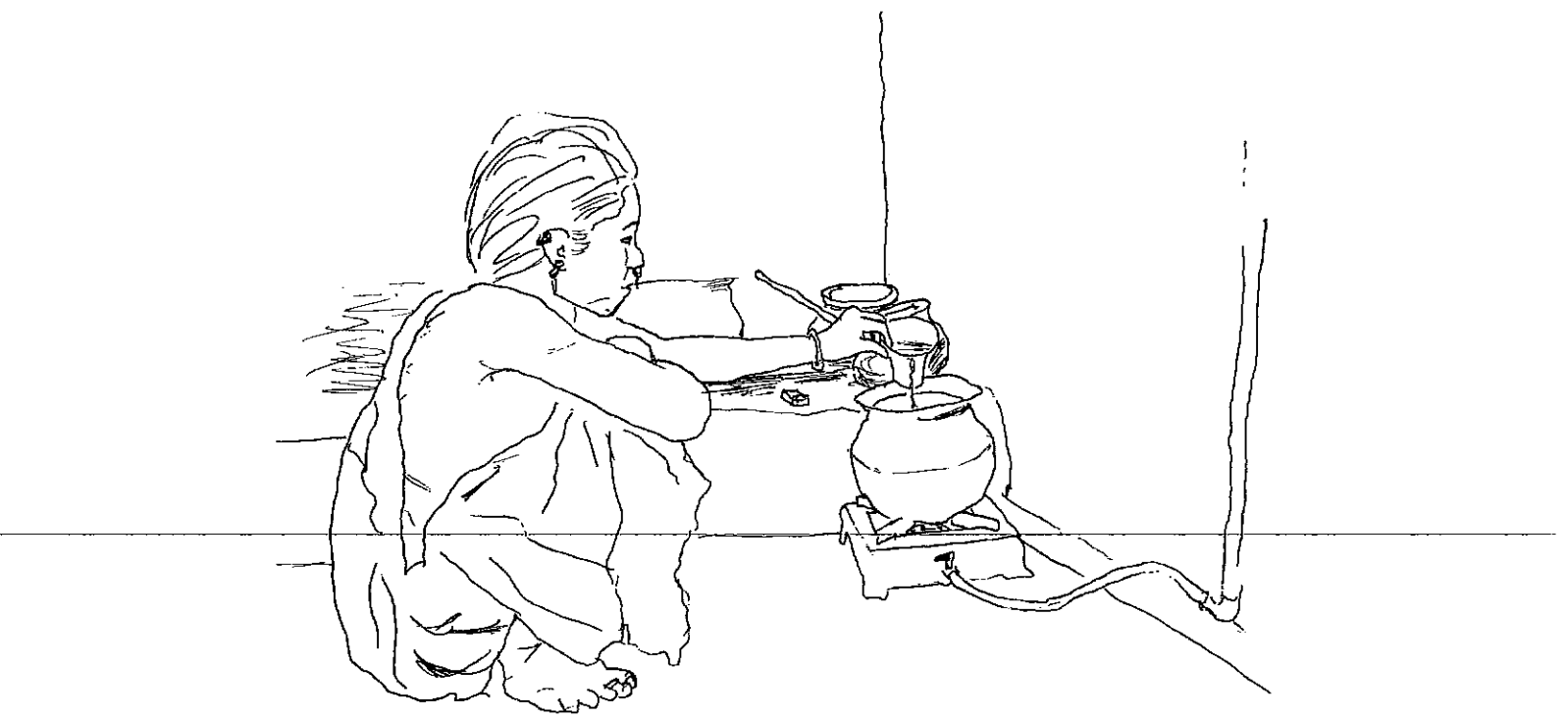
Humanekologiska rapporter 23

BIO-GAS AND DEVELOPMENT

A case study among tribal communities in Orissa India



Mathias Gustavsson

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Bio-gas and Development

A case study among tribal communities in Orissa, India

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Avdelningen för humanekologi

Göteborgs universitet

April 1995

Abstract

Bio-gas is being introduced in many developing countries as an alternative to wood as fuel for stoves. In India, the government has been running a large bio-gas project since the early seventies.

When it is introduced to peasants and rural people in India, bio-gas is a new technology which might change their lives in many ways. The point of departure for the analysis contained in this report is an interdisciplinary one. Topics such as cultural and social patterns, as well as the natural conditions are taken into consideration.

The report is a case study made among tribal people in Orissa, India. The area has been exploited, and today there is very little or no forest left. In the area, a development project has been implemented since 1981. It is called Integrated Rural Development of Weaker Sections in India (WIDA) and is a non-governmental organisation (NGO). One part of the programme is bio-gas development. Bio-gas is seen as a substitute for wood, but also as a way of improving working conditions for the women.

Although bio-gas has many advantages, it is not being used as might be expected. This has to do with different factors concerning the way of life for the local population and the situation in the area. Also, it has to do with the government's and the development agencies' intentions regarding the bio-gas development.

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1. Preface

This report is based on two months' fieldwork in India during November and December 1993. The host in India was Integrated Rural Development of Weaker Sections in India (WIDA), which is partially funded by the Centre for Research on New International Economic Order (CReNIEO), the United Evangelical Lutheran Churches of India (UELCI) and Lutherhjälpen, Sweden.

The paper should be viewed as a preliminary study on the topic. My hope is that the report will provide some advice and ideas to people involved in these issues regarding improving analysis preceding implementation of new development programmes.

Wood is scarce in many parts of the world. Bio-gas is one alternative to wood as fuel for stoves. There are others, such as solar heat boxes, as used in Ladakh, for example. If the aim is to improve the working conditions for women, this can be achieved to some extent through improved wood stoves. Many of these improved stoves are equipped with smoke pipes, as the smoke is a major health problem for women in developing countries (Sarin, 1989).

In the villages where the WIDA project is being implemented, wood for fires is scarce but still available. However, the demand for fuel wood is so high that great pressure is being put on the environment and the supplies are shrinking. In a few years time the availability of wood may be even less, and then bio-gas and other alternatives will be more attractive. When this point is reached, it would be an advantage if the villagers had already been informed about bio-gas. Then it might be easier for people to spread the technology and to share the knowledge of how to utilise bio-gas in a proper way, in their local communities.

The report is a term paper at the graduate level at the Section of Human Ecology, Göteborg University, Sweden. The contacts with WIDA were made through Lutherhjälpen in Sweden.

During the field-work I was accompanied by Maria Janmark. She carried out many of the interviews among the women along with a female tribal interpreter from WIDA.

Acknowledgements

During the work with my project I have been greatful for all the help I have got from every quarters.

To all the staff at WIDA, Lutherhjälpen for the contacts, CReNIEO, Mrs. Prasanna, Dr. Rajaratnam, Prof. Gerald Young, Dr. Maj-Lis Foller, Maria Janmark, the people in the villages (may we dance again sometime), and all the others –

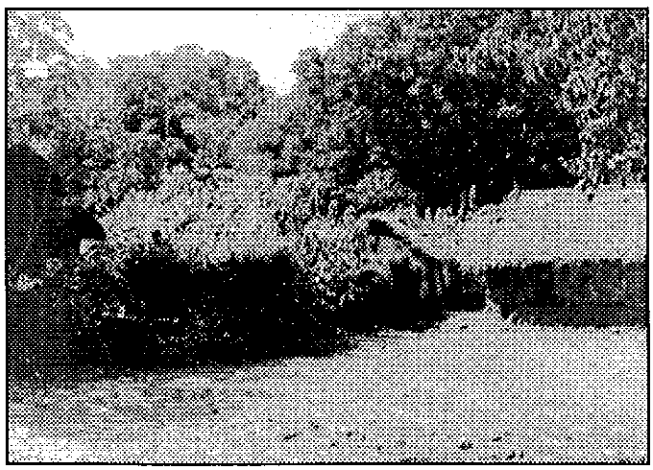
Thank You!

2. Problems and purposes

Problems

> *Sustainable development can be defined as 'improving the quality of human life while living within the carrying capacity of the supporting eco-systems' (IUCN/UNEP/WWF, 1991).*

Fifty years ago, the people in the Koraput district in India were in no need of development. They lived as an integrated part of nature, but the situation has changed radically. The forest in which the people lived has been exploited not only by themselves, but also by industry and the government. When the forest disappeared, so did their main resource. The area has been, and is still, densely populated. When the forest disappeared the carrying capacity of the area was reduced. Even if tree plantations are established today, there will never be a forest similar to that which has gone. New ways of living and doing things have to some extent to be adopted. To do this the people themselves have to participate.



"The village was surrounded by forest"

Firewood was a resource collected in the forest by the people in Koraput district, India. Today branches and brushwood are gathered on the hillsides, usually by the women, as a substitute for wood[1]. There are basically two main alternatives to the firewood from the forest. One alternative is to take a resource which is non-renewable, such as kerosene. This alternative is simple but requires a monetary economy. The other choice is a renewable resource with an origin within the flow of nature. The choice seems simple if the goal is sustainable development, but when a decision is to be made, there are always means of control which play a role. In reality, the choice is not that easy.

Many techniques to meet problems like these originate in other cultures and are introduced to the people through development projects. To adapt these techniques people have to change their whole life pattern, and this can cause friction in the development process. Good development should not be a one-way solution which can lead to a dead end where problems can occur in the future. In striving for sustainable development, a flexible system is desirable. The problem is often to analyse the development process in such a way that sustainability will be the goal. Science examines cycles in nature. Social science and art subjects gather facts about how we use this knowledge. The interdisciplinary point of departure in human ecology is a tool for investigating the interactions between man and his environment.

The brushwood gathered on the hillsides is part of flows in nature, but if the use of the resource exceeds the growth, the carrying capacity will be undermined and the resource will slowly be exhausted. In the Koraput district the pressure on nature for fuel is severe. An alternative to wood is bio-gas. Bio-gas has its origin in fermented biological materials, e.g. dung.

If bio-gas is successfully introduced, it has the potential to be sustainable. All materials in the process are part of the natural cycle. The nutrients in the dung will not be lost, and the effluent can be used as fertiliser after the fermentation process. The gas produced mainly consists of methane, which can be used as an alternative to fuel for cooking or lighting purposes. To investigate if bio-gas is what it seems, an interdisciplinary view has to be adopted where interactions between man and his/her environment can be detected and people's use of the bio-gas can be monitored.

Purposes

The purpose of the project is to examine and analyse how people utilise bio-gas as an alternative to wood used for cooking stoves. The project is a case study carried out in tribal villages in Orissa, India. Looking at how bio-gas is used makes it possible to improve the technique and the way of utilising the resource in the future.

A model to investigate the choice of a resource has been constructed by Emin Tengström (1984). Tengström divides the model into three factors (boxes): Functionality, availability and usableness of a resource. The usableness of the resource is determined by the technical, socio-economic and cultural usableness. In the model used in this report, these factors have been restructed to form four factors (Tengström 1991). It is focused more, on the choice of technology and resources.

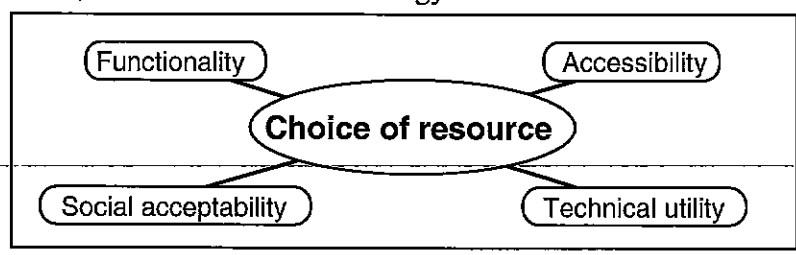


Figure 1. A model showing factors which influence the choice of resource

The four factors affecting the choice are considered below. The four factors reflect the following questions:

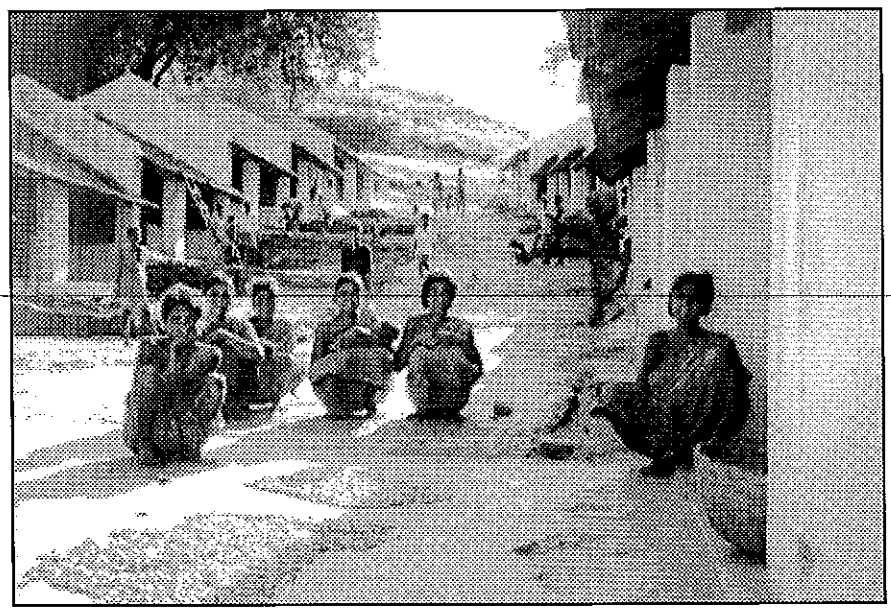
- *Functionality:* Is the resource functional, or are there other sources that could meet requirements better?
- *Social acceptability:* Can the resource be accepted socially according to moral and cultural patterns?
- *Accessibility:* Do the people have access to the resource, and can they afford it?
- *Technical utility:* Will people understand how to use the resource?

When introducing bio-gas all these factors will have importance. Are there enough cattle to produce dung? Is there enough water available? Can people handle dung? Can the units be maintained in a proper way? If the resource can not meet the demands of accessibility, functionality, social acceptability and technical utility, the resource will have problems being accepted by the villagers as an alternative.

The four boxes are interconnected. This makes it very difficult to isolate the bio-gas project from the village, the villagers' lives and the rest of the projects implemented by WIDA. In the analysis the discussion is made from a focus laid on major factors which can be placed in one box.

Attention is drawn to the local situation as well as factors which are not technically related, as the knowledge about the functions of bio-gas is well known. The factors which actually motivate people to utilise bio-gas are less known.

This paper is an attempt to describe the possibilities for and obstacles to adopt the bio-gas technology in the context of the village people in the Koraput district. At the same time, it also tries to describe the importance of evaluating other aspects besides the technical ones when implementing development programmes.

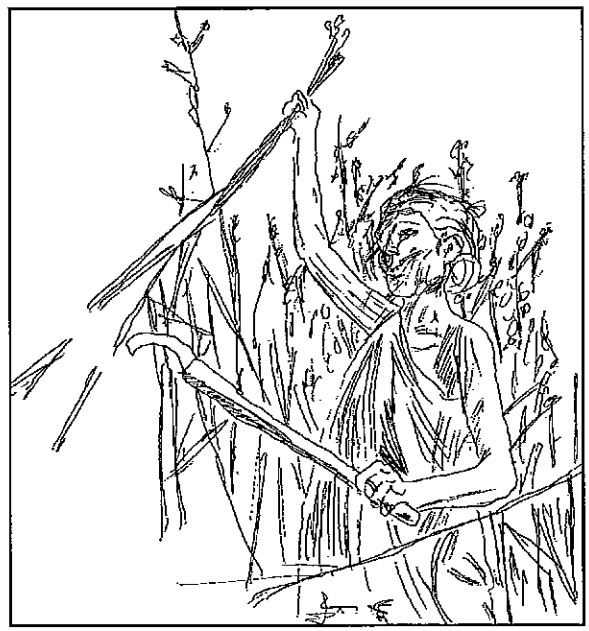


Chikalmari women

3. Method

The village communities in the Koraput district are well defined areas and are suitable for a limited study. The problem is divided into three subgroups, which are thereafter analysed in the light of the model presented. Two groups concern the villagers' lives. One is called *Nature, technical and environmental factors* and the second *social factors* . The third group encompasses factors which indirectly concern the villagers' use of bio-gas, this group is called *other factors*.

Three different regional divisions can be considered, but here the focus is on the *local/people's level.* The other two levels are the *regional level* and the *state level.* The local/people's level consists of the villages and the people living in the villages. The WIDA programmes and staff are also included at this level. At a regional level the policies of WIDA and other Non-Governmental Organisations (NGO:s) are considered. The state level includes subsidies from the government and such.



Woman cutting firewood

To obtain a clear view of all the factors concerned fieldwork was combined with a study of the available literature. The written material on bio-gas mostly concerns its technical aspects. No comparative study was found.

The fieldwork

The Integrated Rural Development of Weaker Sections in India (WIDA) project covered 90 villages in 1993. In eight villages 127 bio-gas units had been built. The fieldwork was done to examine the acceptance of bio-gas by the people in the villages. The fieldwork was planned so that a comparative study could be made. Three villages were identified where different stages of bio-gas development had been implemented:

- Village A (Chikalmari): Village where bio-gas has not been introduced.
- Village B (Ljimkiguda): Village with fully developed bio-gas units which have been running for some time.
- Village C (Bandaguda): Village where some households have bio-gas.

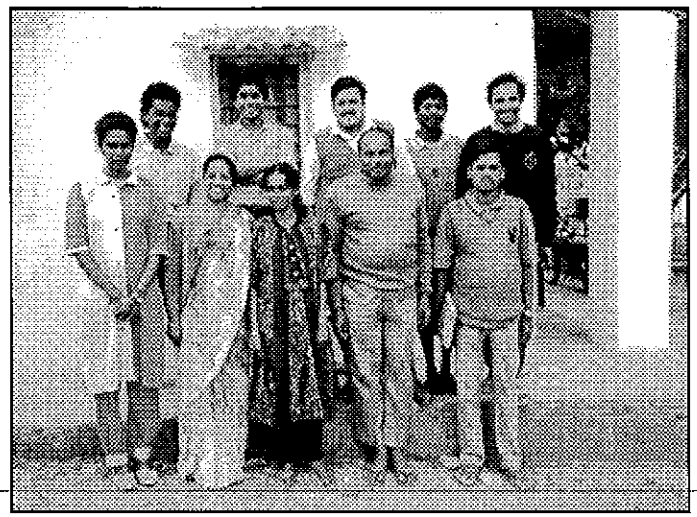
In co-operation with the WIDA staff, it was decided that one week should be spent in each of the three villages.

We arrived in Madras and had some discussions about the Centre for Research on New International Economic Order (CReNIEO) and the work of the United Evangelical Churches of India (UELCI) and about their projects and programmes in general. On 8th November we reached Semiliguda in the Koraput district of Orissa, where the WIDA office is situated. The fieldwork ended on December 20th.

During the fieldwork we stayed in three villages and spent one week in each one. Other villages were also visited in order to obtain an overall picture of the project. The projects range from fishpond programmes to theatre with the villagers acting. For the programme, see Appendix 1.

In this area the harvest period is November and December. People are busy as almost everyone in the villages is a cultivator. More food is available at this time compared to other periods.

The personnel at WIDA are familiar with handling visitors to their projects. It is a rule that guests are accompanied by a staff member when visiting villages. This is a mutual obligation which is positive both for villagers and for visitors. The accompanying WIDA staff member will function as a guide and interpreter. On arrival, the visitor/visitors are presented to the villagers. After that they are invited to the village by the villagers themselves.



WIDA staff

During the fieldwork in the villages we were accompanied by Mr. Gideon. Mr. Gideon had at that time worked at WIDA for six months, and it was his first longer stay in a village in the area. He does, however, come from a tribal village in another district. He has a school leaving certificate from 10 years schooling and speaks English fairly well. He communicated with the villagers in Orya as he did not know *Kuvi*. In the first occassions when we made interviews he could sometimes select information from discussions without telling what the informant said in between. Some of the questions and methods he seemed to find awkward. He was sometimes not interested in the work we did. We disscussed this problem and by the end of the fieldwork we co-operated better.

Our experience in doing interviews and leading discussion was improving during the weeks in the villages. Many of the questions that we asked the villagers in the beginning, and to some extent at the end, were very difficult for the villagers to understand.

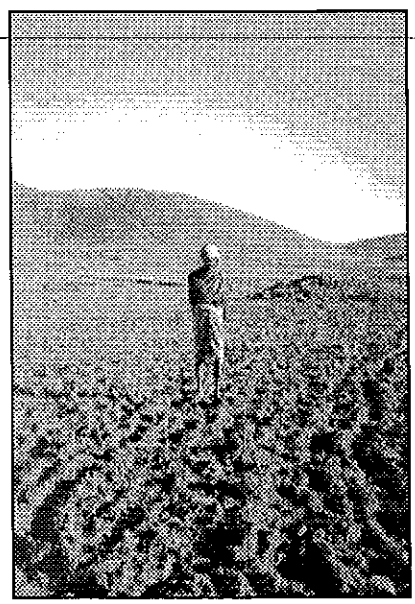
The interviews were made in basically four different ways:

1) Big group discussions: The villagers were gathered and we asked them questions which they tried to answer together. Usually a few men talked while the others listened and nodded. The people in the villages are used to meetings. They usually also had the opportunity to ask us questions[2].
2) Small group discussions: Improvised or planned discussions with a few people. Usually done in the morning/evening, or when they were waiting for something.
3) Interviews with one person or one household: Normally we entered when the food was being prepared to observe and ask about these preparations, as well as including other questions.
4) Conversations with people.

In this report an important source of information was obtained through observation. By observing people in their daily life, we could collect information without needing an interpreter. As often as possible, interviews were combined with observations. In this way, information from interviews could be verified through observations and vice versa.

The men were more difficult to approach than the women. Many women tried more openly to explain and show what they were doing, while men were usually more reserved.

Many people in the villages claimed that they used bio-gas when they in fact did not. This might indicate that they use bio-gas in different seasons, but the villagers also knew who we were and why we were in the village. They knew that we were guests of WIDA, and as the people in the villages are very grateful towards WIDA, they might have told us what they thought we wanted to hear. In this way, they could show that the programmes were working, so that WIDA would continue their work in the village.



A man examining a field

4. Small-scale bio-gas units

Gas which has its origin in biological material can be called bio-gas. One way of producing this kind of gas is through fermentation of dung under anaerobic conditions (without oxygen). The main gas which is released is methane, but other gases, such as carbon dioxide and hydrogen sulphide, are found in lower concentrations.

The process in which gas is produced relies on bacteria. The mesophilic bacteria which degrade the biological material can only work at a temperature above 10°C and below 65°C. The most efficient temperature is somewhere around 35°C (Ellegård *et al.* 1983, UN, 1984).

Bio-gas can be viewed as a renewable resource. The bio-degradation process is a natural process under controlled forms inside a gas dome. This enables the gas to be collected, instead of letting it escape into the atmosphere.

In the fieldwork area dung is used as a fertiliser. It is important to notice that the process will not, if properly run, affect the content of mineral nutrients in the dung. This means that the effluent from the bio-gas unit can be used as a fertiliser which is as good as the dung put into the dome.

In this report only bio-gas originating from fermented dung is considered. In India this type of bio-gas is sometimes called gobar-gas from the Hindi word for dung: *gobar*. The process is sometimes mentioned as methane fermentation, but as the gas consists of more than methane alone, this is not a suitable name.

History

The history of bio-gas stretches back to 1630 when Van Helmont recognised inflammable gas evolving through putrefication of organic mass. In the 1920:s most countries were aware of the technology for obtaining bio-gas, but it was not until the 60:s that interest really arouse. India and China, in particular, recognised bio-gas as an important resource, since the gas could be seen as an alternative both to oil and firewood.

In India the first bio-gas plant was built in 1897 in Bombay. During the following years a few gas plants were built, but in the 1960:s the bio-gas development programmes were intensified. Bio-gas got even more attention after the oil embargo in 1973. Just over 6000 plants had been installed in 1973, but in the fifth Indian five-year plan it was stated that 100 000 new bio-gas units would be built. In 1984 there were 280 000 units in India. (El-Halwagi, 1986, s. 663). This number does not indicate how many of the units were actually functioning.

The model built in India during the 1970:s was usually the Khadi and Village Industries Commission (KVIC) model. This model has a floating drum, which serves as a gas holder. One disadvantage of this model is its high investment cost. A new model was introduced in the 1980:s, which was influenced by the Chinese design. It was called the Janata-model. *Janata* is Hindi and means public. Today an even cheaper model is available, which is named *Dinabandu*, meaning "friend of the poor" in Hindi.

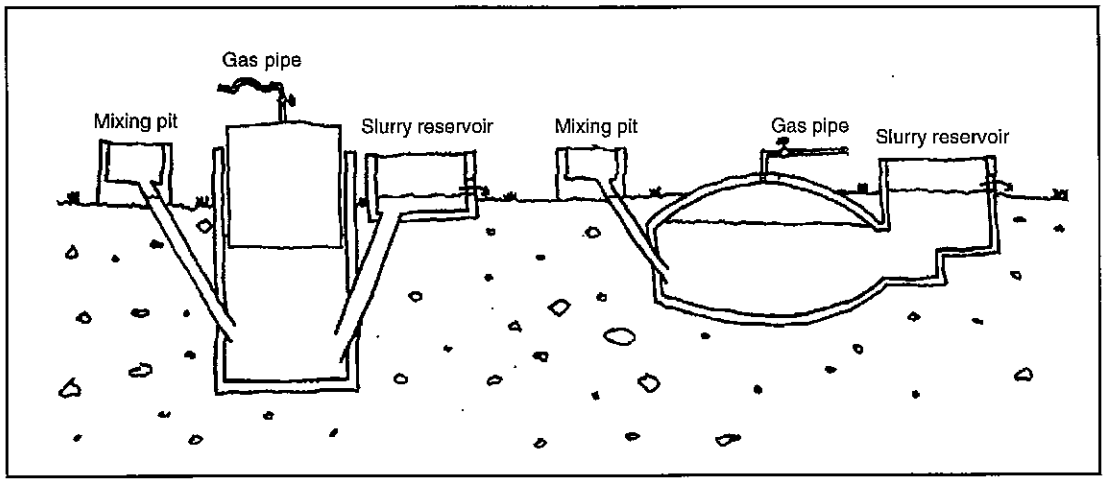


Figure 2. KVIC and Dinabandu bio-gas model

All three of these models are being built today. There are also other designs such as bag digesters. For more information on measures and construction, see for example UN 1984: *Updated guidebook on bio-gas Development.*

The bio-gas unit used in the WIDA project

The models built in the WIDA project are Dinabandu models. The choice has fallen on this model mainly because of its low cost. The units built will produce 2 m^3 gas/day if 50 kg of dung of ordinary quality is fed into the unit every day. The temperature in the ground should not be too cold, at least 20°C, as the unit will otherwise produce less gas. The amount of gas required per person per day has been estimated to be 0.3 m^3 (UN, 1984). This means that, in a household of four, the gas requirement is approximately 1.2 m^3/day.

Expenses for constructing a *Dinabandu* bio-gas as used in the WIDA project are as follows (pers com. Mr Panigrany, Gram Vikas).

Item	*Quantity*	*Amount (Rupees)*
Bricks	1 100 piece	400
Chips	25 tin	150
Sand		150
Pit digging	3x10 feet	100
Cement	13 bag	1 300
Mason		400
Stove	1 unit	200
Light	1 unit	200
Pipe	20 feet	150
	Total:	3 050

Table 1. The cost for one Dinabandu (2 m^3 gas/day) bio-gas unit.

All material, except the stove and the lamp, is available at a local level, although cement and pipes are not made locally. The stove and the lamp are industrial products from KVIC, Bombay Light Agni Doot. The pit is dug by the villagers.

The house in figure 3 is approximately 5 x 6.5 metres. The house is one of a row of houses. It consists of two rooms and one veranda. Attached to the back of the house there is a kitchen. *Kottni* is a hole in the floor where rice and other grains are pounded with a pole in order to separate the shell from the grain. The *zäta* is a hand-mill, usually made of stone. In the kitchen there is one wood stove, *hollo,* made of clay, but also a bio-gas stove. In the village where the house is situated, they have electricity. Every house in the village has electric bulbs. Before electricity were installed, they also had bio-gas lamps but they preferred electric light and sold the bio-gas lamps.

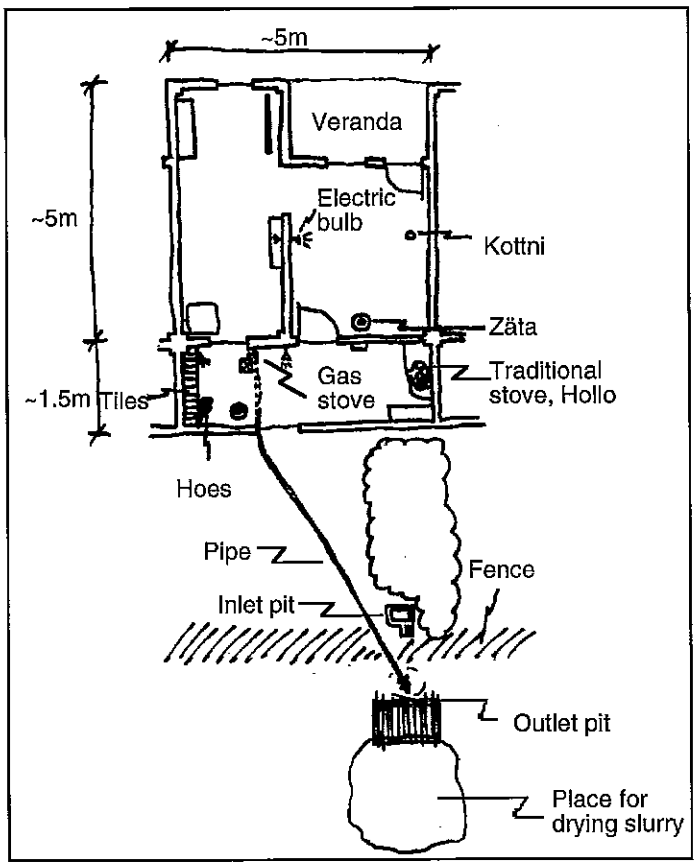


Figure 3. Kosai's house in Ljimkiguda

The bio-gas units are usually built near the kitchen so that as little pipe as possible has to be used. The pipe used in the villages has an outer diameter of 23 millimetres (3/5"). The length of the pipe is about 8 metres. There is no problem with pressure loss (Fulford, 1988). The system is not equipped with any drainage.

Operating a bio-gas unit

To produce 2 m^3 gas/day in the unit, 50 kg of dung is needed. The dung is supposed to be mixed with about 50 litres of water (1:1 ratio) to form a slurry, which is fed into the unit (UN, 1984). The water for this purpose does not have to be perfectly clean but should not contain of too much pesticide as this will have a restraining effect on the bacteria. Pesticides are not commonly used in the area.

When the site is loaded, dung is put in the inlet pit and the outlet is blocked with a stone. Thereafter water is added and mixed with the dung into a slurry. The slurry should have the consistency of thick pea soup[3] (UN, 1984, Fulford, 1988). The stone is taken away and the slurry will flow inside the gas plant. This will cause the effluent level to rise, and if it reaches the slurry outlet hole, it will flow out on the ground where it will dry. The unit in figure 3 was surrounded on three sides by a fence and bushes. To reach the pit, the gas pipe also had to be passed.

Once in a while the dried effluent in the back of the unit should be evacuated. This can be done with a hoe. If the level in the outlet pit rises, which may happen if the hole in the outlet pit is blocked, the gas pressure may rise above the limits. It is also possible for the level in the fermentation chamber to rise and the slurry to enter the gaspipe. This means that the unit must be shut down and the pipes cleaned.

When one operates the bio-gas stove, the first thing is to open the main gas-valve which is placed just above the gas dome. This will pressurise the gas pipe and the gas stove can be lit. It is the difference in slurry level between inside the plant and outside which defines the gas pressure. As gas is used, the difference will decrease and the gas-pressure as well. This is to be met through opening the gas valve on the stove. The valve on the stove is used to regulate the heat from the stove.

Bio-gas will only burn if it is mixed with air in the right proportions, i.e. between 9 to 17% bio-gas in air. As the plant is pressurised no air will enter the dome and the explosion risk is very small. The only time air can enter the dome and the explosion risk is greater is when the unit is started up and reloaded after a shut down.

There is a very distinct smell from bio-gas which will help users to detect leaking gas. If gas leaks inside a confined space the risk for explosion is greater. In the three villages where the fieldwork was carried out, a man, called Mr Wimmo, repaired and serviced the unit if necessary. He has attended the WIDA bio-gas training programme where he learned to repair gas plants and their equipment. He explained that the most common problem is leakage in splices and in 90° bends. He has been equipped by WIDA with a tool kit and some spare parts.

Stoves

Food is normally prepared twice a day in the village. In the morning, the morning-meal and lunch are prepared simultaneously, and in the evening, a meal which is similar to the morning-meal is prepared. The food that is consumed is normally boiled; frying is very uncommon. The pots that are used are normally made of aluminium today, but formerly they were made of clay. The ceramic pots were made by neighbouring villages and served as trade goods. Today ceramic pots are used to make *curries* (vegetables and spices boiled together), as they find that the clay gives the food a better taste than metal. Aluminium pots are bought in the market. The pots are normally round instead of flat underneath. The volume varies, but about 3 to 6-litre pots are used when preparing food for a household of 3-4 adults; the pot for curry is a little smaller. There are also pots for storing food and pots for fetching and storing water. These are bigger than those used when preparing food.

The people living in small villages in the area do not use dried dung for fuel, as in many other parts of India. People living in the towns in this area, on the other hand, could be seen using dried dung as fuel.

Traditional stove

The traditional stove, *hollo*, varies somewhat in shape and design from village to village. The stove is made of clay mixed with cow dung. If the stove cracks, which happens occasionally, the entire stove is rebuilt. This takes about one day and is done by the women. The basic design, see figure 4, is a rectangle with a box inside, where the fire is. Above the inside box there are holes where the pots can be placed. There can be one to three holes. Beside the holes there is some space where pots and other things can be placed. Over the stove many households have placed a tray where they store seeds, but they also use it to dry and give food taste from the smoke. The stove is usually placed close to a wall. In houses without a separate kitchen, the stove seemed to be smaller than in houses which had a kitchen room.

The stove is normally lit with the embers still left in the stove or from live coals from a neighbour. Matches are also used sometimes. The wood is fed into the stove through a hole at the front. The twigs, or pieces of wood, are fed in continuously, which requires the stove to be watched so the fire does not go out.

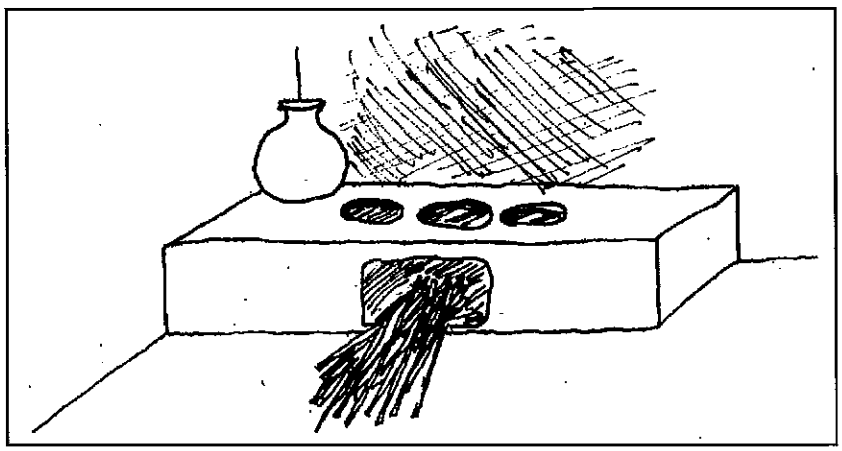


Figure 4. Traditional stove, called Hollo

There are no smoke pipes attached to the stove. Smoke escapes from the cooking holes and then through the door or roof. As a result, the draft in the stove is very poor. During food preparations it is very smoky in the kitchen, especially when the fire is only glowing.

Bio-gas stove

The bio-gas stoves which are used in the villages are manufactured and have partly been developed in India. The stove is called Bombay-Light Agni doot, made by KVIC, and is a standard model. It has one burner with a capacity of 0.4 m^3 gas/h, the dimensions are about 250x250x75 millimetres and it weighs less than 2 kg. It can be used with both flat- and round-bottomed pots.

The installation is done with a flexible pipe from the stove to the gas pipe from the bio-gas unit. The stove is not fixed to the floor or to the wall, but it is not possible to move the stove around very much as the flexible pipe is quite short (~500 mm).

The bio-gas stove is usually lit with matches. When food is prepared on the stove, a valve can adjust the gas flow and thereby the heat on the stove. The stove is not equipped with any wind shield. The stove seemed very sensitive to draft, especially when the flame was small.

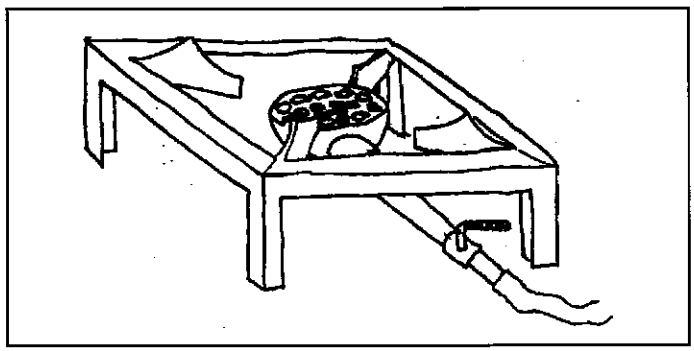


Figure 5. Bio-gas stove used in the Koraput district

A comparison of the stoves

In many ways the woman's daily work changes when she starts using a bio-gas stove instead of a wood stove. Food preparation and wood-gathering are two tasks that occupy the woman for many hours every day. To make a change, the user has to consider the alternative to be better then the original. In many ways, the bio-gas stove, is better than the wood stove, but there are also disadvantages compared to the wood stove.

When the food is prepared, both women and children gather in the kitchen. The people squat on the floor and help each other with the preparation of the food. It is normally very dark inside the kitchen as it does not have any windows. If light is needed, an oil lamp will be used, but people save oil as the oil has to be bought in the market. One woman explained that she preferred the ordinary wood stove, *hollo*, as it provided some heat around about. In the mornings when the food is prepared it can be very cold, down to 10°C, and the heat from the *hollo* is very much appreciated. The bio-gas stove is very efficient, which means that not much heat will escape to the surroundings i.e. it is not warm around a bio-gas stove.

The *hollo* needs to be watched continuously as otherwise it will go out[4]. The bio-gas stove also has to be guarded, lowering pressure must be met and the flame must not be allowed to go out. One woman in one of the fieldwork villages claimed that it took more time preparing food on the bio-gas stove compared to the *hollo*. This could be due to insufficient gas in the units. When there is no gas, the people have to make the food with wood as fuel. This means that they normally have to collect firewood in any case, which means extra work.

Inside the kitchen there is usually thick smoke, as the *hollo* is not equipped with a smoke pipe. If you enter while food is prepared, your eyes start to smart. In this environment children and women are gathered for one or two hours every time food is prepared. If the food is prepared on a bio-gas stove there is almost no visible smoke. However, ventilation is still important, as there are traces of hydrogen sulphide in the gas, which, after combustion, can irritate the mucous membranes.

Often a dish called *roti* is prepared, which is very thick. To prepare this dish the women supports the pot by putting har foot on it and stirs the dish with a big stick. Many times there are cracks in the *hollo* from this kind of food preparation. The bio-gas stove is not attached to the floor or to the wall. I doubt that it would be possible to prepare these dishes on the same scale as on the *hollo*.

Woman preparing food

5. India, and the situation in the Koraput district

India is a vast country with a population of more than 900 million people. The country is like a sub-continent, with many different languages spoken and people originating in different cultures. India is divided into 25 states and seven union territories. Each state has a parliament and a government. The states are dependent on the central government in New Delhi because most taxes are gathered for the central government and then distributed to the states. Big projects like dams and power stations have to apply for money at central government level (Ståhl, 1991).

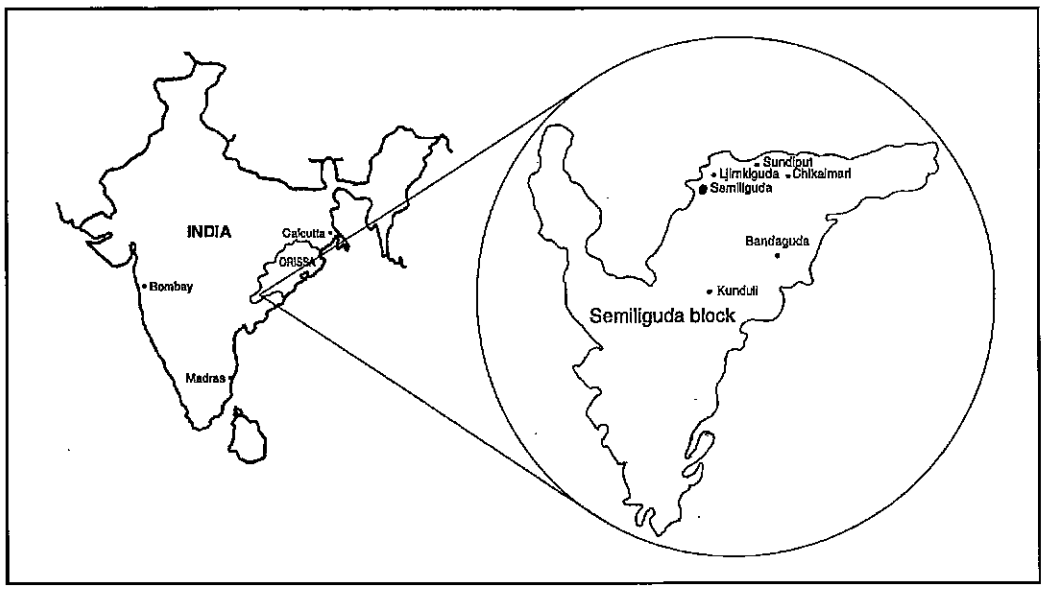


Figure 6. India and Semiliguda block, Orissa

Orissa is one of the eastern states of India facing the Bay of Bengal. In the southern part of Orissa there is a district called the Koraput district. The Koraput district is spread over 26 020 square kilometres, and has a population of 2.5 million people.

The district is divided into blocks which in their turn are made up of many panchayt. Each panchayt consists of a different number of villages.

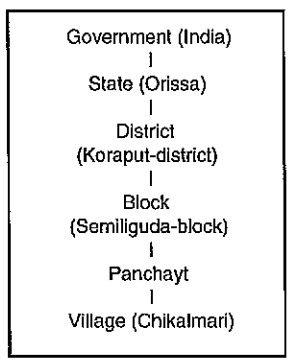


Figure 7. Government to village

Of the population in the district 80% belong to scheduled tribes, Daliths or backward communities (CReNIEO, 1991). These three groups of people are usually called scheduled tribe, scheduled caste (ST SC).

The tribals are the indigenous peoples of India. About 7.8% of India's total population (1991) are tribals. Their culture is often different from the hindu culture. This has led in some cases to great exploitation of the tribals. During the colonisation of India, the tribals in certain areas rioted against the English, who saw them as savages.

> *Tribals are the indigenous people, the natives, the original inhabitants, the aboriginals of an area, territory, region/country, closely knit, homogenous and integrated eco-societies built-up for generations, based on ethnic, cultural, social, and religious foundations. Their social structure is simple, uncomplicated lifestyles. The economy is self contained based on egalitarian values such as, collective ownership, no profit motive in economic dealing, a sense of mutual obligation, sharing, communitarian living, strengthening solidarity through unifying social action (Stanley, Tribal and social justice).*

The tribals in India are divided into more than 250 groups/tribes. The Koraput district lies in an area called Central Southern Tribal region, which stretches from Bihar to Orissa, and is one of seven regions where tribals are more common.

Many tribal communities have been forced to move because their land has been expropriated for large governmental and private development programmes. The exploitation and changes in life and environment have led many tribal communities to make a transition from constructive to destructive dependence on the environment (Fernandes, 1992). Today there is a tribal movement in India which aims to guard the tribal community against exploitation and discrimination.

Daliths are the Hindu people existing at the bottom, or in fact outside, the caste, *varna*, system. Gandhi called Daliths Harijans, which means sons of God, but today many prefer to be called Daliths so as to point out that they want to bring the caste system to an end, which Gandhi did not want.

In the Indian constitution it says:

> *Besides the scheduled castes and the scheduled tribes, there are other sections of the people who also need protection. These are "socially and educationally backward", and labour under various difficulties and conditions of social, economic or educational backwardness. (Constitution of India, s. 595).*

These communities are called backward classes. They usually belong to the *Sudras*, as they are low in the Hindu caste hierarchy.

Even though there are laws against caste discrimination, there is "positive" discrimination in the form of special quotas for ST SC in the universities, in the appointment of

government jobs etc. There are also special subsidies available for ST SC for buying cattle and other things (Ståhl, 1992). Even though these laws and regulations may seem radical, the reality is usually something else, discrimination and exploitation are every day news (Stanley, Tribal and social justice).

The WIDA project aims at helping the ST SC-people in the Koraput district. The villages which were visited during this field study are mostly inhabited by tribals. Therefore the subject of Daliths and backward communities will not be mentioned further.

Climate and water situation

The Koraput district lies in the highlands at an altitude of about 1000 metres. The weather depends on the season. The hot season is from March to May, and the temperature can then rise to 38°C. June to September is the rainy season, with the heaviest rains in July and August. On average, it will rain on 83 days and the total rainfall will amount to 1522 millimetres in one year. October to November is the transitional season just before the winter season in December and January. In December, which is the coldest period of the year, the minimum average temperature is 11°C (CReNIEO, 1991).

Deforestation has led to a change in the water cycle in the area. For example the roots which tied the water to the earth are gone, with erosion as a result. Today water is scarce.

Finding good drinking water in the area is difficult. Drinking water is usually collected in streams, wells or in springs, but is often of poor quality. Health problems due to the water situation are common.

A brief history of the villages

> *"Many years ago there was thick forest around Ljimkiguda. No police or foresters were to be found in the vicinity. The village consisted of 12 small thatched houses with mud walls. People cultivated small pieces of land and gathered fruit and vegetables from the forest. We didn't have to work very hard. The women wore big necklaces. We had many animals grazing in the forest. Things which were used in the village were available in the vicinity. Barter with other villages was common. Wood and building materials were taken from the forest.*
>
> *In 1971 the forest around the village was cut down. The wood was used for paper. Life went on but people had to work harder for less."*
>
> *Told by Mr Vasudev Jani village leader in Ljimkiguda village.*

The district was once covered with rich forest. In the forest there were animals, fruits, vegetables and wood in plenty. The people in the area, mostly tribals, lived as shifting cultivators, as they had done for centuries. They also hunted and gathered in the forest. The villages were small and there were no roads leading to them. The only way to travel was by foot. Water was never any problem. This suddenly changed as the forest was cut down in the 60:s and 70:s. The wood was needed for paper, plywood and fuel for

ironworks. The tribals in the villages got some compensation for the forest, but the forest they lived in actually belonged, according to state rules and regulations, to the government. The exploitation was not only done by industry, the people in the area also saw a chance to earn some money and used the forest as a resource for wood to a larger extent than before. Today the whole landscape has changed. No trees were replanted after the deforestation, and the hard growing conditions and the heavy pressure on the area for wood and grazing will prevent new trees from growing.

Workers on a coffee plantation

About 50% of the food came from the forest before it was cut down. It also supplied wood, fodder and smallwood. If the crops failed, people could gather fruit and vegetables to eat. All of that has to be replaced today with resources originating from other places. To get food more land is cultivated. The barren hillsides are used for grazing the cattle, and people gather brushwood or branches for firewood. There are not many trees which can be used for smallwood. Today, when there is a shortage of food, people have to hire themselves out as labourers so that they can earn money to buy food. The salary for this labour is usually below the minimum wage of 25 rupees. Women often earn even less than men.

WIDA, Integrated Rural Development of Weaker Sections in India

In 1979 a workshop initiated by Jeypore Evangelical Lutheran Church (JELC) and Nordelbische Kirche was held to discuss how the people in Koraput could best be supported through a systematic process of development. A study called "A Vision and Hope for the Downtrodden" was published in which the needs of the area were identified. The Centre for Research on New Economic World Order (CReNIEO) desired to implement a long-term programme "to help the people to help themselves". The programme was initiated in 1981 and was called the WIDA project.

The project has undergone a few extensive changes since the start in 1981. One modification is that the operation area has been reduced from 15 with 5 villages in each block, to one block in which all villages are attended to.

Objectives of the WIDA project

• As ignorance and lack of motivation appear to be the main cause for backwardness, the project aims is to improve the neglected lot by continued development education, health education and to motivate them to take to economic projects, which would be designed, planned and implemented by the people with financial, technical and moral support from our side.

• Training in skills form part of this programme to motivate the people to take self-employment by having small scale industrial units such as tailoring, typing, driving, carpentry, weaving, blacksmithy, pottery, brickmaking and handicraft in addition to commercial and food crop cultivation.

• Women are also given ample opportunities to get themselves involved in every stage of the project. Women's participation is spontaneous especially in the implementation of women's programmes which include child care, nutrition, kitchen garden and sanitation.

• Youth also get involved at all stages and most of the field workers– men and women–belong to this group.

(A Decade of Research and Action, CReNIEO, 1991)

The basic method in WIDA:s work is that staff members visit villages in the area where they attend different meetings and programmes. Health issues are dealt with by a health team which also includes a qualified doctor. Economic projects, such as housing projects, building of wells, are taken care of by an engineer. There is also a women's group, which consists of women, some of whom are tribals from the area. There are also a skill training group and a communication group. There are different staff members for different tasks, but the staff will recognise problems within other teams and inform them at the daily meeting at the WIDA office in Semiliguda. At these meetings the different teams also will inform the other teams of their work and if something special is happening. Every month there is a general staff meeting, where all the staff gather for discussions.

The villagers take an active part in WIDA's work. They are to be seen, says field co-ordinator Stanley, as the most important part of WIDA, without whom there would be no project.

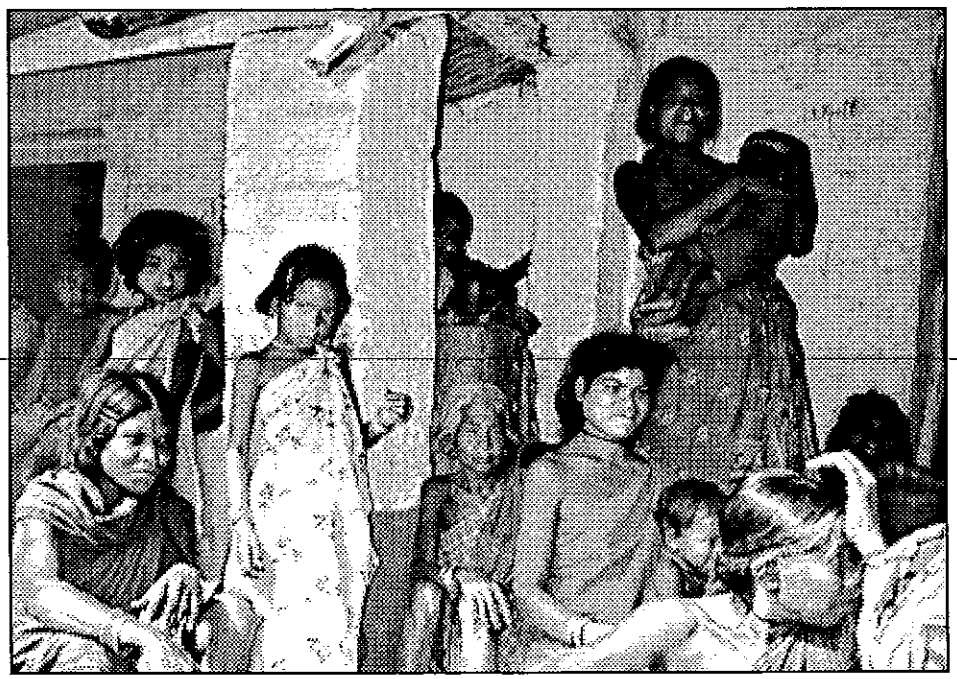
Tribals in this area usually form a meeting called *Lokosangathanas* where they discuss problems in their daily life and it functions as a disciplinary authority in disputes and the like. The meetings are used by the field workers in order to discuss the problems in the village and make the villagers aware of their situation. This work will also hopefully familiarise the WIDA staff member, who has frequent communications with the people at this stage, with the village. Hopefully he will gain the villagers' confidence.

Many of the field workers working with WIDA have spent some time, usually about six months, in rural villages to see and learn about the people.

According to one WIDA staff-member, problems raised in the *Lokosangathanas* meetings were, for example: bad health, lack of food, wood and land to cultivate. Many of these problems have their origins in the deforestation and exploitation of the area. In the villages WIDA has supported literacy programmes, women's groups, housing projects, health education, social forestry programmes[5], a bio-gas programme and more.

Mr. Stanley, Field co-ordinator at WIDA, explains that the main struggle for the people in the area is to get power. Today they do not really "exist". They do not produce anything, they are only consumers, and have to compete in the same market with the same conditions as industrial workers for example.

> *The main objective is to motivate the families by Development Education and conscientisation to fully participate and effectively practice through actual production exercises and become producers rather than remain only consumers for ever (Koraput project, 1989).*



Women and children at a village meating with WIDA staff

6. The villages covered by the fieldwork

All inhabitants in Ljimkiguda, Chikalmari and Bandaguda are tribals. They belong to the Khond tribe, or as they call themselves, *Koivasais*. They have their own language, *Kuvi*, which they speak among themselves. Many can speak Orya, which is the official language in Orissa. In particular, the women are not able to communicate in Orya. There are few villagers who have gone to school. The literacy rate is very low, about 3-4%.

In a village, people usually develop kinship ties with each other. The reason for this is that the boys will stay in the village, taking a bride from another village. Girls leave their village, when given in marriage, and live in the man's village (exogamous, virilocal marriage pattern). The bride's parents receive bridewealth, which is opposite to the Hindu dowry system. The tribals in the area have an animistic view of life.

If the household possesses land, they will be cultivators. Land is passed down from fathers to sons. In the villages, there are usually some landless households. They often descend from cattle herders. The cattle herders will get food from the people owning the cattle as payment. The land is often cultivated family-wise. Landless people can work in the fields and get part of the harvest. The landless can also sometimes get permission to use a field owned by someone else. Usually that field has lain in fallow so that much work is required in order to cultivate the land. Since water is scarce, it is only possible to get a single crop. To supplement their supplies, many households cultivate hillsides which are owned by the government.

Men going for harvest

The main crop grown is ragi, which is the staple food of the people in the villages. Ragi is a grain which is ground and used for different dishes, such as a thick porridge or bread, called *roti*, or boiled together with water to make a thin soup (ragi-water). Ragi is healthy

and consists of many minerals and nutrients. But ragi is considered poor man's food by many people in India. Therefore, if rice is available, it replaces ragi. In the field-work villages the people still used ragi and liked it very much[6]. One man said that his favourite food was *roti* made from ragi, because it made him satisfied for a long time. If he consumed other food, he would soon get hungry again. Rice is also cultivated in two different types, dryland and wetland rice. Rice commands a better price on the market, but requires better land conditions. Another crop cultivated is soua, a grain a bit like ragi. The only cash crop grown is oil seed.

There are not many households that cultivate sufficient food for the whole year. To survive, people hire themselves out as labour. In this way, they will earn money so that they can buy food at the weekly markets.

In the tribal community cows/bullocks[7] fill an important role. Cattle help in the cultivation mainly with ploughing and give the owner manure which is used on the fields as fertiliser. Artificial fertilisers like *Gurumer* and *UREA* are used in some extent, but are known to only give good results for one year. The next year will be the same as before. Dung on the other hand, they claimed, would give a good yield three or four years in a row. One man putting *UREA* on one field told that he sometimes used it because he did not have the time to put dung on the fields. The manure is carried from the village to the fields in two baskets attached to a pole. This way of carrying things is used for everything from rice to sewing-machines.

There is an intimate relationship between the number of cattle owned by a household and the amount of land they cultivate. This is because cattle are used only as help in cultivation, not for pulling bullock-carts. This means that if a household owns many cattle it also shows that the owner is a wealthy person.

Because cattle graze, they are dependent on the seasons for food. The villagers claimed that grazing was insufficient for 9 months of the year in the area. During the rain period there was enough grazing.

The market

The markets fill an important role in the villagers' life. It is a meeting place for people from different villages as well as a source of information[8]. At the market the villagers can sell their products and also buy necessities.

People buy different things at the market. Kerosene or oil used for lamps is bought. They also buy different kinds of food. For example they purchase salt, wheat, small dried fish, potatoes and other vegetables. Clothes are also available in the markets, as well as hygienic and beauty articles.

The villagers, both men and women, use tobacco to smoke and as a kind of snuff called *gulaku*. Whole leaves of tobacco are bought in the market and made into cigars. The cigars are smoked with the burning end inside the mouth.

Things which are sold at the market by the people from the villages are usually products which they have grown, such as pumpkins, dried chillies, ragi grain, oilseed and tamarind. Tamarind is a fruit from the tamarind tree and is used as a spice. But some will also sell wood or other goods they have manufactured themselves, to earn an income.

Market visitors arrive on foot. Many have to walk for one or two hours to get to the market place. However, many people will hitch a ride on trucks or go by bus on this day.

Liquor

The tribals in the area drink alcohol in connection with their worship, *puuja*, and during festivals. In recent years, however, the use of alcohol has been more spread and in certain villages, both men and women drink every day, making them incapable of working. Fighting and wife-beating have also been associated with alcohol consumption.

There are two basic kinds of alcohol available. On the one hand, there is fermented rice, ragi or soua water, which turns into a kind of beer which is not very strong in terms of alcohol by weight. The beer can be made by the villagers themselves. On the other hand, there is distilled hard liquor for sale. This liquor is made from flowers and from a tree.

WIDA have confirmed this problem and have tried to discuss the problem with the people. In the three villages concerned in the fieldwork the women's groups had succeeded in obtaining a decision in the village that drinking alcohol was permitted only on market days and during festivals. This decision is followed by the majority. The liquor problem still exists but is less.

Structure of the villages

In the landscape it is possible to see where there is a village because there are usually still some trees around the villages. The houses stand in rows facing each other, forming a road through the village. Around the houses there are gardens where vegetables are grown, and further away there are fields with ragi, soua, oilseed and rice. The villages are very compact with not very much open space, apart from the open space in front of the houses. Every inch is used for different purposes.

The building material was traditionally clay and bambu for walls and the roof was made of bambu, covered by grass. Today more and more houses have tiled roofs. The grass used for the roofs is hard to find as it grew in the original forest.

In the three villages where the fieldwork was carried out, WIDA has implemented housing projects. Whole villages have been reconstructed. The new houses are designed by the villagers so that they will be attractive and practical for them to live in. The planning work went on for many months. The houses built cost about 10 to 18 thousand rupees (320-580 US $) each. Houses are built of burned bricks or stabilised mudblocks and have tiled roofs. There are two entries, one at the back and one at the front. This enables the household to build an extra section of the house in the backyard. Many households have done this and have a kitchen section. The traditional houses have

verandas, and so do the newly built houses. One difference from the traditional houses is that the new houses have windows in order to improve the indoor environment. The village is now less compact than before, but there is still not much space behind the houses. Behind the house, or attached to the back of the house, the cattle sheds are situated. This makes the area behind the house muddy.

Bio-gas units are built in the backyards. There is normally not very much space around the bio-gas unit, which makes it more difficult to fill the inlet with water and dung. There is also conflict as to how much space should be used for drying the effluent as the space could be used for other purposes.

Twice a day the cattle have to pass the area behind the house. This causes mechanical damage to the unit. Leakage in splices is the most common problem according to the man responsible for repairing the units in the field-work villages. Cracks in the dome could also occur but are much more difficult to detect.

The outlet pit is usually covered by a wood pile or a net of branches, to prevent animals and children from falling into it.

Chikalmari, a village with no Bio-gas

Chikalmari is inhabited by about 80 people divided into 23 households. The village is remote, and until a few years ago it could only be reached on foot. Today there is a road to the village. The nearest market is 3 kilometres away, but the people in Chikalmari usually attend the market in Semiliguda, which is about 16 kilometres away.

The people are cultivators, but they do not possess very much land. Together in the village they own 23 acres of land, but in November 1993 18 acres of these were mortgaged[9]. The land they can cultivate is very dry, while the mortgaged land is more fertile. The situation has been like that for many years.

There are goats, chickens and bullocks in the village. Seven households have cattle, see appendix 2. In Chikalmari there are, however, more animals, as people take care of cattle from a neighbouring village. As payment for herding the animals, they will get the firstborn calf.

Vegetables are grown in gardens behind the houses, but not all households have one. In the gardens people cultivate pumpkin, chilli, green beans and more. Some of the gardens are possible to irrigate parts of the year, but still the vegetables will not last the whole year. The tamarind trees standing around the village of Chikalmari produce fruits which provide an important income for the people. Every tree will produce tamarind fruits worth approximately 200 rupees. There is a total number of 18 trees.

Water is available from a spring with a spring-protection well. It takes approximately 15 minutes to walk from the village to the well and back. During the summer season the well dries up, and water is then taken from a stream at the bottom of the valley.

There is no school in the village, and the parents do not send their children to school in other villages. One man explained that he had once been to school when he was young,

but he ran home the same day because he felt alone. He does not think it is right to force the children to go to school, but he also explained that if all the children from Chikalmari were sent at the same time it could be alright.

The houses in Chikalmari stand in two rows and are made of stabilised mud blocks and have tiled roofs. They were built in 1993 with support from WIDA. The design is very similar to the house in figure 3 and was drawn by the villagers in co-operation with WIDA. In a few houses kitchens has been attached to the back of the house. There are cattle sheds behind some houses. Chikalmari is a poor village in relation to other villages in the area.

During the period when the fieldwork was carried out the people in Chikalmari, with assistance from WIDA, were trying to redeem the land which they had mortgaged. This would result in an improvement of their life as they could cultivate more crops. Chikalmari have 20 acres of social forestry plantation just above the village. The land was given to the village women's group by the government. On the plantation there is mango, jackfruit, tamarind trees, etcetera. WIDA has implemented housing, health and literacy programmes, among other projects in Chikalmari.

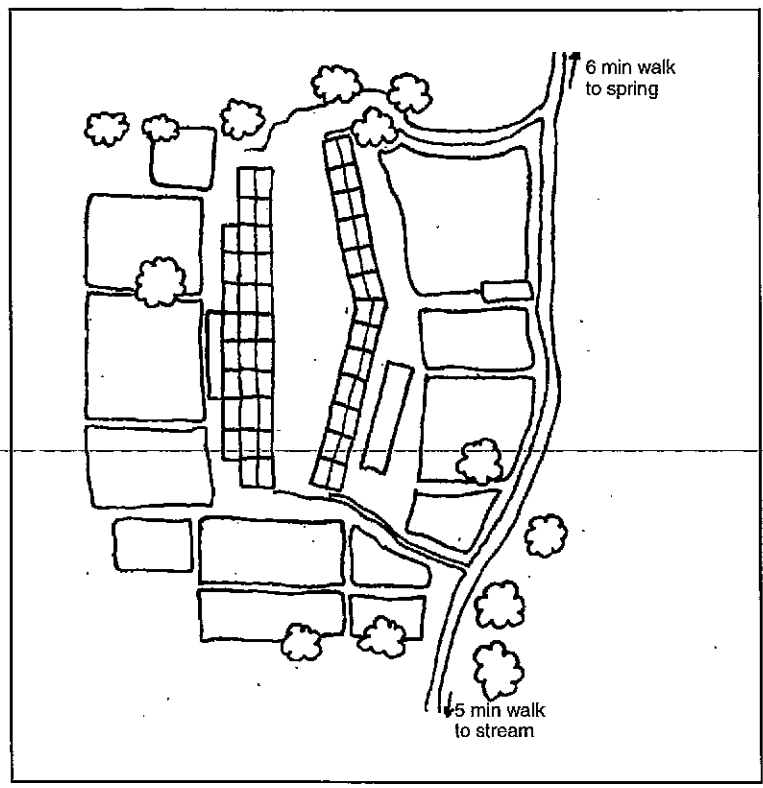


Figure 8. Chikalmari

Ljimkiguda, a village where every household has bio-gas

Ljimkiguda is situated about 2.5 kilometres from the main road. In the village there are 21 houses in two rows and one house where a herder and his wife live. About 100 persons inhabited the village in November 1993. One of the houses is a community house where literacy classes and health programmes, among others, is held.

In Ljimkiguda there is also one Department of Science and Technology (DST) staff member living with his family. DST is sponsoring a sericulture project which WIDA is implementing in the area. In Ljimkiguda a house has been built for rearing silkworms and reeling silk. To feed the silkworms, a five-acre mulberry plantation has been established. It is irrigated with an engine pump with water from the stream. The money earned from the sale of silk filament will go to the people working with the manufacturing of the silk.

Cattle are common in Ljimkiguda. Usually cattle sheds are attached to the back of the dwellings, but this attracts many flies. As a consequence, the Ljimkiguda villagers decided to place the cattle sheds at one end of the village when they built the new houses. Today there are not as many flies inside the houses as in other villages. There are herders taking the cattle for grazing during the day time. They live close to the animals (inside the cattle sheds) to guard them during the night.

There are two deep wells in Ljimkiguda. The two wells are situated at one end of the village. To get water from these, the women use a small bucket tied to a rope, ~4 m long. There is also a stream from where some households take their water. It is about 6 minutes' walk to the stream.

Almost every household has a 2 m^3 gas/day bio-gas unit connected. The households own different numbers of animals. The units were built at the same time as the houses in 1992 to meet the need for alternative to wood as fuel for cooking. The units were equipped with both a gas stove and lamp. Today the lamp has been replaced with electric light as the village has electricity. The units are placed in the backyard of the houses and then connected with a pipe to the kitchen. Of the total number of 18 bio-gas units built, six (33%) are used today, see appendix 1.

WIDA has worked in Ljimkiguda for many years. The work started in 1985 and is still continuing. Housing, bio-gas, literacy and health programmes are some of the projects implemented in Ljimkiguda.

Ljimkiguda possesses 160 acres of land, which gives the village sufficient ragi for the whole year but not enough rice. Oil seed is cultivated as a cash crop and sold in the market. Compared to other villages in the area Ljimkiguda is a rich village. They send their children to school. In the near future Mr Stanley (WIDA) expects the village to be able to get irrigation to some fields. This would enable them to produce multiple crops and strengthen their economy.

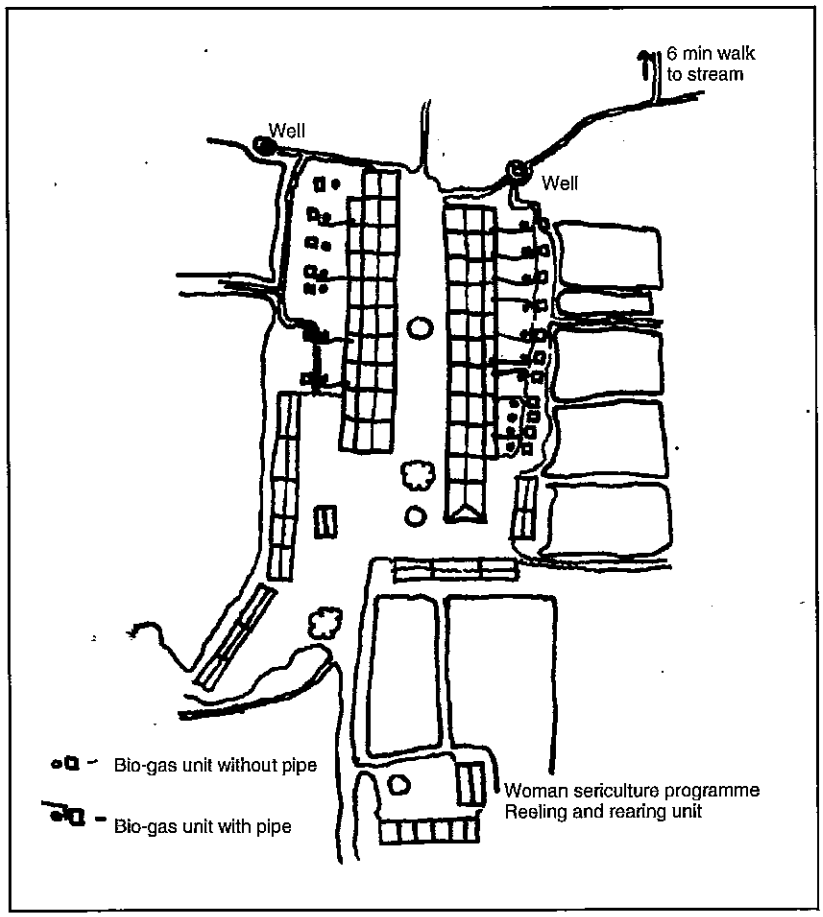


Figure 9. Ljimkiguda

Bandaguda, a village where some households have bio-gas

Bandaguda consists of 45 households, with about 200 people. There are some households which have a great deal of land and are managing very well, but some are landless. Some people send their children to school, while others do not. The block-chairman of Semiliguda-block lives in Bandaguda. There is also one woman living in Bandaguda who is an executive member of the Indian Council of Indigenous and Tribal Peoples. She is also a ward member in the panchayt.

The water in Bandaguda is collected from either a spring two minutes walk from the village or from a pump inside the village. Behind the houses, on the left side in figure 5, lies an area with gardens. This land can be irrigated. There are also some wetlands just below the village. In Bandaguda there are households owning land which gives multiple crops.

Twenty-two bio-gas units were built in Bandaguda, both 2 m^3 gas/day and 3 m^3 gas/day units. These were constructed and installed before the housing project was implemented in 1992. When the new houses were built, the bio-gas units were re-installed in

as many houses as possible. Because the village has become less compact, some owners have moved to places where there had been no houses before. As a consequence, 7 units are not installed in any house today. Of the 15 which are installed, 5 are not functioning and 3 are not used. This means that ~50% of the units which are installed are still used. The households which use bio-gas own on an average 9 head of cattle while households which do not have bio-gas own fewer (see appendix 2).

WIDA has worked in Bandaguda since 1988, which is as long as they have worked in Chikalmari. In Bandaguda they have implemented a housing project, literacy, health and skillstraining. All but two houses were built with support from WIDA:s housing project in 1992. The two houses not supported by WIDA were built before the housing project started and made of concrete.

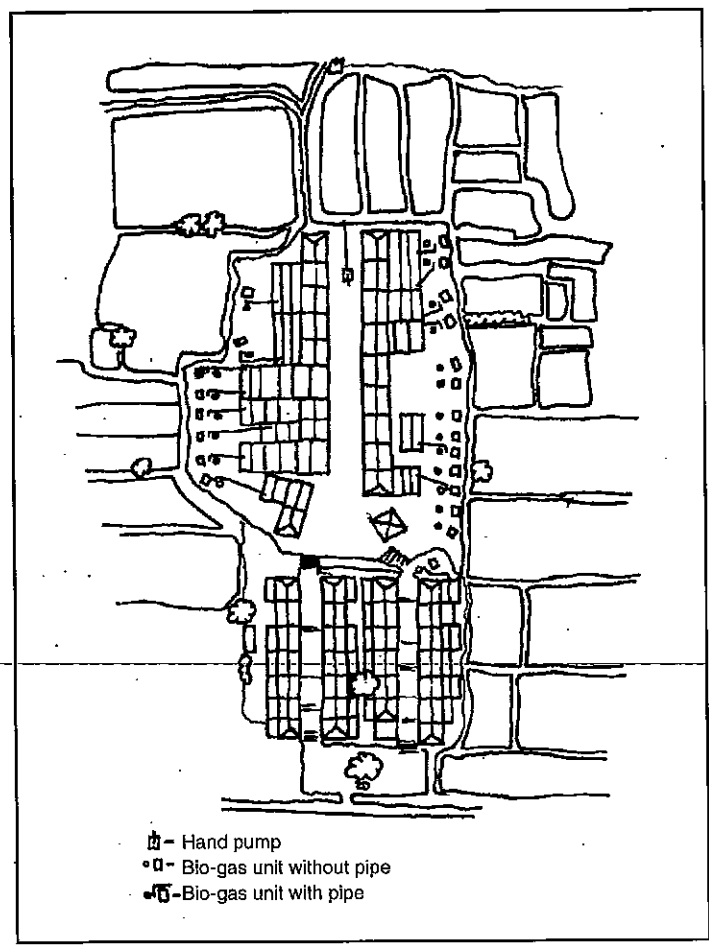


Figure 10. Bandaguda

7. Life in the village

> *"The people in the villages consider a person to be rich when he or she has sufficient food and clothes and possesses a good shelter" WIDA staff-member.*

The people in the villages are poor and for many of them there is a daily struggle to get food. During the daytime all people work in the fields or work as hired labour. Women have the major responsibility for child care, housekeeping and household chores. They also spend more days during a year in the fields compared to the men (Sachi Praba).

All households in the three villages were involved in cultivation. If they did not own land, they were able to cultivate hillsides or work on someone else's land. The life follows the changes in season. Their view of time could be described as cyclic, while the Western view is more linear (Frykman *et al.* 1979).

In many aspects the people in the villages live like they have always done. Cultivation strategies are old and labour intensive. Hoes and wooden ploughs are used in order to prepare the land. Poles are used for carrying loads. However, modern technology is now being integrated into their culture. Mopeds, bicycles, radios and electricity are just a few of the things that have been introduced in their life. Village funds have been set up in banks to meet bad years. More and more, they are participating in the world outside their tribal community. This may mean that their view of time will become more linear.

Resources available in the environment are usually not available for immediate use, with the exception of, for example, water, fruit and vegetables. Normally a resource has to be transformed in different ways to be usable by people. In the villages the land is prepared and cultivated. The grain is then pounded in *kottnis* or milled in *zätas* into flour. The flour is then prepared for food. The transformation of the material requires energy but also know-how. The more thoroughly the matter is transformed, the more know-how and information are needed (Tengström, 1983).

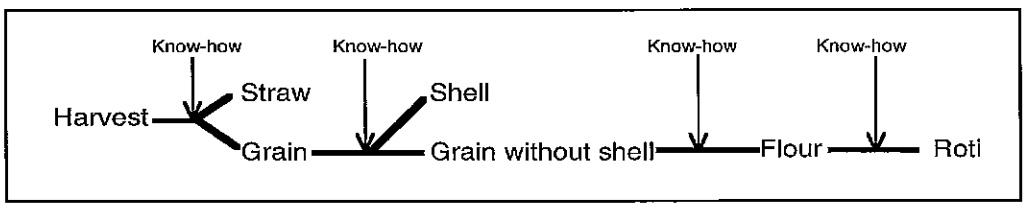


Figure 11. Transformation of harvest to Roti

In the village context, know-how about their use of resources is passed on orally from generation to generation. Children participate in the daily work of their parents, thus they will learn these processes as they grow up. The transformations are well known, but the raw material is restructed/transformed only in small steps:

In this context bio-gas is an exception. Methane gas is derived from the dung, and after, the dung is still functional as fertiliser. The transformation of dung to bio-gas requires the user to have a basic knowledge about managing the bio-gas process.

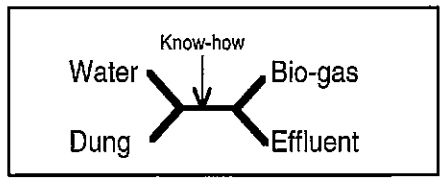


Figure 12. Transformation of dung to bio-gas

Fulford (1988) explains that it is important for the project's staff to know about the bio-gas process, but does not mention the importance of know-how in the user group. In the Chinese bio-gas programme, initiatives has been taken on at the user level. People have done experiments with their own units. One explanation for this is the fact that there is a compost tradition in China. Composting is similar to the bio-gas technique in many ways. Both are ways of managing resources in nature. From this tradition the Chinese have also gained a basic knowledge about managing bio-gas. In the Indian fieldwork villages few knew how to manage bio-gas.

The gas available in the unit is not produced from the dung which was put in the same day. To run a bio-gas unit properly, it is necessary to feed it continuously every day at the same rate. Changes have to be slow (UN, 1984, Fulford, 1988). There is an inertia, however, concerning the retention time of the unit. The effluent is usually not totally fermented, which means that if slurry is not put into the unit for a few days, there will still be gas available. When slurry is fed into the unit again, the variety of bacteria has decreased and the process slows down. In order to make the unit work properly, an extra daily routine should be added to the daily scheme, while other routines, gathering wood for example, could disappear. This seems simple enough, but the people in the villages normally do things at the time when they have to be done. Many households said that if they had time to put dung and water in the unit they would do that. Otherwise they would only use wood instead. All households except one used bio-gas as a supplement to wood.

One day in the villages

The daily pattern changes from season to season, but there are some daily routines which are performed every day. An attempt to describe the daily routines during the transitional season (November, December) is made below. In many ways, however, this description will outline daily patterns during other seasons also.

The period of November to December is harvest time. Almost all people work with the harvest. Few go to work as hired labourers outside the village, as there is work to be done in the village. Otherwise, the people working as hired labourers leave the village early in the morning and will not return until the evening.

In the morning at about three or four o'clock the village wakes up. One starts hearing pounding sounds. It is rice which is pounded so that the ear will be separated from the grain. There are also sounds from grinding ragi or soua. The women are preparing grain for the whole day. At this time of the day it is dark, nobody is outside, only the women are awake. This continues until five. It starts to get light outside, and one can see men gathering around small fires or on verandas with blankets around them. Small children are sometimes seen with the men.

Inside the houses the women have started to prepare the food. Two pots are used for the morning meal, ragi, rice or soua and, if possible a curry. One pot is also used at the same time to prepare ragiwater for lunch. Sometimes a pot is placed on the stove with bathing water for the man or children. The stove will be utilised for preparing food from one to two and a half hours. During the preparation of the food the women do other things such as putting away the beds, sweeping the house inside and also the area in front of the house.

Girls doing the dishes

When the cattle have been taken out to graze, around seven or eight, the cattle sheds have to be cleaned. This is done by the woman. The cleaning involves carrying away the dung and sweeping the floor in the shed. This takes approximately 15-30 minutes depending on the size of the shed and the number of cattle. If the household uses bio-gas the women will take the dung, mix it with water and let it into the fermentation chamber at the same time as they clean the sheds.

In the morning women and young girls can be seen walking to the spring, well or stream carrying pots. They will do the dishes from the evening meal and also fetch water. It usually takes a few minutes to walk to the place where water is collected.

The men go to the fields after the cattle have gone. At around nine or ten they return to eat the morning meal together with the rest of the household. They eat sitting on the floor inside the house. The man takes his food first. After the meal the men, accompanied by some of the women, return to the fields. At this time, they bring ragiwater for lunch. If the field is a long distance from the village, food is brought in the early morning and they will not return to the village until the evening.

Between the morning meal and the preparation of the evening meal, the women attend to different tasks, from collecting water to working in the fields. Women wash clothes and bathe at the same time as the dishes are done at the waterhole. On the way home they will bring water to the house. Wood is collected either on the way home from the fields or as a separate task.

The men start to return to the village at four or five. They gather in small groups and talk or do different kinds of small tasks like mending tools. The cattle return to the village also around this time and are placed in the cattle sheds for the night.

The evening meal is similar to breakfast. It is prepared about four or five in the afternoon, and it takes one or two hours to prepare. This meal is taken at around six in the evening. It is now dark outside and, after eating, the men gather around fires, the women sit on the verandas. Now is the time for talking, singing and dancing[10].

At about eight in the evening people go to bed and soon everything is quiet until the next morning.

Bio-gas in the village context

Bio-gas involves many changes for the people when it is introduced in the villages. The changes can be analysed on the basis of three different resources in the village context. The resources taken into consideration are:

- Water
- Wood
- Cows

Changes in the use of these resources can be placed in the boxes described under "Method".

Water

In the village context, water is used in two different places:

- At the stream (dishes, bathing, washing clothes...)
- In the village (cooking, bathing children, washing the front yard...)

Much water is used where the water is available and collected, i.e. the water hole. The other place where water is used is at home. This water is usually carried by the women. At the watering hole, water is used for washing, doing dishes, bathing and so forth, while the water used at home is used for cooking, to some extent bathing (men and children), and to spray the front yard with a mixture of water and cow dung. Each day approximately 20-30 litres are carried home. This water is not carried at once but on two or more different occasions. The women will usually bring water home after having done the dishes, or something else at the stream, well or spring.

The bio-gas units need as much water as dung, a ratio of 1:1. If 2 m^3 gas/day is required, about 50 litres of water are needed to mix 50 kg of dung. This means that a doubling or tripling of water used during a day has occurred. The water has to be added

at the same time as the dung. This means that if all dung is put into the unit in the morning, large quantities of water are needed at once. Water has then to be collected from the water hole many times in a row, without doing other work in between. According to the villagers, it was uncommon for water to be fetched for the sole purpose of using it in the bio-gas unit. Usually, they explained, the rest of the water available in the house was used. The increased amount of water needed for the household, as well as changed water-collecting practices are an obstacle to the use of bio-gas, as it seems[11].

During the transitional season, the water situation is fairly good compared to the summer season. In the three different fieldwork villages it took about 3-10 minutes to walk to the place where water was taken.

The villagers explained that in the summer water was scarce as the spring of Chikalmari and wells of Ljimkiguda and Bandaguda usually dried out, but they could normally collect water in streams. However, water was available throughout the year as the villages all are located relatively near streams.

Wood

The gathering of firewood is usually done by the women, but also sometimes by the men. Wood is gathered on the way home from the fields, but people must also walk some distance away, particularly to collect firewood. The people we asked had the opinion that collecting wood was not hard work, although it was not easy.

During the rainy season it is difficult to find dry wood. Therefore, wood is saved and stored during the rest of the year for use during this period. It is also common for people to collect wood for fuel during periods when there is not so much work with the agriculture in order to save time when much work has to be done in the fields.

It is possible to collect branches and small trees but the work is quite time-consuming. The situation was described by the villagers as less acute in some villages. In Ljimkiguda they told us that it was not so much of a problem to get firewood, but in Bandaguda and Chikalmari they said that it was quite a problem. An estimate of the situation is that it takes at least one whole working day for one person to collect wood for a household of four persons per week.

Cows

The amount of dung is directly connected with the amount of food the cattle get. As there is less grazing during 3/4 of the year, this means that less dung is produced. In order to get enough dung for the bio-gas unit (about 50 kg/day) six or seven cows are needed at least under these conditions. However, the dung which the cattle produce during the daytime is not gathered, which means that even more cattle are needed. Another complication is that, for bio-gas purposes, the quality of the dung is lower when there is insufficient grazing.

Conditions	Number of cows
Sufficient grazing, all dung produced collected	3–4
Insufficient grazing, all dung produced collected	5–6
Insufficient grazing, dung produced during night collected	7–9

Table 2. Number of cattle needed for a 2 m^3 gas/day unit under different conditions.

The Bio-gas supervisor at Gram-Vikas, Mr. Panigrany, said that for a 2 m^3 gas/day unit six cows which were given proper food were needed. He also argued that if the dung was collected to a larger extent, three cows would be sufficient. When discussing the issue in the villages, the people claimed that at least ten cows were needed to get enough dung.

In appendix 2 the table shows the number of cows owned by the households who had and used bio-gas. In Bandaguda these households had an average of about 9 cows each. Some other households without bio-gas units, randomly picked out, had an average of two cows each. In Ljimkiguda the people who used bio-gas had an average of about five cows. The average number of cows owned by the rest of the village, bio-gas users not included, was six cows.

	Average no of cattle, household with bio-gas	Average no of cattle, household without bio-gas
Ljimkiguda	5	6
Bandaguda	9	2

Table 3. Average number of cattle owned by households in Ljimkiguda and Bandaguda.

As the dung collected for the bio-gas unit is the dung from the cattle sheds only, and it would be very time-consuming to gather dung from the grazing areas, a solution would be to keep the cattle fenced in. The herders believed, however, that this would be impossible, and they had never heard of people doing this. A solution like that would not be functional in the area as it would raise other problems such as watering the cattle, the use of good land to keep cattle, storing food for seasons when the grazing inside the fences is not enough and so on.

8. Health

The village is a place where all kinds of different activities take place side by side. People and animals live very close together. Certain areas outside the village are used as latrines. According to the WIDA-staff, it would not be possible to introduce latrines in the villages today.

The area in front of the houses, the village road, is swept and sprayed with a mixture of dung and water every day. Still there is animal faeces in the village, as cattle pass the area twice a day. This attracts flies, as do the cattle sheds in the back-yards. The sheds have mud floors which are cleaned, and the dung is carried away every day, but it is still very muddy inside the sheds.

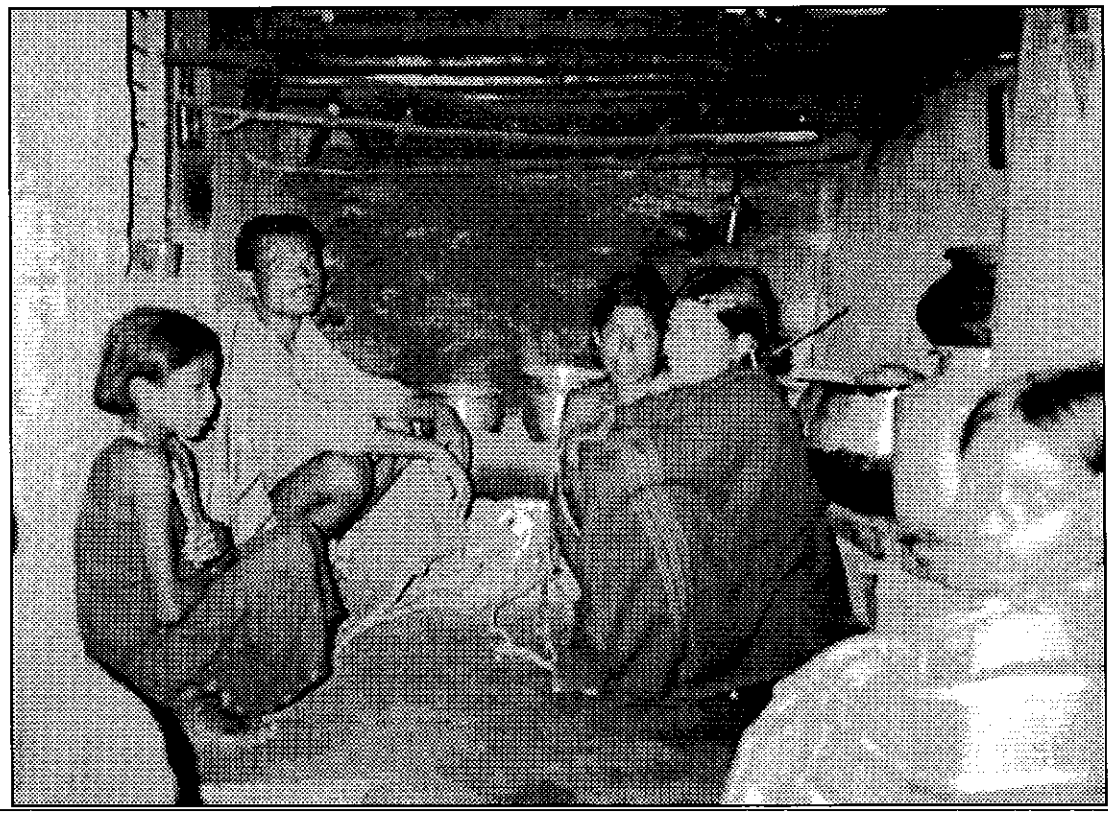
As mentioned before, the cattle shed is normally attached to the back of the house, which causes unhealthy conditions. In Ljimkiguda they have tried to overcome this problem by placing the cattle sheds at one end of the village. There were fewer flies inside and around the houses in Ljimkiguda, compared to the other villages.

Bio-gas effluent does not attract flies. The bacteria in the dung, e.g. coolie bacteria, do not survive the anaerobic digestion (UN 1984, s. 93). Parasites are also killed to a large extent (Ellegård *et al.* 1983). These three factors have a positive effect on the health status in the village. The doctor at WIDA did not know about the impact bio-gas has on health issues. The bio-gas project in the villages had not been investigated from the point of view of health improvement..

The smoke from the stoves is a big health problem. Few investigations have been made on this topic (AMBIO, 1985), but they point out some interesting facts about the environment in which the women prepare food. The concentration of different gases such as carbon monoxide and formaldehyde exceeds the concentrations a heavy smoker exposes himself to. Pilot studies have indicated that several types of chronic and acute respiratory diseases are associated with smoke exposure. It is also claimed that the largest source of mortality in developing countries today is respiratory diseases together with gastrointestinal disorder (WHO Annual Statistics Report Reveals Major Public Health Killers (Press Release WHO/8, World Health Organisation, Geneva June 21, 1984)). According to the doctor at WIDA, many women have respiratory problems.

When food is prepared there are usually many people in the kitchen. Small girls help the women in the preparations and babies are often carried by the women. The smoke is very thick, it makes the eyes run and coughing is common. The problem with all the smoke is noted by the people, and they argue that bio-gas does not smoke. It is worth noting that bio-gas also requires good ventilation, as the gas in some cases contains traces of hydrogen sulphide (H_2S). H_2S will oxidise to sulphur dioxide, which is highly irritable to eyes and mucous membranes (Ellegård *et al.* 1983).

The health status in the area is very poor. People are often sick and many die from diseases. Koraput lies in an area where malaria is widespread. WIDA is making a great effort to improve the villagers' health. This is done mainly through informing them about preventive measures. They also support and educate local doctors (medicine men/ herbalists) and midwives.



People gathered in the kitchen

9. The Bio-gas programme

Since the early 70:s there is a massive bio-gas programme in India, which is supported by the central government. Research and development concerning technical issues around the process are in progress. Much of the programme is based on subsidies and favourable loans for investments in bio-gas units. The amount of subsidies given depends on the type of group and the size of the unit.

Group	Amount of land	Subsidy 1990 (Rupees)
Scheduled Tribe		3100
Scheduled Caste		3100
Other Caste		
Small farmer	1/2 acres, 1 Ha	3100
Marginal farmer	1 acres, 2 Ha	3100
Big farmer	>1 acres, >2 Ha	1900

Table 4. Subsidies available for 2 m^3 gas/day unit in 1990.

The subsidies given have been lowered since 1990. The units in the fieldwork villages were built with the assistance of the subsidies above.

The government bio-gas programme is carried out in the states by different agencies. In Orissa, the Orissa Renewal Energy Development Agency (OREDA) is responsible for the programme. OREDA gives subsidies to people who build bio-gas units. In the Koraput district, 80% of the installed bio-gas units were built by, or with the assistance of Gram-Vikas. Gram Vikas is an Indian non-governmental organisation (NGO). They receive a labour commission from the government of 500 rupees for every built unit.

In 1993, the units built in the villages could be constructed for a cost of 3 050 rupees each. This means that the units would not cost the villagers anything if they were given a Rs 3 100 subsidy. It is important to note that even the cheapest bio-gas unit is expensive for the majority of the people if they have to pay the entire cost (Ellegård *et al.* 1983, Fulford 1988). When discussing the cost of bio-gas it should also be considered that if more cattle have to be bought, that is a cost for the farmer. One bullock costs about 2 000 Rupees.

Bio-gas programme, implemented by WIDA

The bio-gas programme which WIDA is implementing is meant to give the people an alternative to wood as fuel as this resource is beginning to be scarce. It is also meant to improve the situation for the women in the area. The programme has had much help from the organisation Gram-Vikas, because WIDA did not have the necessary know-how to run a bio-gas programme when the programme was initiated.

Today WIDA has the necessary knowledge to implement their own bio-gas programmes. They also have a 30-day bio-gas training programme designed to teach the

people about bio-gas and how to maintain the units. In Gram-Vikas there are, however, specially trained people for building bio-gas sites. They have, to a large extent, supervised the construction work in the villages, together with the people. In Bandaguda, Gram Vikas implemented the whole project from planning to construction, while in Ljimkiguda, WIDA asked Gram Vikas to provide one man to help them in the implementation of their project.

Mr Panigrany, bio-gas supervisor at Gram-Vikas, has helped WIDA in Ljimkiguda and other villages in the building of bio-gas units. He describes how he usually initiates a bio-gas programme in a village.

A meeting is held where he describes the benefits gained from bio-gas for the people and the environment. His arguments are:

- Cooking is free. An economic calculation where wood bought at the market is replaced with bio-gas. Bio-gas is considered free.
- The forest is saved.
- Light is free. A similar calculation to that for the cooking is made, but here kerosene is replaced with bio-gas.
- Dung is free. As the dung will be concentrated in one place instead of many different piles, dung will be saved. [Mr Panigrany said that much dung disappears through this handling].

After explaining these benefits, he will ask if they are interested in having a bio-gas unit, and makes a list of those interested. The number of cattle is also noted on the list. He will then check that the information given is correct, and also if it is practically possible to build a unit at the house in question. If the households have a problem in financing the unit, Gram-Vikas can help them to finance it through a five-year governmental bank loan.

He explains that he confronts the men first. If they do not respond positively, he talks to the women. If people still do not show attention, he will collect a group and take them to an exhibition plant at the Gram Vikas office.

Information material

Information and know-how are essential to use a resource. WIDA:s vision contains education as a leading word. The intention is that, through education, people will become aware of their problems and able to solve them on their own. Projects start with discussions where the villagers discuss their situation and if there are any problems, and if there are, what solutions are there. WIDA staff help them to find methods to solve problems discussed. One problem which is discussed often is the problem of finding wood, so is the lack of forest. As a part of a solution, bio-gas is mentioned.

Apart from the information given by WIDA and what the villagers already know, there is a slide-show and a brochure that can be used as instructional material. The material is not made particularly for WIDA but has their name on it. The brochure can be seen in many community houses in both villages with and without bio-gas.

The text on the brochure, translated from Orya, is as follows. Description of the picture inside [ ]:

- Instead of firewood–Gas [Picture showing hills with no trees, women carrying wood, bullock cart loaded with logs]
- Instead of kerosene–Gas [Picture showing kerosene stove]
- Instead of cow dung–Gas [Picture showing woman with dried dungcakes]
- Gobar gas plant [Picture showing a plan of a bio-gas site. A man puts in dung on one side, arrows going to plants, lamp, engine and a cooking pot.]
- Other uses–Light [Picture showing man lightning a bio-gas lamp.]
- Keep in mind (how to use the gas) [Picture showing woman lighting a bio-gas stove. Big stove with large clean pot on it.]
- What is bio-gas? [Picture showing woman sitting in front of two bio-gas stoves (smaller). One pot illustrating soot.]
- Bio-gas slurry is a good fertilizer [Picture showing woman sitting with baskets filled with vegetables, also showing picture of grain in a field.]

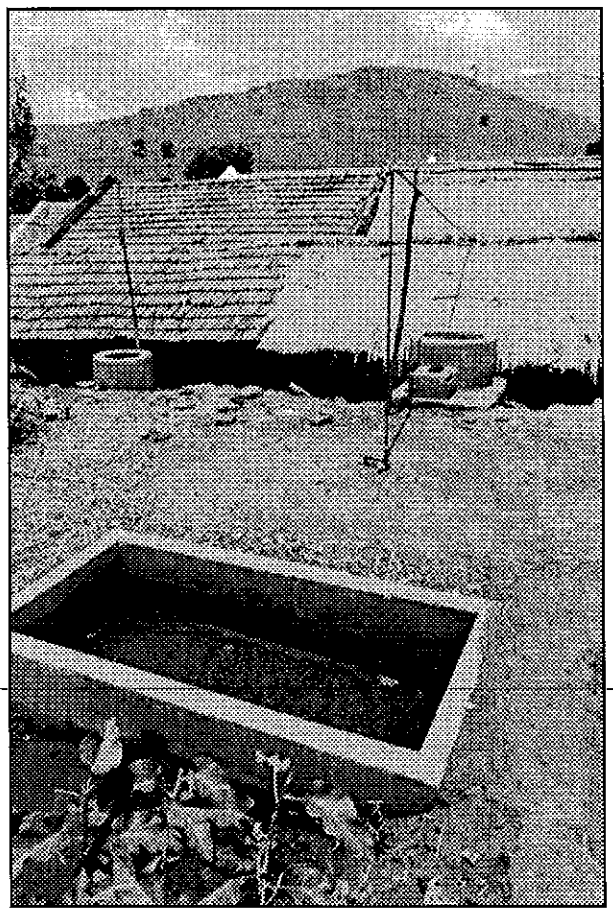
The pictures in the brochure can also be found in the slide show but here there is more text. The slide-show audience is informed that a gobar-gas stove is quiet[12] and does not smoke. It also explains that cooking pots not will turn black. Another picture tells that 35 cubic feet ($1m^3$) gas is equivalent to 13 cow dung cakes which can be used as fuel. 35 cubic feet ($1m^3$) gas is also said to be the same as 0.6 litres of kerosene. In this picture it is also stated that you will not only save money personally, but also help the country, which would otherwise have to pay a lot of money to the people selling kerosene. Another picture tells the viewers that "Health will be increased as flies are not attracted to the slurry." The slide show contains a total of 59 pictures. Most of the pictures show units under construction.

When people in the villages are asked about bio-gas, they could say that you would not have to use firewood and that you would get free light. People also knew that time would be saved but also that you needed many cows. Very little knowledge of how the units actually worked as to be found. Some people that were asked about bio-gas did not know anything about it.

The information material has not been produced exclusively for the tribal community in Koraput. There are pictures showing men working with the units, although in the villages the women are doing all work with the units. There are many arguments pointing out the economic benefits gained with bio-gas. In the villages wood is seen as a free resource. From this point of view all economic benefits gained from choosing an alternative to wood could be viewed as a loss if there are expenses related to it, as in that case they would have to pay to get their fuel. The villagers might have difficulty in believing or understanding this kind of information owing to social and cultural differences.

To get light from bio-gas instead of from kerosene can be viewed an economic benefit as kerosene has to be bought. In Ljimkiguda, where bio-gas lamps were installed, they now have electric light at a cost of 50 rupees per month. This may indicate that economic benefits are not that important in their choice of resource.

The information should focus more on how to run the unit. The information should be aimed at reaching the women who are the main beneficiaries of bio-gas. If the women were to come to the conclusion that bio-gas would help them in their daily life, much would be gained. Today bio-gas is an issue handled almost exclusively by the men but the units are operated by women.



Bio-gas unit behind the house

10. Bio-gas and development

"The most important issue for us is unity. Without unity there is no future for us" Tribal woman when we asked her about the future.

WIDA is an organisation sponsored by different funds, such as Lutherhjälpen in Sweden, and United Evangelical Lutheran Churches in India (UELCI). WIDA:s vision is realised through education. Programmes such as health, development and technical education and also literacy classes are fundamental to their vision of the future. Today, many people in the villages believe that education is important. More and more children are sent to school, but this work takes long time. Results can not be seen straight away.

There are also programmes, such as the housing project and the bio-gas programme, where the village infrastructure is considered. These programmes are quite spectacular compared to health education, and as such they are very good for fund-raising. They are visible in a short time perspective, pictures can be taken to show the funders the progress being made. Bio-gas units are visible, and they are also interesting to view for almost everyone as they cater for a variety of interests. Westerners are also allowed to inspect and get to understand the bio-gas technique used. These "building projects" are complementary to the other projects. As Mr. Stanley said when discussing this issue; "The most important development is the people's development."

WIDA works with bound labourers, landless people, marginal and small farmers, tribals, daliths, women and weaker sections in the area (Integrated Rural Development of Weaker Sections in India). These groups are usually very poor, many living under the poverty line. They do not own much or any land. The number of cattle a household has is intimately related to how much land they have; the more cows, the more land, and vice versa. To get 2 m^3 gas/day the household needs at least six to seven cows, which in the village context is a large number. The bio-gas technique is not accessible to the poorest as they do not own cattle or possess land.

When a development programme is implemented, an investment is made both by the development organisation and by the people. This investment is not only in monetary terms. The people will invest in confidence in the organisation and its total work. If the programme fails, it might lead to failing trust in development programmes and in the organisation as a whole. A bio-gas unit is very difficult to take away if it breaks down or fails. The unit is not possible to hide either. The failed units will become monuments of failure. Failed projects might not be crucial for WIDA as an organisation, but may be crucial for the confidence in their programmes. If there are too many failures, people may become sceptical towards participation in further work with WIDA.

11. Concluding remarks

A bio-gas project concerns many different fields and there are many factors to keep in mind in the analysis. To summarise, I will shortly mention some of the material presented in the preceding chapters:

- Bio-gas can positively affect the situation of the women.
- Bio-gas is an alternative to wood as fuel.
- The natural conditions which are needed in order to make the bio-gas units work exist in the area.
- Many households who have built bio-gas units do not use them.
- At least seven cows are needed to get enough gas for each household.
- Bio-gas is used to supplement the ordinary wood stove, *hollo*, in the villages.
- There is not much knowledge about bio-gas in the villages.
- The investment cost for one bio-gas unit is very low for the villagers.

If the factors which have been discussed thus far are placed inside the model from figure 1, it would look like this:

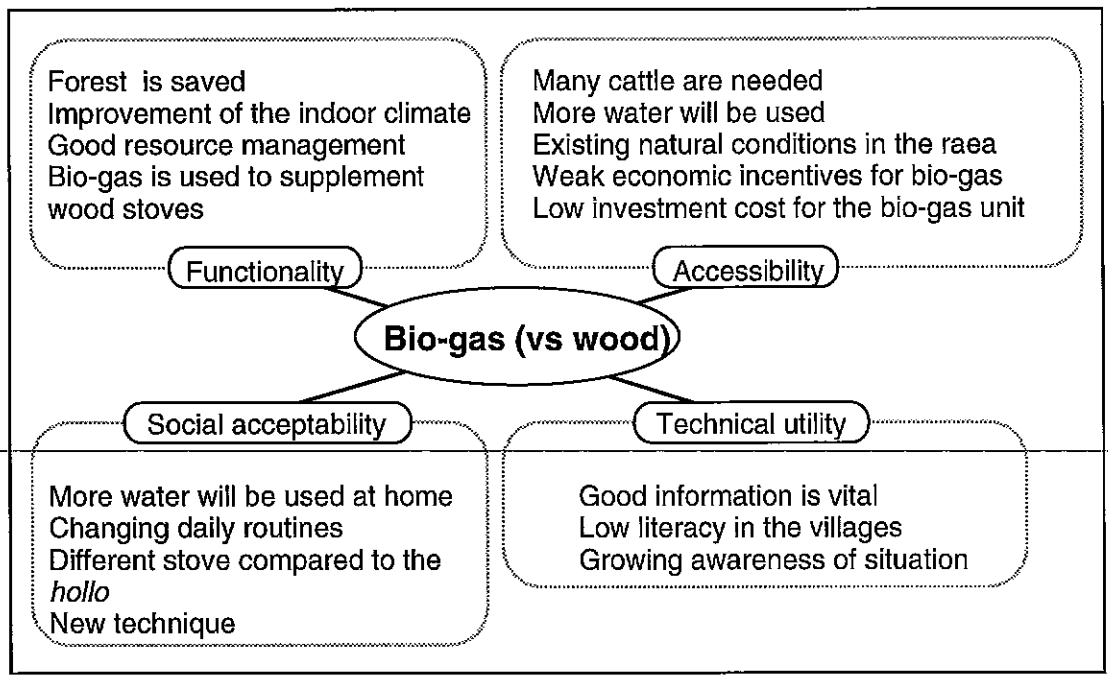


Figure 13. Factors placed in the model from figure 1

The natural conditions for bio-gas exist in the area, although the temperature can be very low sometimes. These conditions give basic accessibility for bio-gas. However, there are problems concerning animals, as the number of cattle required for obtaining sufficient dung for the unit is at least six or seven. This means that many households do not have the possibility of using solely bio-gas. Households which use bio-gas use it to supplement their wood supply. This makes bio-gas less functional as they have to get wood anyway.

Using only bio-gas affects the life of the households in many ways. Daily routines have to change to some extent. Water usage at home will at least double or triple if bio-gas is to be used solely, but the pattern of collecting water also has to change. This will interfere with the cultural patterns. To bring about any change, it is essential to make bio-gas socially acceptable in the village context. Information is also required to make the bio-gas technically usable and functional for the people.

What seems to be the most important issue in the implementation of the bio-gas programme is information. That is, to make the technique technically usable, but also to make it functional. Information is also very important to make the resource socially acceptable, as it has to be adapted to the people using it. If the women do not think they gain anything by changing from wood to gas, the gas will not be accepted so easily. The information issue is to some extent neglected in the WIDA (also Gram Vikas) bio-gas programmes. The focus on women and bio-gas has to be more specific. Also, the information must be more relevant to the tribal community. Economic incentives are very weak for bio-gas, and, as the monetary system has not been totally adopted by the people in the villages, the arguments for bio-gas are not very strong.

Are there any alternatives to the wood stove which are as good as the *hollo* ? This question is very hard to answer, as it includes the problem of integrating the resource in the culture. There are solar boxes, there is bio-gas, there are also more efficient wood stoves, but all of these alternatives will have to confront "soft" questions relating to social and cultural patterns to a greater or lesser degree. The research on alternatives to wood has, as I see it, mostly been focused on technical issues related to the problem. This research will not have the concepts to answer "soft" questions satisfactorily.

Societies are in a constant state of change (Keesing, 1981). This means that there is always some kind of development going on within a society. Sustainable development is not a condition, but a process in which you work. In the villages the development process is constantly going on.

Appropriate technology implies that the technique in question makes good use of resources, a sound fashion of development and that it can be locally maintained (Carley, 1992). The bio-gas programme introduced in the Orissa villages is meant to be appropriate technology, but this depends on how the technology is used. The bio-gas project is aimed at sustainability, but the point where it works by itself lies some years ahead.

Bio-gas development can be seen in two different ways, depending on what the intentions are. A small model can illustrate the different statements.

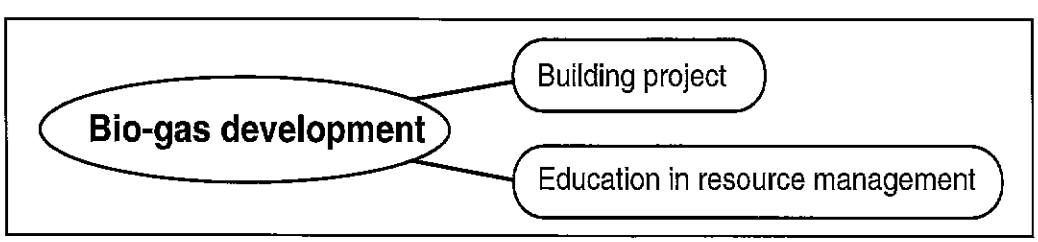
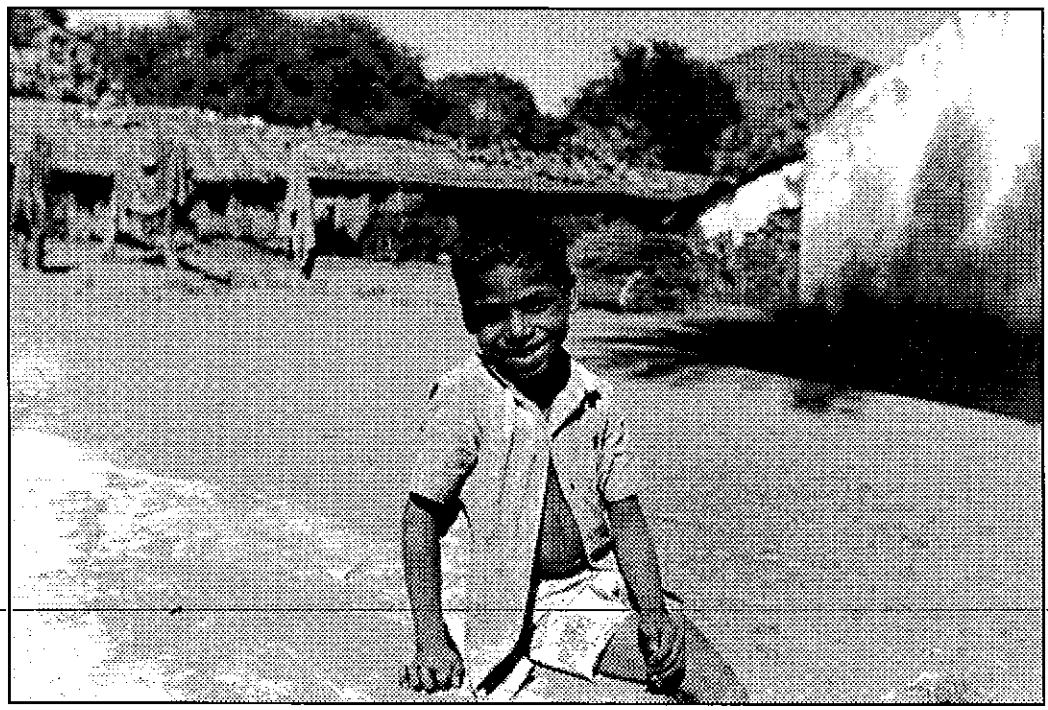


Figure 14. Two ways of looking at bio-gas.

In some respects the bio-gas project can be seen as a "building project". It is visible and interesting and the benefits gained can be understood by urban people. In this perspective, it would be important to motivate the households in order to make them use solely bio-gas, or at least use wood to supplement bio-gas instead of vice versa.

Bio-gas can also be seen as an education in resource management. The resources in the area are scarce, and those resources which are available must be properly managed in order to keep them from being completely destroyed. The technique has to be integrated into the tribal culture and they have to build up a tradition in handling it. Changes in water usage, dung management and resource handling must take place. In this light, bio-gas can have a very important role to play, even if it is only used to supplement wood.



Young boy in Ljimkiguda. The cattle sheds can be seen in the background

Notes

[1] In the following text the word *wood* will refer to branches or brushwood. Wood in the form of logs is sometimes cut from trees growing on the sides of roads but is rarely used.

[2] Questions about whether we had poor people in Sweden and whether there was forest where we lived were common. People also asked if we had problems with alcohol in Sweden. One question usually raised was if we have tribal people in Sweden.

[3] The consistency can be measured through the specific gravity. If the slurry has the right consistency, it should be in the range from 1 045 to 1 190 (6-24 Baume). If the consistency is too thin, the slurry tends to separate into layers inside the unit. Solids will fall to the bottom, water will stay in the middle and light matter will float on the top. If the slurry is too thick, the gas will not be able to pass to the surface. The gas production will be noticeably reduced in both cases (UN, 1984)

[4] In the mornings some women will leave the food on the stove and let it cook very slowly as the fire dies down, and then put more wood on the fire and heat it up again.

[5] Social forestry programmes are essential, but the land around the villages is not owned by the tribals. Since 1894 the government has restrictions against the use of forest and forest products (Fernandes, 1992). The government has given some land to some villages for plantation of social forestry in recent years. There are state-subsidies given for tree-planting in the area.

[6] When we asked what people liked for food, they would usually answer: "Anything". They are grateful for the food they can get. Many people have difficulties in getting enough food every day. In many villages malnutrition is widespread, especially among children.

[7] The cows/bullocks in the villages are either *zebu* oxen, or water buffalos. In the following text the word cattle will refer to *zebu* or water buffalo.

[8] On market days the roads will fill with people. Young girls and women will be dressed in bright red or yellow *Hamboris* (tribal sari). Many will have flowers behind their ears, as is the custom. Men come in their best clothes, usually a shirt and a pair of trousers or a *lungi.*

[9] When the people mortgage their land in this area, they will not be allowed to use it. The money-lenders will cultivate the land and get the harvest as interest. To get food the people must labour to a great extent and sell wood and other things at the market. People will mortgage land when they need money, for medical treatment, for dowry or to buy food, for example.

[10] The villagers like to dance very much. The people dance in a row and make different kinds of steps to music from drums and a flute or pipe. The person in the front leads the dance. During the dance certain rhymes are sung as instructions for the musicians. It is usually the youngsters and children who dance while the elder people watch or play the music.

[11] The difficulty in getting more water home can also be noted in the establishment of gardens behind the houses, the kitchen gardens. According to one staff member, there were some problems in the development of kitchen gardens as it was hard to get people (women) to carry water for the purpose of watering their gardens.

[12] Kerosene stoves make a hissing noise when used.

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Integrated Rural Development of Weaker-sections in India (WIDA)

Visitation programme

Mr. Mathias and Ms. Maria - student from Sweden

Period - 06th November to 19th December 1993

Date	Day	Programme	Staff-in-charge
08.11.93	Monday	Health programme, Women´s literacy programme at Koraput	Health team
09.11.93	Tuesday	Literacy programme at Puriakhudi, Komarkhudi	Mr P C Benu
10.11.93	Wednesday	Champakenda	Mr Stanley
11.11.93	Thursday	Village visit to Pandriguda, Gunthaguda & Podaguda	Mr Stanley
12.11.93	Friday	Village visit to Gullel, Popadar, Zone I	Mr Mohanty
13.11.93	Saturday	WIDA campus / Semiliguda	
14.11.93 to 21.11.93	Sunday to Sunday	Stay at village Chikalmari	Mr Gideon
22.11.93 to 23.11.93	Monday to Tuesday	WIDA campus / Semiliguda	
24.11.93 to 01.12.93	Wednesday to Wednesday	Stay at village Jhimkiguda	Mr Gideon
02.12.93 to 03.12.93	Thursday to Friday	WIDA campus / Semiliguda	
04.12.93 to 11.12.93	Saturday to Saturday	Stay at village Bondaguda	Mr Gideon
12.12.93 to 16.12.93	Sunday to Thursday	WIDA campus / Semiliguda	
17.12.93 to 19.12.93	Friday to Sunday	General staff meeting	

CC : Director, CReNIEO, Madras
Concearned staff WIDA `

Appendix 2: Bio-gas users

Bandaguda

House	People	Acres in house-hold	Using biogas	Light/co oking	How many animals	Basket dung/day	Pot water/day	Using wood also	Dim. of biogas unit	Own oppinion if using
1	4	2	Y	C	2	1	-	Y	2	Y
3 *	5	4	Y	C	12	3	3	N	2	Y
6 *	7	10	N	C	13	4-5	4-5	Y	2	N
7	3	-	N	C	2	1	-	Y	2	N
8	7	-	Y	C/L	6	2	2	Y	2	Y
9	4	2	Y	C	6	2	2	Y	2	Y
12	8	14	Y	C	12	4-5	3-4	Y	3	Y
14 *	5	2	Y	C	7	1-2	1	Y	2	N
15	12	15	Y	C	12	3	-	Y	3	Y
16	6	5	Y	C/L	12	3	2	Y	3	Y
17	4	2	Y	C/L	13	3	-	Y	2	Y
18 *	13	14	Y	C/L	7	2	-	Y	3	N
19	9	-	Y	C	2	1	1	Y	2	N
21 *	5	2	N	C	6	2	-	Y	2	N

* Reparations

House	Acres in house-hold	How many animals	People
13	1	0	5
23	2	4	6
27	-	-	-
38	0	4	4
40	0	2	3
45	0	0	3

Houses randomaly choosen

Ljimkiguda

How many animals	Bio-gas installed Y/N	Using bio-gas Y/N	Note
2	N	-	
4	N	-	
5	Y	N	
8	Y	N	
10	N	N	
22	Y	N	Joint family two houses
5	Y	Y	
6	Y	Y	
-	N	-	Nobody lives here
12	Y	N	
4	Y	Y	
6	Y	N	
7	Y	Y	
4	Y	Y	
2	Y	N	
0	Y	N	
6	Y	Y	
4	Y	N	
-	N	-	Community house
-	N	-	DST-staff house

Chikalmari

People in house	Land	Cattle
3	Y	N
4	Y	N
4	N	N
3	N	Y
6	Y	Y
5	Y	N
4	N	N
2	Y	N
5	Y	Y
3	Y	Y
3	N	N
2	Y	N
2	Y	N
4	Y	N
5	N	N
4	N	Y
2	N	N
2	N	N
3	N	N
4	Y	Y
4	Y	N
3	Y	Y
3	N	N

Appendix 2: Bio-gas users

Bandaguda

House	People	Acres in house-hold	Using biogas	Light/co oking	How many animals	Basket dung/day	Pot water/day	Using wood also	Dim. of biogas unit	Own oppinion if using
1	4	2	Y	C	2	1	-	Y	2	Y
3 *	5	4	Y	C	12	3	3	N	2	Y
6 *	7	10	N	C	13	4-5	4-5	Y	2	N
7	3	-	N	C	2	1	-	Y	2	N
8	7	-	Y	C/L	6	2	2	Y	2	Y
9	4	2	Y	C	6	2	2	Y	2	Y
12	8	14	Y	C	12	4-5	3-4	Y	3	Y
14 *	5	2	Y	C	7	1-2	1	Y	2	N
15	12	15	Y	C	12	3	-	Y	3	Y
16	6	5	Y	C/L	12	3	2	Y	3	Y
17	4	2	Y	C/L	13	3	-	Y	2	Y
18 *	13	14	Y	C/L	7	2	-	Y	3	N
19	9	-	Y	C	2	1	1	Y	2	N
21 *	5	2	N	C	6	2	-	Y	2	N

* Reparations

House	Acres in house-hold	How many animals	People
13	1	0	5
23	2	4	6
27	-	-	-
38	0	4	4
40	0	2	3
45	0	0	3

Houses randomaly choosen

Ljimkiguda

How many animals	Bio-gas installed Y/N	Using bio-gas Y/N	Note
2	N	-	
4	N	-	
5	Y	N	
8	Y	N	
10	N	N	
22	Y	N	Joint family two houses
5	Y	Y	
6	Y	Y	
-	N	-	Nobody lives here
12	Y	N	
4	Y	Y	
6	Y	N	
7	Y	Y	
4	Y	Y	
2	Y	N	
0	Y	N	
6	Y	Y	
4	Y	N	
-	N	-	Community house
-	N	-	DST-staff house

Chikalmari

People in house	Land	Cattle
3	Y	N
4	Y	N
4	N	N
3	N	Y
6	Y	Y
5	Y	N
4	N	N
2	Y	N
5	Y	Y
3	Y	Y
3	N	N
2	Y	N
2	Y	N
4	Y	N
5	N	N
4	N	Y
2	N	N
2	N	N
3	N	N
4	Y	Y
4	Y	N
3	Y	Y
3	N	N

Bandaguda

House	People	Acres in house-hold	Using biogas	Light/co oking	How many animals	Basket dung/day	Pot water/day	Using wood also	Dim. of biogas unit	Own oppinion if using
1	4	2	Y	C	2	1	-	Y	2	Y
3 *	5	4	Y	C	12	3	3	N	2	Y
6 *	7	10	N	C	13	4-5	4-5	Y	2	N
7	3	-	N	C	2	1	-	Y	2	N
8	7	-	Y	C/L	6	2	2	Y	2	Y
9	4	2	Y	C	6	2	2	Y	2	Y
12	8	14	Y	C	12	4-5	3-4	Y	3	Y
14 *	5	2	Y	C	7	1-2	1	Y	2	N
15	12	15	Y	C	12	3	-	Y	3	Y
16	6	5	Y	C/L	12	3	2	Y	3	Y
17	4	2	Y	C/L	13	3	-	Y	2	Y
18 *	13	14	Y	C/L	7	2	-	Y	3	N
19	9	-	Y	C	2	1	1	Y	2	N
21 *	5	2	N	C	6	2	-	Y	2	N

* Reparations

House	Acres in house-hold	How many animals	People
13	1	0	5
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38	0	4	4
40	0	2	3
45	0	0	3

Houses randomaly choosen

Ljimkiguda

How many animals	Bio-gas installed Y/N	Using bio-gas Y/N	Note
2	N	-	
4	N	-	
5	Y	N	
8	Y	N	
10	N	N	
22	Y	N	Joint family two houses
5	Y	Y	
6	Y	Y	
-	N	-	Nobody lives here
12	Y	N	
4	Y	Y	
6	Y	N	
7	Y	Y	
4	Y	Y	
2	Y	N	
0	Y	N	
6	Y	Y	
4	Y	N	
-	N	-	Community house
-	N	-	DST-staff house