangli and Kolhapur Districts during the last 6 years ending 30th June, 1990, was found to be above 90% of the total work done. These districts, therefore, received the Researcher's attention most and the effect of bio-gas technology on improving rural life was studied with the help of a sample survey conducted and the expert opinion obtained from three experts in this area.

Objectives of this study were :

i) To study the work done by Shivsadan Society in respect of adoption and implementation of bio-gas technology;

ii) To study the effect of bio-gas technology on improving rural life and

iii) To make suggestions for improvement, if any.

Methods of Data Collection :

Data were collected using the following methods :

I) Data were collected from the office of Shivsadan Society. Data pertaining to work done for institutional customers were not available for all the years. A list of individual customers, particularly for the six years ending 30th June, 1990, was prepared from the Registers maintained by the Society. Financial data were mainly

collected from the Annual Reports of Shivsadan Society.

II) A survey of 100 sample customers obtained from Satara (50), Sangli (30) and Kolhapur (20) Districts was conducted. A schedule, prepared in advance, was used for this purpose. For this, multi-stage and quota sampling method was followed.

Population involved in this research project was quite large. It was 6672 customers in all the six districts for the six years ending 30th June, 1990. Multi-stage sampling was done wherein, firstly, three districts of Satara (51.5% of the plants), Sangli (28.4%) and Kolhapur (11%), with due weightage to the proportion of work done, were selected. In the second stage seven talukas from these three districts were selected giving due weightage to the work done. From Satara District, Karad, Patan and Jaoli Talukas were selected. From Sangli District, Miraj and Tasgaon Talukas were selected. Shirol and Hatkanangale were the talukas selected from Kolhapur District. In the third stage 100 customers were selected on quota-sampling and convenient sampling method from 17 villages of from the above mentioned 7 talukas. This type of sampling had to be followed mainly because the population involved (Satara 3174 + Sangli 720 + Kolhapur 539 =) was as high as 4433. The population involved was quite large and it

was not practical to maintain percentage at the time of selection of the sample. Hence quota sampling was followed by taking 50% samples from the villages in Satara District, 30% samples from the villages in Sangli District and 20% samples from the villages in Kolhapur District.

III) Export Opinion was obtained from the following three persons who are known in this field to be the experts :

i) Shri P.G.Kulkarni, Uttur, Dist. Kolhapur :

Aged 52 years, Shri Kulkarni is a practising Chartered Accountant and a progressive agriculturist. He was installed in his village 3 bio-gas plants. He has about 18 acres of land in his village Uttur which is about 40 miles away from Kolhapur on the Southern side.

ii) Shri P.S.Thakur, Sangli :

He is a retired Deputy Superintendent in Agricultural Department of the State Government of Maharashtra. He was the Parishad Agricultural Development Officer for a number of years in Sangli. He was instrumental in starting grape-cultivation in Sangli District in the early 60s.

iii) Shri Sudhakar Mundhe, Kharshi, Dist. Satara :

Aged about 45 years, Shri Sudhakar Mundhe, is a progressive agriculturist from Kharshi (Dist. Satara). He owns about 16 acres of agricultural land out of which

more than 10 acres of land is under irrigation. He was installed 2 bio-gas plants in his farm.

Chapter Scheme :

The Dissertation is divided into 6 chapters the details of which follow :

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I	Introduction
	(A) Background Analysis
	(B) Methodology
II	Profile of Shivsadan Society
III	Work Done by Shivsadan Society
IV	Impact on Rural Life
V	Evalution of Shivsadan Society's Work in respect of Gober Gas Plant
VI	Summary and Conclusions

Limitations of the Study :

Following are the major limitations of this study :

1) Data on institutional members could not be obtained and, therefore, not considered.
2) Sample size had to be restricted to 100, as the geographical spread and the large population made it impractical to have a large sample.