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SOCIAL IMPACT ASSESSMENT OF THE APOLLONIA MODEL VILLAGE BIOGAS PROJECT

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A B S T R A C T

This study presents the status of biogas usage in Apollonia and discusses the scope for future action on similar projects.

The study reveals that the enthusiastic attitude toward the biogas technology among the people of Apollonia has waned considerably in recent times. The reasons for this situation has been examined, a major factor being the need to highlight the link of biogas with the main economic activity of the village. It was also felt that the project did not identify and work with women as the direct users of biogas for cooking. In addition, far from minimising the workload, the technology has increased the time for cooking whereby most of the biogas user households continue to collect the same quantity of firewood in addition to using biogas.

Recommendations towards achieving optimum conditions for the development and transfer of the biogas technology are presented. The strategy underlying these recommendations, sees rural development as a total mix within which the energy factory is one aspect.

CHAPTER ONE - BACKGROUND TO THE STUDY

1.1 INTRODUCTION

One of the aims of the National Energy Board (NEB) is to restore improved productivity and efficiency in the procurement, transformation, distribution and use of the country's existing energy supply sources.

The Apollonia Model Village Biogas Project was undertaken within this framework. The objective was to develop biogas technology for cooking and lighting in Apollonia as a full demonstration project with a view to extending it to other rural communities.

The project begun in December 1987. Last year (1989), two social surveys were conducted to assess the impact of the technology on the people of Apollonia. Mr. George Osei-Asibey conducted the first study from May 25th to June 15th 1989. Mr. E.J.K. Ofori-Nyarko and Samuel Adu-Asare carried out the second one from December 12th to 22nd, 1989. These studies looked merely at the energy intervention as the case in point without integrating it into the total fabric of the Apollonia society.

This third study synchronises the findings of the two surveys and attempts to uncover other aspects of biogas use in the village.

1.2 PROJECT BACKGROUND

The aim of the project was to use Apollonia to study the optimum conditions for the development and transfer of biogas technology. The knowledge acquired would be used in the transfer of the biogas technology to other parts of the country.

The project document indicates that Apollonia was chosen after a survey of eleven (11) villages within the Greater Accra District. The site was chosen for the following reasons:

- i. It is near Accra and easily accessible for purposes of execution, monitoring and evaluation of the project;
- ii. Apollonia has a typical rural setting and it depends on traditional sources of fuel (firewood and charcoal) while forms of commercial fuel like electricity and kerosene are not easily available;
- iii. There is sufficient water (a major raw material for biogas production) all year round in streams, dams, reservoirs and dug-out water catchments;
- iv. Farms of inhabitants are close to the village making it possible for the use of digester effluent as organic fertilizer;
- v. The village is well organised and enlightened and has a high communal spirit;
- vi. Apollonia is surrounded by many other villages.

The project had three specific objectives namely:

- i. Developing Apollonia into a "Biogas Village" that is, a village which is largely dependent on biogas technology to satisfy most of its domestic, agricultural and other energy needs.
- ii. Using Apollonia to study the various factors that might influence the transfer of biogas technology in Ghana.

- iii. Using Apollonia to demonstrate the full socio-economic benefits of the biogas technology and thereby help to accelerate the process of biogas technology transfer in Ghana.

For operation purposes, the NEB in collaboration with the Industrial Research Institute (IRI) have constructed eight (8) biogas plants: six (6) single household 10m³ and two (2) 30m³ communal types for cooking.

For purposes of implementation, two structures were established at the project and local levels. The project team consisted of two project co-ordinators from NEB and IRI respectively. Others were the mason and a driver. At the local level, the inhabitants were expected to provide communal labour. There was no specific team to manage the project at the local level. However, the district assemblyman and some patriotic young men of the village voluntarily supervise the operation of the digesters.

For the purposes of monitoring and evaluation, a Project Management committee (PMC) was formed and the project co-ordinators were required to submit monthly reports to the PMC. The PMC was to pay periodic visits to the project site.

1.3 STATEMENT OF THE PROBLEM

The Apollonia Model Village Biogas Project started in 1987 within the framework of the NEB's efforts to develop the indigenous energy resources in the country for the benefit of rural communities.

Woodfuels in the form of firewood and charcoal are the main sources of energy for cooking in rural communities. The

daily chore of walking long distances to collect and carry firewood for cooking in rural households increases the workload of women and children. Women and children's health are consequently adversely affected while time that could be channelled into productive activities is wasted. In addition, the continuous cutting of wood for firewood and charcoal has negative consequences on the environment and is a contributing factor in the gradual depletion of the nation's forests.

It is with a view to tackling the above mentioned problems that the NEB aims at developing renewable energy sources from available local raw materials. In the Apollonia case, biogas which is produced from cow-dung and water has been introduced. But the choice of Apollonia for the introduction of the biogas technology has been based on misleading assumptions.

It is a fact that cow-dung is easily available in the community as cattle-rearing is a major income-generating activity, but water is not easily available as was assumed as one of the reasons for choice of the site. Inhabitants depend on little dams constructed as sources of drinking water for cattle in the settlement and the nearest dam is about 800 meters away.

Secondly, in the introduction of the technology, no effort was made to identify the real needs of the people in the community. It was assumed that once the raw material (cow-dung) was available and the technology is new, its acceptance would be automatic. Subsequent development has proved otherwise.

Thirdly, the work patterns both within the productive and household sectors were not studied as factors that would

have consequences for the introduction of biogas technology. In a situation where natural woodlots provide all the firewood needs of the community, it is doubtful whether an alternative energy resource for cooking like biogas would be found attractive, without a conscious effort at educating the people about the long term consequences on the environment of continuous wood-cutting.

Finally, cooking is an activity predominantly undertaken by women. However, in the design and implementation of the project, women's involvement and their needs are not specifically addressed. Hence by ignoring the above socio-economic factors, the Apollonia Biogas Project does not seem to have reduced the inhabitants' dependence on firewood nor does it seem to have had much effect on the living conditions of the people.

This study will therefore like to investigate the assumptions underlying the introduction of the biogas technology in Apollonia. In doing so, it hopes to unearth the limitations (and prospects) of the approach adopted.

1.4 AIM OF STUDY

The aim of this study therefore, is to assess the extent to which the people of Apollonia have been affected by the biogas technology as an alternative energy source for cooking.

The specific objectives are:

- i. to establish whether Apollonia is a viable site for the biogas technology;
- ii. to find out if the biogas technology satisfies a priority need of the village;

- iii. to establish whether subsistence and income-generating activities have been influenced since the introduction of biogas for cooking;
- iv. to find out if biogas introduction has affected (the time) for cooking;
- v. to establish whether women's workload has minimised in the household with the introduction of biogas for cooking;
- vi. to identify socio-economic factors that have developed over time since the introduction of the facility;
- vii. to draw out the implications of the findings on the living conditions of the people of Apollonia and on the biogas project itself;
- viii. to make recommendations based on the available data for future action.

1.5 METHODOLOGY

A framework for assessing the social impact of the Biogas Project was developed to fit the specific case of Apollonia. The framework consisted of exploring the economic and socio-cultural characteristics of the village as well as other indicators related to the various stages of the biogas technology. A set of questions were developed on the basis of the indicators identified.

Majority of the people of Apollonia lack formal education. Thus it was found more appropriate to adopt an interviewing method based on an unstructured questionnaire. This enhanced discussion and enabled the respondents to talk freely on issues including others not raised in the

questionnaire.

In addition to the Programme Officer (Social Impact Assessment), two national servicemen were trained as research assistants to help conduct the survey. Ga, the local language was the medium of communication used.

Inspite of the relaxed atmosphere of the interviewing process, the people were often reluctant to be precise in their answers. Participant observation whereby the observation and experiences of the researchers are also taken into account was adopted. In addition, focus group discussion with both users and non-users of biogas was adopted.

The interviewing period lasted five days - from January 5th to January 9th. In all there were sixty-five (65) households in the village. The households were grouped into three clusters; the north-east, south east and west. Out of these clusters, thirty-five (35) households were selected using the Random Sampling method. The number was found to be quite representative of the target area as it constitutes one half of all households.

In the selected households, a woman (usually the mother or eldest female) was interviewed. This choice was based on the fact that women are directly responsible for the energy requirement for cooking and cooking itself in the home. As such, they are more likely to know in what ways the biogas technology is responsive to their needs. The conventional method of interviewing the head of household, who is usually assumed to be male, was not relevant in this context.

Three other social categories were interviewed:

- i. Children: Because they often help their mothers in performing household chores including firewood collection and water-fetching; as such they are likely to provide some of the labour inputs of the biogas technology.
- ii. Opinion Leaders: For general information about the village and about the project.
- iii. The Leadership: Made up of the chief and assemblyman, for information about the organisation and decision-making processes of the village.

CHAPTER TWO - BACKGROUND OF APOLLONIA

2.1 INTRODUCTION

The conditions within which any group of persons live affect their perception of social reality. A people's history, their social and cultural values, their access to resources for their economic well-being and the existence of health facilities, schools, and recreational facilities has some relationship to their acceptance of new ideas, values and technologies. This chapter, deals with the history, decision-making process and other characteristics of Apollonia.

2.2 HISTORY OF APOLLONIA

Apollonia is a village in the Ga-Adangbe rural district. It is approximately 11km away from Tema. The Apollonians migrated from Kpone (which they refer to as their ancestral home), in search of alternative income-generating activities other than the traditional occupation of fishing in Kpone. On the way, they first lived at Kpone Bawalashie and finally settled at the present site a few kilometres away.

The town derives its name from the Bible. Initially, leadership was based on age with the oldest man in the settlement being nominated as chief. The first leader was Numo Gbodago. Over time, this mode of selection has given way to a system where three families have been identified as a chief selected on rotation basis. The present chief is Nii Tei Adomoa II.

2.3 POLITICAL/DECISION MAKING PROCESS

The chief of Apollonia who has always been male, is the highest authority in the political set-up of the village. He had an advisory body made up of his elders, the 'Asafohene' and 'Mankrado'. There is no queenmother in the

village and women and men all have to rely on the chief to take decisions on their behalf. Specific needs of women as in other communities in the country are not central among discussions at the decision-making level of the village.

Since the 1981 December 31st revolution, such organs like the June Four Movement (JFM) and the Committee for the Defence of the Revolution (CDR) have been set up to complement the traditional form of decision making. Within the framework of the decentralization process going on at the national level in the country, whereby district assemblies have been created, Apollonia falls under the Ga-Adangbe rural district. An assemblyman, Joseph Tetteh Nyamong co-ordinates all the developmental efforts of the government and the people at the village level.

2.4 SOCIO-CULTURAL CHARACTERISTICS

The people of Apollonia are predominantly christians of the Methodist and Apostolic faith. Indigenous cultural practices among them are overshadowed by a strong belief and practice of christianity. The main Ga festival 'Homowo' is hardly celebrated in the village; some inhabitants however travel to the ancestral home, Kpone, to take part in the festival when it is due.

It is Christmas, the commemoration of the birth of Christ, that is keenly celebrated in the village. Two popular dances the 'Allaha' and 'Gome' are favourite activities of the occasion which all inhabitants look forward to. Friends and relations travel from surrounding and far-off places to join in the festivities.

The patrilineal system of inheritance operates in the village. Authority is vested in the eldest male but inheritance is distributed equally among the sexes. In

Apollonia, people are very relaxed in their attitude to political and emerging authority and the sense of a communal work ethic among the people is also relaxed. Though the people consider themselves as relatives, there are no strong bonds of obligations attached to this recognition. This fact contradicts one of the reasons for choosing Apollonia as the project site: namely, a strong communal spirit among the people.

According to 1984 figures from the Statistical Service, the total population of Apollonia stood at six hundred and forty-six (646). Table 1 below shows the population distribution of Apollonia according to age and sex.

TABLE 1: POPULATION DISTRIBUTION OF APOLLONIA BY AGE & SEX

Dangbe L/C		0 - 14	15 - 44	45+	
Apollonia	M	326	156	124	46
	F	320	136	126	58
Total	646	292	250	104	

Source: Statistical Service, Census Data 1984

In all, sixty-five (65) houses were recorded with an average of fifteen (15) persons in each household. In this study, one homestead was defined as a household as all residents had access to the biogas if it was available. By a rough estimate therefore, the population of the village now is about nine hundred and seventy-five (975) which is an increase in numbers of about three hundred and twenty nine (329). Each homestead which the study defines as a single household is separated from the other with a wooden fence. The single household is usually the nuclear type. This is somewhat different from the typical Ga family where wives

reside in their patrilocals. Heads of households are predominantly males. There are however a few female-headed households. In this case the women are usually widows. As is the case in other parts of the country, women are responsible for the maintenance of family members and they are also responsible for the socialization of children.

Also, like other rural communities in the country, Apollonia lacks basic amenities like good drinking water, places of convenience, electricity and formal employment opportunities. The only sources of water are dams that serve human beings, cattle and pigs alike. As places of convenience, the people go to the bush on the outskirts of the village. There is a school complex from the nursery to Junior Secondary School (JSS) level. School drop-out rate is high though figures were not available. This is particularly so among females who either drop out to take care of younger ones at home or due to teenage pregnancy. Illiteracy rate among adults is equally high.

With regard to the health needs of the village, the people combine the benefits of both modern (orthodox) and traditional sources of healing. Traditional Birth Attendants (TBAs) are usually responsible for child deliveries in the village. Malaria is almost always treated with herbs. Recently, a health post has been established by the Rotary Club to deal with minor cases. In extreme cases, people travel to Tema, Ashiaman or Accra for treatment. Bilharzia is a common disease in the village. This is a direct consequence of the poor quality of drinking water in the village.

Social groups are the Rotary Club and the 31st December Women's Movement. The latter was established last year (1989) and has so far cultivated a farm.

There is a general acceptance of women as capable and hardworking as their male counterparts yet there is no corresponding recognition that women are equal to men; the men and even the women always referred to themselves as "only women" who have to be guided by their male counterparts. Women's consciousness here is therefore quite low.

2.5 SUBSISTENCE AND INCOME-GENERATING ACTIVITIES

The Apollonians are predominantly farmers. They grow cassava, the main staple, corn, tomatoes, calabash, pepper and groundnuts, both for food and cash. In addition cattle rearing for cash is undertaken by several households in the community. Domestic animals like goats, fowls, sheep and pigs are also reared under the free-range system.

Other income-generating activities are trading, firewood cutting and charcoal making. Trading in items like salt, fish, meat (occasional) and cooked food is usually undertaken on a very low scale by women. Capital is usually not available and the women often buy on credit basis from Ashiaman. The items are usually to serve the needs of the village.

Firewood cutting and charcoal making are active income-generating activities undertaken especially by the male and female school drop-outs of the village who would otherwise be unemployed. The implications of this activity on the environment in the long term is however one of the reasons for the introduction of an alternative energy source, biogas.

Land is communally owned and individuals irrespective of sex, can cultivate any size free of charge. Outsiders who wish to acquire land are expected to present two bottles of

schnapps to the chief. They become automatic members of the community and can then cultivate any size anywhere in the community.

The farmers usually rely on tractor service to prepare the land. This service is difficult to come by as there is none in the village. Ashiaman and Tema are sources for acquiring the tractor and owners usually operate on an hourly basis for a fee which increases every year. Last year (1989), the fee ranged from four thousand cedis (¢4,000.00) to three thousand, five hundred cedis (¢3,500.00) per hour.

Seeds are usually preserved from the previous year's harvest. Source of capital for paying tractor service and chemical fertiliser purchases depends on the household's income levels. Though the people were unwilling to give information on their levels of income, from the discussion, three classes of farmers could be identified: the rich farmers, middle level farmers and the poor farmers. This division has no correlation with other classification elsewhere as a rich farmer in Apollonia could be rated poor in different circumstances.

The rich farmers usually had their own credit facilities in embarking upon their farming activities. The middle level ones often borrowed from the rich to supplement it with their own. The poor farmers usually planted for their subsistence needs only and their plots were not very large. When they required to borrow, they did so from the middle level and rich farmers.

Husbands and wives cultivate separate plots. With assistance from children, they help on each other's plot. However, women tend to help on their husbands plot regularly especially during the harvest season.

Women have control over their incomes and other resources generated from their farming activities.

Like other communities in the country, women face a double burden as they have to combine their income-generating activities with the maintenance of their households, cooking, looking after children and the sick, fetching water, washing and so on. During the period of the survey, men were usually found playing cards under shady trees while women were usually busy doing housework.

CHAPTER THREE: ANALYSIS: SOCIAL IMPACT OF BIOGAS TECHNOLOGY

3.0 INTRODUCTION

Of the sixty-five (65) households in the village, ten (10) are beneficiaries of the biogas technology for cooking. Conclusions about the case under study has to take into account the fact of this small number of households enjoying the facility. If more households were beneficiaries, it is likely they would express other sentiments from those noted in this study.

3.1 BIOGAS AS AN ENERGY SOURCES FOR COOKING

All the thirty-five (35) women interviewed in the selected households agree that the whole community was informed about the introduction of the biogas technology for cooking. The chief and assemblyman shared this view also. They all said they did not know the nature of the technology but because, it was something new, they were all eager about its introduction and hoped to benefit from it.

The implication of this eagerness is that the Apollonians are not unresponsive to change: their initial reaction was enthusiastic, a point that has to be noted for subsequent issues that have developed after the introduction of the biogas technology. This point also negates the assumption that rural communities are against change. It is the form or method adopted for change that often poses a problem.

In an answer to a question, "does the technology satisfy what you imagined it to be?", the women indicated that they thought it would satisfy all the cooking needs of the beneficiary households, but this has not been the case: both non-biogas and biogas user households continue to rely on firewood for much of their cooking needs. Table 2 indicates sources of energy used in cooking Apollonia.

TABLE 2: SOURCES OF ENERGY USED FOR COOKING IN APOLLONIA

TYPE SOURCE	FREQUENCY	
	Abs	%
Firewood	22	62.9
Biogas	-	-
Both	9	25.7
Other	4	11.4
Total	35	100.0

According to the figures, not one of the biogas user households depends exclusively on biogas for cooking. Majority of the women interviewed depend on firewood as their energy source for cooking (62.9%) while the others combine it with biogas (25.7). This second group would be biogas user households.

Several reasons are given for the high dependence on firewood as an energy source for cooking. First of all, village is naturally endowed with woodlots which caters for the fuelwood needs all year round. Secondly, firewood collection is an activity that has been carried out by the people since time immemorial and has become almost second nature. It is labourious, especially when the collection points are far away from places of residence. In the case of Apollonia, the shortest distance is about 1.6km from the village. Despite this, the people undertake it because they require firewood to meet a need. If there is an alternative which will minimise this labour, the people will prefer it. On the other hand, if the new technology does not reduce the work involved in firewood fetching, adoption will not be easy.

One of the objectives of introducing an improved method of cooking - the biogas technology - is to minimise the time used in cooking. To this end, questions were asked to find out whether among the ten (10) biogas user households, the time for cooking had minimised. Table 3 indicates the relationship between biogas use and time for cooking.

TABLE 3: BIOGAS AND TIME FOR COOKING

Time Effect	Frequencies	
	Abs	%
Firewood	22	62.9
Biogas	-	-
Both	9	25.7
Other	4	11.4
Total	35	100.0

Of the ten (10) households, only one (1) which represents 10% of biogas user households said the time for cooking had minimised. Four (4) of the households (40%) said the time had increased explaining that they continue to collect the same quantity of firewood in addition to using the biogas facility.

People's attitude towards an idea or project sometimes depends on whether the idea or project satisfies an immediate need. The people were therefore asked whether the biogas satisfies an immediate need. Table 4 indicates immediate infrastructural need of Apollonia.

TABLE 4: IMMEDIATE INFRASTRUCTURAL NEED OF APOLLONIA

TYPE SOURCE		
	Abs	%
Firewood	22	62.9
Biogas	-	-
Both	9	25.7
Other	4	11.4
Total	35	100.0

Of the thirty-five (35) women interviewed, twenty (20, 57.1%) cited water as being an immediate need. As the table shows, only one (1, 2.9%) cited biogas as satisfying an immediate need. Tractor is mentioned by nine (9) people (25.7%) as satisfying an immediate need, which is second in ranking. It is worth noting that tractor service is directly related to the economic activities of both women and men in the village.

3.2 BIOGAS CONSTRUCTION AND RELATIONSHIPS

As noted under 3.1, attitude towards the introduction of the biogas technology was favourable. However, there is often a change of attitude over an issue or technology from the time of its inception to the point of completion.

According to opinion leaders of Apollonia, when it was realised that not all households would benefit from the technology, there was disappointment. The criteria used in selecting households as beneficiaries was availability of a roofed fireplace ('kpata') within the house. Hence, even some of the people in the community, who voluntarily constructed the digesters, did not become beneficiaries if

they did not have the 'kpata'. This brought disaffection among the biogas user and non-biogas user households. It was felt that the former had been favoured. However, other factors about the biogas itself developed and this attitude changed. Now even the beneficiaries were not enthusiastic about the facility as they had been on its introduction. Table 5 indicates attitude towards the biogas technology among ten (10) user households.

TABLE
ATTITUDE TOWARDS BIOGAS TECHNOLOGY AMONG
THE PEOPLE OF APOLLONIA

Year of Assessment	Level of Receptiveness			
	High recep.	Indifferent	Low recep.	Tot.
	Abs	Abs	Abs	
Dec. 1989	6	3	1	10
Feb. 1990	4	1	5	10

Enumerated problems according to low receptiveness in February 1990:

1. lack of water for mixing cow-dung
2. Scarcity of cow-dung
3. Insufficiency of biogas to meet all the cooking needs;
4. Increasing work load with regard to:
 - i. distance from home to kraal;
 - ii. distance from home to water source.

Last year (1989) December, six (6) of the users had a high receptive attitude to the technology, with only one (1) low receptiveness recorded under the table. However, at the time of the survey (February 1990), a low receptiveness to the technology was recorded among five (5) users. As the time indicates, the reasons given for the later phenomenon

are: lack of water for the mixing of the cow-dung; insufficiency of biogas to meet all the cooking needs and the increase in workload with regard to the collection of the raw materials for charging the digesters (water and dung).

From observation, the people who said they still value the technology highly (4) were usually only being polite to the researchers as there was little indication from an examination of the biogas coalpots that they use the facility at all. The woodstoves were always in use whereas the biogas stoves were too clean to have been used.

3.3 CHARGING THE DIGESTERS

There is a sexual division of labour at the various stages of charging the digester. It is also at this point that one notes a major cause in the change of attitude to the biogas technology.

According to the instruction from the project co-ordinators, the digesters have to be charged once every week. The single household types require collection of nine (9) bucketsful of water and cow-dung. The two materials are mixed in a container and poured into the digester. An equivalent amount of eighteen (18) bucket full of slurry is then collected and dumped into the bush as a by-product that can be used as organic fertilizer. The communal household types require double the quantity of water and cow-dung.

The biogas user households do not feel repulsive about collecting cow-dung, but adult Ghanaian males are traditionally not used to carrying things for use in the household. Even when a man and his wife are returning from the farm, it is the woman who carries a baby on the back in addition to the heavy load on her head. Thus collection and

carrying of cow-dung and water is undertaken by women, while the men mix the dung.

The assumption is that mixing the cow-dung is more tedious and women cannot undertake it, hence the need for men to 'help'. This does not take into account the long distances women have to walk to cart the cow-dung and collect the water. These activities seem to be taken for granted as within women's capacity to perform them.

Table 6(a) indicates who carries cow-dung for charging the digesters. In all the ten (10) biogas user households, there is no record of an adult male carrying cow-dung for charging digesters.

TABLE 6(a): COLLECTION OF COW-DUNG FOR CHARGING DIGESTERS

Collection of Cow-dung by sex		Frequencies	
Adult:	Male	Abs	%
	Female	2	8.6 (30)
Children	Male	3	8.6 (30)
	Female	4	11.4 (40)
Not applicable		25	71.4
Total		35	100.0

Slurry collection is also done almost exclusively by men as table 6(b) indicates. Six (6) households depend on men while two (2) depend on boys). Only one slurry dump was noted during the survey.

TABLE 6(b): COLLECTION OF THE SLURRY FROM THE DIGESTERS

Collection of Slurry by sex		Frequencies	
Adult:	Male	Abs 6	% 17.1 (60)
	Female	1	2.9 (10)
Children	Male	2	5.7 (20)
	Female	1	2.9 (10)
Not applicable		25	71.4
Total		35	100.0

Especially during the dry season when the cows have to walk to far distances to graze, cow-dung becomes scarce. They drop the dung on their way and there is little left in the kraals. Water is also a problem. The nearest dams dry up and one has to walk distances of about 2km to fetch water to drink. Thus collection of nine (9) buckets of water for charging the digester becomes a bother.

Hence, though the biogas users said they follow the technical instruction of charging the digesters every week, observation of the digesters, the stove and the fact that only one slurry depot was seen throughout the village imply that some digesters have not been charged properly. The gas delivery in the kitchens is also low due to improper charging of the digesters. To date one digester has broken down in Apollonia.

As the re-charging is becoming irregular, the users tend to depend on firewood the more. Some of the stoves in the kitchens look too clean to have been used recently. The people always said they were due to re-charge the digester

the following day. But it was clear that everyday was the following day.

Here also, no household mentioned adult males as responsible for water collection for charging the digesters. However, three (3) households mentioned male children as responsible for this task. In such cases, the boys were the grown up ones among children of both sexes within the household. It is rather adult females and young girls of seven (7) households who account for the highest group by sex of water collection. The implication of this for women's workload is obvious.

At the next stage of preparing the raw materials for, charging the digester, adult males predominate. Table 6(c) represents characteristics by sex of who mixes the cow-dung and water. Seven (7) households mentioned males as responsible for this activity (four (4) men and three (3) boys). In two (2) households, women were responsible while girls were responsible in one (1) household.

TABLE 6 (c)
MIXING OF COW-DUNG AND WATER FOR CHARGING THE DIGESTER

Collection of Cow-dung/water by sex		Frequencies ,	
Adult:	Male	Abs	%
	Female	2	8.6 (30)
Children	Male	3	8.6 (30)
	Female	4	11.4 (40)
Not applicable		25	71.4
Total		35	100.0

Carrying the cow-dung is predominantly a female activity: (three (3) households use adult females and four (4) households use female children) a total of seven (7) households have their women carrying the cow-dung. Two (2) reasons can be deduced from this: women are responsible for the reproductive activities of their communities. This include caring and rearing children, undertaking activities related to cooking (i.e. water and firewood collection). Biogas is directly related to cooking thus women are directly responsible for organising the activities needed to utilise the facility.

Water collection for the digesters is also a predominantly female activity at Apollonia. Table 6 (d) indicates, who collects water for charging the digesters.

TABLE 6 (d)
FETCHING OF WATER FOR CHARGING OF THE DIGESTER

Collection of water by sex		Frequencies	
Adult:	Male	Abs	%
	Female	3	8.6 (30)
Children	Male	3	8.6 (30)
	Female	4	11.4, (40)
Not applicable		25	71.4
Total		35	100.0

3.4 BIOGAS AND INCOME-GENERATING ACTIVITY

As noted earlier, the main income-generating activity of Apollonia are farming (crop and animal), firewood cutting, charcoal making and trading.

Biogas introduction has a relationship with farming but not the other income-generating activities. The household that sells cooked food like kenkey and rice depend on firewood rather than biogas, even in biogas user households. The reason given is that energy produced is too low for bulk cooking. (The low energy produced by the biogas may be due to the non-compliance with the time frame as well as quantities of raw materials for re-charging).

However, with regard to crop farming, the by-product of biogas, namely slurry, can be used as organic fertilizer. But this will require some effort on the part of the project management as will be elaborated later.

Again, the biogas users claim they do not save time for cooking with the facility. Were the contrary to be the case, one could then deduce that people would have more time left to undertake their income-generating activity. As it is the technology has not had any direct impact either positively or negatively on the people's income-generating activity.

However, the user households concede that as a technology, biogas is good as an improved source of cooking. Table 7 indicates numbers of households who look on the technology as an improved energy source for cooking.

TABLE 7
BIOGAS TECHNOLOGY AS AN IMPROVED METHOD FOR COOKING

Response	Frequencies	
Yes	Abs 9	% 25.7 (90)
No	-	-
Not applicable	26	74.3 (10)
Total	35	100.0

Reasons for saying 'yes':

1. Elimination of smoke effect;
2. Convenient for cooking at all times;
3. Convenient for cooking during the rainy season.

3.5 BIOGAS AND SOCIO-CULTURAL CHARACTERISTICS

The socio-cultural characteristics of Apollonia has had no direct effect on biogas use. There were no existing taboos or cultural practices that could have some influence on the adoption of the technology.

However, one interesting phenomenon has developed since households begun using the technology. The cattle owners claim that the number of miscarriages among their cows has increased since women started entering the kraals to collect cow-dung. One may dismiss this as mere superstition and without scientific basis. Yet it has resulted in the banning of women from entering the kraals. They wait outside while a boy (from the concerned household) collects it for the women to carry. There may be two (2) related underlying reasons for this development:

- many of the cattle owners did not benefit from the biogas technology and are therefore reluctant to give it freely to those who have the technology. They are therefore using this excuse to prevent people from charging their digesters;
- a specific attitude to women especially in periods of technological change whereby specific aspects of women's subordinate position in society take on new forms. In this case, two (2) stages of women's life cycle, namely pregnancy and child birth are being linked to those of the pregnant cows which miscarry, and used to deny women access to a vital raw-material, cow-dung, required for charging the digesters. Ironically, by social definition women are assigned the duty of carrying water and firewood for example, and in this instance, carrying of cow-dung, which this new development of superstition is denying them a chance to undertake.

CHAPTER FOUR: CONCLUSIONS/RECOMMENDATIONS

4.0 INTRODUCTION

From the study, certain conclusions can be established with the hope that they will be taken into account in future NEB projects that seek to introduce improved energy sources in rural communities.

4.1 CONCLUSIONS

The first conclusion to be established from the study is that as a technology, biogas as an energy source for cooking is an advance. However, in its introduction in Apollonia, the approach adopted has greatly affected the projects' viability. The assumptions for choosing Apollonia were based merely on the physical qualities of the community (see chapter 1 for reasons for choosing Apollonia). Socio-economic facts of the locality were not studied for incorporation into the implementation of the project. For example, the availability of cow-dung and water at one point in time does not mean availability all year round nor does availability connote accessibility. Again, the mere availability of biogas cannot ensure a shift in the energy use pattern if it is not woven into the socio-economic life of the people.

- 4.2 A second conclusion can be drawn from the economic activities of the village. The biogas technology has an indirect relationship to farming, a major activity in Apollonia. People's interest in an improved technology is greatly enhanced if it is likely to lead to an increase in income levels. In the case of Apollonia farming is the main economic activity and the main input required for this activity is tractor for ploughing the land. NEB does not deal in the supply of tractors but it can identify an institution capable of providing this service, collaborate

with the identified institution to provide this need for the Apollonians, while encouraging the people towards the use of biogas in their homes. The indirect relationship of biogas with farming can become directly important or beneficial if the slurry is dried and used as organic fertilizer. This can replace the use of chemical fertilizer which is used on a large scale in Apollonia. This would even have a positive impact on the environment. Yet for the people to appreciate the use of the slurry as fertilizer, a sustained educational campaign as well as practical demonstration of use by the project management team will be required.

- 4.3 The labour component of the technology was not studied. It was assumed that once the technology is introduced, the people would automatically provide the labour input. There is the existence of a sexual division of labour in the community within which there is an allocation of different, stages of work activities to particular sex and age, with the work done by men, seen as more valuable than that by women. Unless this fact is taken into account in the design of projects, there is a tendency of the project objective being lost. As an improved energy source for cooking, the biogas project sought to minimise time used in looking for firewood, but the labour component of re-charging the digesters is essentially provided by women and girls who are now not only being denied access to the kraals but also who find it more convenient to collect firewood than to collect cow-dung and water for charging the digesters. In the event, women's workload is not minimised nor is their oppression improved, as a new restriction in the form of a taboo or superstition is used to control their physical movement into the kraals.

- 4.4 Discussions of the cost of the project did not involve the community or beneficiaries of the project. The criteria for

selecting households did not include ability of beneficiary households to pay. Hence the people are now unprepared to pay any amount on the use of the biogas, as they were not part of the decisions that made them beneficiaries. As the labour input of the project has become a problem, perhaps NEB may decide to organise a local team to charge the digesters regularly, but who will pay such a team?

- 4.5 The project did not identify women as the direct users of the biogas for cooking. The existing work organisation of the women were therefore not studied to make the technology compatible with it. The utilisation of the facility by women in the beneficiary households is therefore low as they continue to use firewood more than the biogas facility.

4.6 **RECOMMENDATIONS**

On the basis of the conclusions drawn, the following recommendations are made:

- a. Before the NEB introduces any improved energy source into an area, an in-depth study of the proposed target area should be carried out. This will uncover all the economic, social, political and cultural factors of the area to enable the NEB decide on what kind of technology to introduce and the method of introduction.
- b. The raw materials (resource base) required for the technology should be carefully studied to determine availability all year round.
- c. The various stages of the technology should be outlined. The issue of the existence of a sexual division of labour in the organisation of work and in the utilisation of technological components should be taken into account to determine levels of participation

among the people according to sex and age group.

- d. As far as possible, technology should have some direct relationship with income generating activities. Income directly affects peoples' lives and a tool which improves income levels is usually more desirable.
- e. The role women can play in specific projects should be identified as a component within the broad framework of the project.
- f. Regular monitoring of the project is necessary to identify the intended and unintended effect of implementing the objectives of the project.
- g. The cost of the project should be discussed with the beneficiaries and terms of payment arranged to suit NEB and the community where necessary.
- h. The immediate need factor of the target area should be noted. If it is unrelated to the promotion of energy resources within the NEB work programme, it will be necessary to identify the relevant institutions and link up with them to provide that need. This will then facilitate the NEB's energy input in the area.
- i. An education programme should be an essential component of NEB projects that aim at disseminating improved energy technologies. For example, the people of Apollonia believe that the natural woodlots of the locality will be always available. There is the need to educate the people (through an appropriate mechanism that would have to be developed) about the deforestation processes going on in the country and the need to introduce alternative sources of energy for

sustainable development.

- j. For a project such as the Apollonia one, there is a need to mobilise and organise some people in the locality to constitute the 'local team' who will manage the project from the base of the locality.

4.7 This study has only raised some of the essential limitations of the Apollonia Model Biogas Village Project, with a view to drawing lessons for future action on similar projects. There is the need to ensure that future NEB technologies that are introduced take into account the socio-economic framework within which they will be utilised.

APPENDIX

FRAMEWORK FOR ASSESSING IMPACT OF BIOGAS FOR COOKING USAGE IN APOLLONIA

GENERAL QUESTIONS	SOURCE OF INFORMATION
History of the village	Chief/Assemblyman
Political/Decision-making process	Chief/Assemblyman and one female inhabitant
Socio-cultural characteristics	All interviewees
Economic relations of production/reproduction	All interviewees
Population of Apollonia	Statistical Service

SPECIFIC QUESTIONS

1. How old are you?
2. How many people live in the household?
3. How many are women/men/children?
4. Who is the head of the household?
5. What is the level of your education?

ECONOMIC INDICATORS

6. What kind of income-generating activities are undertaken in this village?
7. Which ones do you undertake?
8. Which activities do women/men predominate?
9. What natural resources are available in the village?
10. Who has access/control to these resources; i.e. land, finance, products, institutional machinery?
11. Who allocates these resources?
12. What other inputs do you require in carrying out your economic activities?

SOCIO-CULTURAL CHARACTERISTICS

13. What are the cultural norms of Apollonia?
14. What social institutions exist in this town (church, school, health, social groups/clubs)?

BIOGAS FOR COOKING

15. Are you aware of the biogas technology in the village?
- 15b. What do you use in cooking - biogas/firewood/
16. Were you consulted before the introduction of biogas technology in the village?
17. Do you have the facility in your household?
18. Does it satisfy what you imagined it to be?
19. Does biogas satisfy an immediate need of your household/village?
20. If no/yes give reasons for your response.
21. What is the immediate need of your household/village?

CONSTRUCTION OF THE DIGESTER

22. Who constructed the digester?
23. Did the persons who were involved in the construction benefit from the facility?
24. What criteria was used in selecting households as beneficiaries of the project?
25. What effect did this have on relationship in the village?
26. What is the feeling on the project now?

CHARGING OF THE DIGESTER

27. Who collects the cow-dung?
28. Who collects the water?
29. Who mixes the cow-dung and water?
30. Who collects the slurry?
31. Where do you dump the slurry?
32. Would you say the activity of charging the digester conflicts/fits into your time schedule?
33. In terms of workload, how would you describe this activity?
34. What is the distance from your household to the cow-dung collection depot?
35. What is the distance from your household to the water collection points?
36. How do you feel about collecting and mixing cow-dung and water of the digester?
37. What about firewood, where do you collect it from?
38. What do you find most convenient; firewood collection or digester charging?
39. Which is most suitable for your cooking needs, biogas or firewood?
40. How often have you been told to charge the digester?
41. How often do you charge the digester?