Energy Resources and Utilisation

Profile of a Village Community

DISSERTATION SUBMITTED IN PARTIAL
FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

Master of Philosophy

IN

Science Policy Studies

BY

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M.Tech.

Guidance & Supervision
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CERTIFICATE

This is to certify that the work embodied in the dissertation work titled "Energy Resources and Utilisation profile of a village community" was carried out by Sri K.K. Govil under my guidance and supervision, in partial fulfilment of the requirements of the degree of Master of Philosophy at the Centre for studies in Science Policy, School of Social Sciences, Jawaharlal Nehru University.

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STATEMENTS

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ANNEXURES.

ABBREVIATIONS

AP	Agricultural Power
CS	Commercial Supply
CI	Cottage Industry
DS	Domestic Supply
MS	Main Supply (More than 20 KW)
SP	Small Power (less than 20 KW)
S/Light	Street Light
Q	Quintals
Kg CR	Kg Coal Replacement
Kg	Kilo gram
KW	Kilo Watt
KWH	Kilo Watt House
CMPDI	Central Mine Planning & Design Institute.
DST	Department of Science & Technology.
K&VIC	Khadi & Village Industries Commission
MHD	Magnate Hydro Dynamics
NCAER	National Council of Applied Economic Research.
NCST	National Committee on Science & Technology
RE	Rural Electrification
REC	Rural Electrification Corporation
S&T	Science & Technology
KH	Katcha House
PH	Pakka House
KPH	Katch Pakka House
AP	Andhra Pradesh
MP	Madhya Pradesh
UP	Uttar Pradesh

CONVERSIONS

Area

1 Acre	= 4840 Sq. yards = 5 Bighas = 1 Killa
1 Bighas	= 960 Sq. yards
1 Hectare	= 10,000 Sq. M. = 11.5 Bighas = 2.3 acres.

Energy.

1 Kg dry dung	= 0.4 Kg coal replacement or equivalent
1 Kg of fire wood	= 0.95 Kg coal -do-
1 KWH electricity	= 1.0 Kg.coal -do-
1 Kg.oil products	= 6.5 kg coal replacement
	= 2.0 kg. coal equivalent
1 HP	= 0.748 KW
1 K Cal.	= 1000 Calories
1 Kal	= 3.98 BTU

Weight

1 Mound	= 40 seers = 37.2 kg.

PREFACE

Man's needs and activities depend on energy. This dependence is direct when heat, mechanical power or electrical energy are needed to fulfil essential or non-essential needs like cooking, transport and lighting. The energy is indirectly needed when material resources are converted elsewhere into useful products used by him. The ways in which energy is used by society has a far-reaching influence on the forms of civilisation, life styles, social structures and commercial activities. Conversely the society through science and technology influences the choice of energy sources used and the way they are used.

In India, a country of millions, where land to man ratio is low, in spite of the green revolution, it is difficult to see the break through in the living conditions of a common villager. India claims to be an industrially developed, possessing very large technical man power, large sections of which are under utilised and unemployed. It is difficult to solve the paradox, unemployed technical manpower with no new technology of our own for the villages. There is a continuous growth of 10 - 12 % annually in electric power consumption and about 7.5% in oil consumption (except the downfall of 30% in 1973-74 due to crude price increase) since independence. But Electricity and oil in village get exhausted in cultivation and there is not much left to a villager as a human being to improve upon his living condition.

In late sixties it looked as if we would be able to sustain the continued growth in our electricity and oil consumption, resulting in prosperous future for the village community, sooner or later. Increase in crude oil prices about 10 times between 1973 to 1978, and short supply of coal setting in as early as 1978-79 with less than 13000 MW of operating thermal installations has alarmed us. The recent increase in crude oil prices has again puzzled all planners and specialists in the energy sector. The import bill of crude oil is expected to go up to Rs.2700 crores during 1979-80 - projecting a dismal picture on the energy front.

P.T.O.

Energy management problems have been equally acute. Decline in % generation from installed thermal generation capacity, heavy losses in transmission due to scattered load and sabotage, and heavy shortage in installed capacities against planned targets in hydro, thermal and atomic plants have added to the problem of electricity shortages. The heavy dependence on electricity has posed problems. Shortage of coal, low reservoir levels and power station break downs have resulted in frequent power cuts in many states.

It was considered appropriate to take up this case study under the discipline of science policy at this stage. Firstly to find the energy requirements of a village community from their own perspective, and secondly to assess how within its own energy resources their standard of living can be improved?

The approach here and suggestions made may not sound appropriate to those who consider development as synonymous to adoption of new technologies proved and adopted else where. The economic viability of new technologies based on the existing commercial set up having deep profit motives may also not be sound. The visualisation of the whole technological exercise in the frame work of small science, and contribution by our abundant skilled and unskilled man power in their small way to improve our living condition can help ameliorate. Prevailing science and sophisticated technologies alone are viewed as panacea for our backwardness but they have not brought the results expected. In blind perusal of advantages of automation and increasing dependence on machine we ignore the fact that finding a way to utilise our idling animal power and unemployed manpower is a more rewarding technology than solving our inadvertantly enlarged problem.

Readers will find the scope of study wider than the title suggests. I should admit that the study presented and ideas conveyed are not confined to commonly accepted scientific aspects. But any such study at the interface of science and technology, economics, society and politics is bound to break the narrow barriers in order to become meaningful. Whereas problem has been viewed in a national perspective, case study is limited to a village. Title suggests only energy profile for study, whereas the information collected encompasses the total socio-economic and natural environment in which the community exists. Data presented conveyrs much more than the limited content in which it has been cited. All this is done, only with the intention of presenting to the reader a comprehensive socio-economic picture so that generalisations made for a village community from data on a village can be appreciated. It may sound awkward, but it is perhaps a more scientific manner of drawing inferences in areas where affect of other related factors are extremely important but equally difficult to quantify.

Conclusions drawn may not be found new or basically different from those suggested by most of the contemporary energy scientists. But the study provides a fuller picture of the environment which promotes these views and further reinforces them.

However, the study uniquely depicts the environment in which the energy requirements exist and develope. It underlines the meaning of 'improvement in living conditions' of families in their own view, and gives indication of their difficulties which can become a sound basis for fixing priorities in development programmes for rural society.

The study has deliberately given importance to the necessity of looking at every possible energy resource in whatever form available in the natural environment of a village for exploitation in improving living standards. Through the approach of optimising the system from micro to macro level, from village to national level, can we hope to develop a stable and happier socio-economic structure?

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CHAPTER- I

1. INTRODUCTION.

Energy from sources other than man's own muscular power has been harnessed and utilised by him for variety of purposes and in a number of forms. The more he became aware of apparantly hidden resources of energy, the more he became conscious of finding ways to utilise this energy to acquire more and more material conforts by minimising the use of his own muscle power to provide for his living. Science and Technology provided the spark to the unending fire of energy consumption which threw up unending alternatives for energy utilisation for glamorous confortable and the so called prosperous living.

1.1 Energy for Prosperity

There has been larger and larger utilisation of energy in the pursuit of prosperity. The highly developed industrial nations of the world have dazzled the industrially underdeveloped countries to such an extent that these nations which are in the process of acquiring knowledge on science and technology see the target of their progress in following the footsteps of the technologically advanced nations.

Material progress seems to have fired the imagination of all people, atleast those who have not experienced the fruits of this progress. The trend which follows is likely to reach its limit only through the realisation of limited resources which the planet earth can provide to the hunger of prosperity among humanity. While the desire to live in confort and the pride of conquering nature may not be separated from the human ego for centuries, sooner than later they are bound to be forced into a compromise with nature.

When the stock of non-renewable fuels on earth is exhausted, human mind will have to solve its energy problem by utilising whatever is available rather than by utilising whatever it can ?

In the world of today when men feel confident of solving all their problems with the help of Science and Technology every nation endeavours to manipulate its supply and demand to match working within its own resources. How the resources are utilised at a point of time depends on the sum total of its requirement and how they are met. Through Planning process nations try to fulfil the growing demands of its population to acquire more material comforts. While in free economy the demand and supply is levelled by the price of commodities, the demand and supply of energy even in free economies are largely affected by the forms of energy available, technology available to use these forms of energy and the living habits of population. Consumption level of these energy sources once picked up, has low elasticity and is only marginally affected by the change in prices. To add to the difficulties, any hike in the prices of widely used energy forms turns into a political issue, and affects adversely any democratic government. This makes energy policy all the more important for any democracy.

1.2 Forms and Requirements.

Energy is an undisputed component of prosperous life and takes many forms. Every conversion of raw material into useful forms also requires energy. With the growing influence of Science and Technology, our industrial production has an insignificant portion of muscle power used in it. Most of the items of our utility are now manufactured on powered machines which are many times automated. It is the natural gift of Science and Technology that more human beings have been released to do mental exercises by taking away the drudgery of physical human labour.

Fire and light were perhaps the first forms in which man used external energy apart from his own. Animal power was also a form of energy used by men from primitive times. Water and air as a source of energy are also very old, although they were not known as a source of electrical energy before the electrical energy was invented and proved to be the most convinient form for use. Steam engine, petrol engine and diesel engine gave rise to new possibilities of transport, replacing animal power, which was used for this purpose till then. Invention of Electricity opened up immence possibilities of using external energy for domestic and field appliances.

At the present level of development, Energy in the form of Electricity is abundantly used through out the world in lighting fan, refrigeration, cooking, heating, ironing and other domestic comforts. It is also abundantly used in irrigation for agriculture. Other forms of energy used include steam for space heating and steam locos, Diesel in trains and motor vehicles and petrol for motors and aeroplanes. Industries like chemicals/paper/cement/fertilisers/synthetic fabrics also use large amounts of process heat and energy rich materials in their production.

Requirements of energy by men may be classified into thefollowing broad categories:-

1. Cooking.
2. Lighting.
3. Transportation.
4. Agricultural appliances.
5. Domestic work and appliances including heating and cooking/radio etc., and ;
6. Industrial production.

In India dung and wood were used and continue to be used for cooking. Hard coal is also extensively used in small cities and suburbs where kerosene and gas are not easily available. Kerosene and gas are largely used in big cities and metropolitans as cooking media. Electricity is also used in a limited way for this purpose. In villages, however, cowdung and agricultural waste with limited quantities of firewood are the main sources of energy for cooking. The industrially marketed cooked foods are using coal, oil or gas as their primary source of energy.

For lighting electricity in the cities and to some extent in electrified villages, and kerosene in the villages are the main source of energy. Except for some human-propelled home appliances, like flour grinding and chara cutting machine, most of the home appliances are electricity based. For transportation we have wide variety of basic energy forms utilised. While in walking and cycling human energy is used, Baggi and Tonga commonly used in country side are animal based. Motor bikes, cars and jeeps are based on gasoline. Heavy motor vehicles and some lighter vehicles are based on diesel and Railways consume coal, diesel or electricity. Aeroplanes use petroleum products.

In India agriculture continues to be predominantly based on animal power although tractor for cultivation and electric pump sets for irrigation are being increasingly used.

Apart from the above energy requirements directly identifiable with men, there is always an energy component of the industrially manufactured products utilised by men. Sugar, bread, vegetable/refined oil and even fuel and the appliances using electricity require certain amount of energy in mixed forms for conversation from raw materials into the utility products. Fertilisers and construction materials like cement and steel also require coal/petroleum products as basic inputs. Widely used synthetic fibres for clothing are appreciable consumers of petroleum. Solar energy in the form of heat and photosynthesis forplants are also universally used by men in normal living.

All these forms of energy are basically derived from some primary sources either through a natural process or from the natural deposits. While petroleum products, kerosene and coal are derived from natural deposits, wood and cow dung are from natural processes. Electricity is a converted energy form and can be derived from a number of primary sources. With the advancement in science and technology methods are also available to convert primary sources from one form to the other within the limitations of technological development.

Electricity can be produced in three primary manners according to the establishedxx technologies. The hydro-electric power station produce electricity utilising the energy of water collected at higher levels while falling to a lower level through a water turbine. Water is continuously evoparated due to the solar heat and drops back during rainy season. Hydro-electric power is thus provided through a cyclic natural process.

The other method of electricity-generation commonly known as thermal power generation basically utilises heat of combustion of coal oil or gas to generate steam(or gas in gas turbine) at high temperature and pressures which convert heat into mechanical and then electrical power through a turbine generator set.

The third established technology of electric-power generation today is based on atomic-power. So far this is considered to be the only source which can replace the thermal power generation to an appreciable extent. However, the feared environmental effects of this source are still under debate and it may take some time to establish its availability for human exploitation without fear of its dangers.

1.3 Awareness of limitations.

In the present state of development, electricity occupies the pride of place as a form of energy having wide application to provide human conforts. It is versatile, clean, and is easily-convertable into any required form of energy used by man. Its utility in providing living comforts is so great that it can be easily counted as the best form of energy in the service of man. Not only that it is the best form for use, it is widely considered to be the best form for transport of energy from one place to another. These characteristics of electricity have obviously cought the imagination of man kind to such an extent that whenever they think of any form of energy available from or provided by nature they invariably think of converting it into electricity.

Technological developments of today which are in search of new sources of energy and methods for their conversion into useful forms by creating minimum environmental pollution, are the outcome of the awareness of the limited sources of known energy forms on earth and the concern for maintaining healthy environment in the face of industrial growth. Price hike of petroleum crude during 1973 by oil producing countries demonstrated the necessity of an overall review of the World's energy culture. This has lead many distinguished authors to think in terms of limited growth as evident from the book edited by Dennis Clark(1977). There are optimists who do not concede the necessity to check the unrestricted growth, like Kahn and Waeries(1967) who have predicted 'affluent, humanistic, leisure, oriented, and partly alienated - might be quite stable' society in the year 2000. Yet men of science and technology, the world over, are busy searching for technologies which may give:-

1. High efficiency heat cycles, to maximise the utilisation of heat available.

2. Methods to convert naturally available crude energy sources into utility forms at minimum cost(in terms of natural resources) with minimum environmental disturbances.

3. More efficient industrial and domestic appliances in terms of energy utilisation.

4. Evolving technologies and social orders to enhance the life span of civilized life on a planet with finite fuel resources. The search undoubtedly is being made to either find some cheap(in terms of resources in the existing commercial set up) and abundant source of energy to replace the depletable resources or to economise on the existing consumption rate of known sources. Success in former may concede unlimited growth for some more time till further problems are faced. But in the sphere of making economy, the decision maker faces a vital question. Limited by the efficiency of energy utilisation technologies, when economy is carried farther, it may result in cutting down on energy consumption within a certain framework of living habits for man, which in turn may require a change in life styles.

   On the other hand when planning to improve the standard of living of those who are not so dependent on energy aids, we will have to invariably start from what people desire to improve upon their present way of living. What people desire again depends on the socio-economic and political systems with which they have grown. The requirements for improving the living standards generally grew with the aspiration level of people and the value system prevailing among them.

1.4 <u>The Indian Scene</u>.

In order to make our considerations more meaningful, we focus attention to the Indian scene. We would like to relate our energy policy and planning to seek its ultimate aim, i.e. providing energy in those forms and those quantities to our population, in which our people require them for leading a a satisfying life. India is a country of vast population, spread throughout the land, with large percentage, 70-80% living in villages. Being a tropical country its climate is such that except in some regions for the period of very cold days in winter, external heating aids are not required. Sun is largely available here and photosynthetic conversion of solar heat is abundant, of course if water resources are also properly utilised.

Energy requirement of any society depends on its living habits, climate, level of industrial development, and equally important its cultural and social value system. Interestingly India's non-commercial energy consumption had been higher than commercial energy consumption till about 1970 considering all forms of energy utilisation as seen from fuel policy Committee Report(1974).

Following table shows the comparison:-

Table -1 - Growth of commercial and non-commercial Energy Consumption.

Sl No.	Year	Commercial energy consumption.		Non-Commercial energy consumption
		MtCe**	mtCr*	mtCr
1.	1960-61	71	101	148
2.	1965-66	102	147	163
3.	1970-71	130	197	179

**mtCe - million tonnes of coal equivalent.

*mtCr - million tonnes of coal replacement.

In the commercial energy alone India's energy consumption has grown quite fast as is evident from the following table:-

Table : 2 - Growth of commercial energy consumption in million tonnes of coal equivalent.

Sl No.	Year	Coal	Oil	Electricity	Total commercial
1.	1953-54	28.7	7.3	7.6	43.6
2.	1960-61	40.4	13.5	16.9	70.8
3.	1965-66	51.8	19.9	30.6	102.3
4.	1970-71	51.3	29.9	48.7	129.9

(Sources : Report of the fuel policy committee, India-1974).

Table 3 : Growth of commercial Energy consumption in million tonnes of coal replacement.

Sl No.	Year	Coal	Oil	Electricity	Total commercial energy.
1.	1953-54	28.7	23.8	7.8	60.1
2.	1960-61	40.4	43.9	16.9	101.2
3.	1965-66	51.8	64.6	30.6	147.0
4.	1970-71	51.3	97.2	48.7	197.2

It may be seen from the tables that due to the higher efficiency of usage to which oil can be put its coal replacement value is put much higher compared to its coal equivalent value. The same has not been applied to the electricity. However, the manner in which energy is derived from the primary sources, and the usage to which it is put, are important facters in our total requirement and in terms of their heat equivalents.

1.5 Village Scene

Villages provide the bulk of our non-commercial energy resources which mainly includes firewood, dung cakes (gober cakes) and agricultural wastes. These non-commercial energy sources do not enter the profit making commercial exchages. This is an important factor making the cost of living in villages much lower. Even for the food products, housing and labour services the village population does not enter the purely commercialy arena and the barter system of exchange or traditional use of materials is still being practiced even in modern villages of India to an appreciable extent.

Leaving apart the deposits of minerals and fuels at specific locations, and the natural availability of water resources at certain places due to their geographical location, villages provide us most of the resources based on agricultural and natural processes. Science and Technology has given us added confidence due to the knowledge of natural processes which opens up new possibilities of manipulation to suit our requirements. But our requirements originate from the life style and are to be satisfied from natural resources. If we are looking for a steady state of social existance, we may have to derive most of our requirements from products of renewable cycle of our nature. Our dependence on external energy sources with increasing emphasis on comfort, have undoubtedly made energy component of our lives second to food only. In order to sustain the comforts made possible by sicence and technology, we may have to review the philosophy of '<u>Unlimited consumption</u>' linked with the concept of '<u>economic growth</u>'. Generation of 'demand' for articles of ' 'consumption' becomes an economic necessity in a society standing on the foundations of <u>Industrial Production</u>. We may have to find ways and means not only to stop the ruthless increase of unlimited consumption of energy but also to reduce its consumption where it is practically wasted. The emphasis on consumption also debars the poor sections of society from even getting their needs, as they see them, fulfilled. The <u>need</u> rather than <u>production</u>

for consumption can thus be seen as the starting point of our investigation and planning of energy supplies. It is in this context that study of a village community is likely to enlighten us on the needs and aspiration of an ordinary citizen, improvement of whose lot is claimed to be the most pious objective of our social and economic planners and political systems.

The most economical energy is likely to be obtained by tapping the natural cycles at suitable points for the needed forms. Sometimes it might be necessary to enhance quantities of energy in those forms with new science and technology. Liquid fuels are needed in large quantities, fermentation process to convert carbohydrates may be the solution, which uses not only plant products as raw materials but also the solar energy to keep the temperature at suitable level for efficient fermentation. Similarly when mechanical energy is required, say, to lift water wind power may be more appropriate than anyother form.

CHAPTER- II

2. SEL CTION OF PROBLEM

2.1 India's resources and consumption pattern.

Population in India would be around 650 million at present. Based on the present indication we have the following depletable energy resources :-

	Original units	Coal equivalent mtCe
Coal	83000 mt	83,000
Oil	4000 mt	8,000
Natural gas	63000 MCuM	12,400
Uranium	22000 Tonnes	-
Thorium	450 mT	5000,000

Our estimated Renewable energy res urces per anum are of the following order:-

Hydro-electric	420 Twh	420 Mtcr
Fire-wood	630 mt	600 mtCr
Animal dung	250 mt	100 mtCr
Agricultural waste.	47.5 mt	45 mtCr
* Animate Energy		60 mtCr

(Source : M.R.Kulkarni, 1975-76. Ref. 24)

*based on 250 million cattle of which 30% are used for traction, each working 8 hrs. a day, 200 days in a year and at 0.5 KW average power.

The above estimates of renewable energy are the maximum obtainable with present water, land and cattle resources. Renewable res urces being utilised at present per anum are of the following orders:-

Fire-wood and charcoal	- 125 mtCr
Dung	- 25 Mtcr
Agricultural waste.	- 40 mtCr
Animate.	- 60 mtCr
Hydro-electric	- 40 mtCr
Total	- 290 mtCr

Depletable resources being utilised today per anum are of the following orders-

Coal	- 100 MtCr
Oil	- 170 MtCr
Thermal electric power	- 60 MtCr
Total	- 330 mtCr

Although above estimates are liable to be questioned due to non-availability of very accurate assessments, it is clear that we are just crossing over from more renewable to more depletable energy sources utilisation. With the possibilities of increase in fire-wood, dung or vegitable wastes being limited and pace of hydro-electric power resources exploitation slow, we are bound to be pushed into more utilisation of coal and oil. The atomic power hardly adds 1 mtCr of additional energy every year for our use. From the commercial energy consumptions of the last decades in the domestic sector(1960-1970) as per the figures of fuel policy Committee Report(1974) it can be seen that increase in the consumption of Electricity in domestic sector is 2.6 times against 1.45 times for coal and 1.66 times on oil products. Emphasis on rural electrification, energisation of large number of electric pump sets in villages, and fast urbanisation have increased the share of electricity to a much larger extent. India has launched on a massive programme to increase the installed capacity of electric power generation during the Sixth Plan(by about 15000 MW) to provide for more electricity for our industrial growth and better living. It is, however, clear that large share of the increase in electricity consumption in villages goes to replace manual labour and animate energy because increase in consumption of Agricultural power in villages mostly replace animate energy. However, electricity is generated at low efficiency from thermal power stations (Sharing 60% of electrical energy) by convertion heat into mechanical energy. Use of electricity by converting back into mechanical and heat forms not only brings down the efficiency of use of energy in fuel but also results in wasteful capital investments in converting energy from one form to the other. Using electricity in the form of heat and mechanical energy also deprives the utilisation of animal and human energy which may be wasted. It also acts as a disincentive in finding technological solutions to use locally available energy resources.

2.2 DECISION MAKING CRITERIA IN PLANNING

Our planning approach in most of the sectors at present is based on future projections and increased demands based on the past trends or the growth rate of GNP planned as evident from Energy Survey of India Committee(1965) and Fuel Policity Committee(1974) reports. Further, as far as energy is concerned the coordinated effort in planning our resources is lacking. All sectors are planning for the future keeping in view their energy requirements based on the available/in practice technology and without having a close look at the pattern of our resources and the type of our needs to identify a more rational approach. The possibility of dovetailing our energy resources into our energy needs with the help of science and technology still remains to be studied.

Targets for achievement set in several sectors are mostly seem to have two main criteria in decision making. First one is the rate of growth and second the level of operation in western countries. We are always in the habit of comparing our levels of consumption with the western world without appreciating the feasibility in the new political and trade system. Without considering our own parameters of resources, needs and technology, we have been trying to set targets, not too realistically, obviously leading into problems in attaining them.

Considering our projected energy consumption(per capita) in the year 2000 at the present growth rate of about 3% and comparing it with the world average in the year 1967 (1.47 tcr) to set our targets as done by HR Kulkarni(1975-76) (1.47 tcr in year 2000) may not be a sound basis(6(a)). Similarly comparing our present per capita electricity consumption of about 130 kWh/year with much higher consumption of other countries(3990 kWh for Japan, 3830 kWh for USSR, 4520 kWh for UK during 1974) does not lead us anywhere in setting planning targets.

2.3 <u>CONTEMPORARY VIEWS</u>.

There are a number of authors who have shown concern for the existing trends in the growth of our energy supply and demand.

Zaheer SH(1974) felt(during Presidential address to the National Academy of Sciences, INDIA, forty third annual session, 1973) perhaps before the energy crisis(when crude oil price increase to more than 4 times from Jan, 1973 to Jan 1974) that we have to increase our production by more than 10 times to attain a reasonable average rate of consumption. He considered the R&D effort in development of fusion energy, solar energy, geo-thermal energy and tidal waves was totally inadequate, when we had spend enormous money on the development of fission energy.

Narottam Shah(1973 and 1975-1976) has prescribed a drastic shift in the pattern of our energy base with corresponding shift in the technology of production. He has suggested massive plantations in villages, reverse shift from wood to kerosene, scooters to bicycles and setting up of gobar gas plants among other things.

Rangarao BV (1974) has given a comprehensive scheme of survey and study of possible sources of energy, their present usages and conversion techniques known. He considers the utilisation of solar radiation and subsequent forms to be the only long term solution.

Gautam S(1974) has expressed concern overthe increasing import bill of crude and supports a proposal of non-government experts to establish a central directing machinery with full time members which will laydown guidelines for survey, planning and allocation of energy resources.

Bharde T.S.(1974) believes' gobar gas plants' can energise the villages, but due to the poor response from our villagers some incentive subsidy of grants may have to be given to propagate its use. Patel JJ(1975) has made cost estimates of gobar gas plants with the improvements in its design made by KAVIC hopes that it will be found economically viable by villagers. Gandhalekar GH has made economic analysis of the investment in gobar gas plants by villagers and taking into account the income due to gas and manure produced finds it very economical.

Kini M.K.(1975) is optimistic in suggesting a fuel policy based of better utilisation of our coal resources and directing our R&D efforts on its efficient use and conversion to oil. It seems that the considers it possible to solve the energy problem with the help of technology. According to him India has got very large tidal power potential. Venugopal.K (1974) had also suggested use coal and oil shale for conversion to oil. He further suggests combined gas turbine-steam turbine cycle or MHD power generation for higher efficiencies. Good opportunities of power generation through our thorium reserves, with fast breeder reactor are also seen. Sethna HN 1974), himself,an atomic scientist, sees solar energy and fusion technology to provide us with major energy requirements during the next century. He is, however, confident that gobar gas can be the source of energy in future. Rao VA(1973) found good possibilities in development of unconventional energy sources, solar power and wind power.

Pathak AN(1974) finds long term solution of energy problem in use of remeable resources, solar radiation and cellulose. India being free of energy traditions of the advanced countries, he advocates disposition of technical manpower and material resources, to large scale utilisation of replenishable energy resources. Prasad CR etal(1974) have made an economic analysis of the application of Biogas Plants to a village economy and compared biogas plants with rural electrification. They have also made techno-economic comparison of large scale coal-based fertiliser plants with Bio-gas based fertiliser plants and found that in both the above cases biogas plants are not only productive, but also profitable to the village economy. Reduction in use of raw materials for biogas plants are suggested. However, they foresee the crucial socio-economic problem in application of biogas plants, that of satisfying the energy demands of villagers who do not own cattle. Behari Bipin (1974) has predicted reversal in production technologies to use other sources than oil and recalled the vision of Gandhiji to advocate natural production possibilities and natural consumption patterns.

Srinivasan MR (1975-76) has pleaded for a new relationship between energy and man. He has proposed a scientific study of the kind of life styles that we should plan for having regard to conservation of material resources, including depletable energy sources. He has also predicted change in the attitude of even developed countries towards use of energy, unlike theconsumption oriented life styles they have been leading in last 20-30 years.

2.4 STRATAGY FOR DEVELOPMENT

The strategy of rural development conceived by Subramanian (1978) is also based on comprehensive survey of natural resources and equitable sharing of available resources. He mentions of an effort started by CSIR scientists in this direction of entering into a dialogue, with the rural people, particularly thepoorer section, as to what they can do with some help from outside to improve upon their living conditions. He mentions of wind mills and biogas plants to solve the energy problem. However, Reddy AKN (1978) has presented comprehensive theoritical model of rural development in which he emphasises the need to screen the choice of technology in developing countries to find need based satisfaction to our social wants while utilising whatever knowledge from west is available to us.

NCAER(1960) had made estimates on demand of energy in India 1960-75 based on consumption patterns in 1958 and growth in various sectors. But these estimates were based on wide approximations. Estimates were also made by Energy Survey of India Committee(1965) and Fuel Policy Committee(1974).

Against the need to tackle energy front in a comprehensive way as far as possible, with the locally available non-commercial(at present), energy resources, there is a strong view expressing direct relationship between rural electrification and agricultural production. Development of rural based industries are also considered to depend largely on electrification of villages. Kocha

NCAER(1977) has also made few studies on the cost benefit due to selected RE schemes. One such study was made for selected schemes in MP and UP States. NCAER made four random sampling frames for selected electrified villages to constitute the sample, house holds using electricity afor domestic purposes 5, Industrial units 3, Farms using Electricity for agriculture 4, and Commercial Establishments using electricity 3. NCEAR concluded that the benefit due electricity to commercial units, Industrial units and Agricultural units are substantial and average benefit cost ratio is greater than 1 for villages electrified for more than 40 months.

Kochar B.S.(1978) concedes that although R.E. was started in the early 1950's two thirds of the villages still remain without power. Apart from quite low transmission efficiencies and peaking problems, his analysis shows that with the present agricultural tariff RE schemes are a continuous burden on public exchequer. Position in some states as quantified by him gives the following picture:-

TABLE 4 - OPERATING COST OF RURAL ELECTRIFICATION AND TARIFFS.

Sl No.	State	A.P. Tariff Paise/kWh	Cost at 11KV assuming 10% losses paise/kw	Investment per BHP installed. Rs	Operating expenses Paise/Unit.	Net revenue/ profit(+) loss(-) Paise/Unit
1	2	3	4	5	6	7
1.	A.P.	19.37	18.10	1320	24.25	(4+6-3) (-) 22.98
2.	Maharashtra	22.00	14.11	1430	26.28	(-) 18.39
3.	Punjab	12.50	13.30	666	12.24	(-) 13.05
4.	M.P.	25.18	15.84	1285	23.61	(-) 14.27
5.	U.P.	22.00	19.53	1760	32.34	(-) 29.87
6.	W.Bengal	32.00	19.43	1930	35.47	(-) 22.90

Many state Electricity Boards are running into heavy losses due to the above.

Issues of pricing electricity and application of social cost benefit due to RE are discussed by Ranganathan (1976-##). In order to make RE scheme economically viable he has suggested partial/total take over of the lifting and sale of ground water by the government. Arokiaswamy(1977) has pleaded that street lighting in villages and discreminatory power tariff in favour of small farmers(based on consumption levels) should be practiced to overcome the economic problem of RE schemes.

Zenith business corporation, Calcutta had come out recently with integrated rural development method(1977) 'Integrated spilling-system' in which they propose to start the electrification of villages producing electiricity from their own resources. These villages are later planned to be interconnected when centres of high electricity potential are available.

The Hindu(June 1978) organised a group discussion among some top level persons in thefield of energy which was published in Outlook. Among theseven participants were Dr. Gupta of IIT Madras, Mr. Raghavan, ex-chairman BHEL, Mr. Nair, Chairman Kerala State Electricity Board and Mr. Sankar, Secretary, Fuel Policy Committees 1974. Opposing views emerged during this discussions on energy utilisation, one pleading to recognise the limitation of our energy resources and the other for allowing free growth of consumption for next 20-30 years till our industrial development reaches a higher level. It was mentioned that 50% of our population is below poverty line and an ordinary villager cannot afford to buy commercial good fuels(gas or electricity) even if it is made available to him. Cowdung is almost free to him. Mr. Shankar made an interesting point - 'In 50's we over sold nuclear energy, now we oversell solar energy, and we underestimate the problem of rural electrification. It was stated that a number of studies have been made to examine why bio-gas plants have not become popular inspite of their economy ? It was revealed that elite of the rural community having more than four heads of cattle are not interested in soiling their hands with such a plant. It was felt that it requires organisation of villages for integrated development and technology issues should be decided to meet the demands of energy.

Murthy KK(1978) has pleaded conservation of energy to fill thegap between demand and supply on a global scene. He has suggested 3 tier plan for energy conservation, a) controlling demand, b) Raising efficiency and c) the systems approach - The holistic approach in fuel substitution including using rejected heat and adjusting life styles to conserve energy without sacrificing the quality of life. Neils I Meyer(1978) rightly points out that energy vector depends on a country's infrastructure especially the structure of its production sector. He predicts that the sustainable society will need low-quality energy forspace heating, it will need medium quality energy for cooking and some production processes and high quality energy for transport, illumination and a number of production processes.

Most important policy problems in theenergy sector today relates to the R&D efforts being made. Kapoor KC(1979) pioneer worker in the field of solar energy in India feels confident of the three level utilisation of solar energy a) for accelerating of production of biogas 45-50°C b)60-65°C for heating systems and c) 70-80°C for refrigeration purposes. **Biomass** utilisation has recently received real attention of the government when a National Steering committee has been set up on the subject. In a recent interview on Delhi T.V. Jean Ripert(1979) when asked about the foremost problems facing India today, mentioned the 'absence of integrated rural development programmes.' It is felt that India is still obsessed by sold technologies and has remained ignorant of the need to promote rural development with its own technology.

2.5 EXISTANCE OF THE PROBLEM

It is found that no serious study could be traced which may bring out the need based energy requirements of our village population. The energy requirements in the social milieu and the infrastructure of a village depend mostly on the production methods used, living habits, and economic conditions of villagers. Agriculture continues to be the dominent production sector of villages.

India has grown with its own cultural heritage and its requirements for providing better life to its people cannot be derived from practices of the western countries. The need for electricity and other energy forms in the village economy require proper understanding before integrated development programmes for villages can be designed. The limitation in availability of capital resources are often quoted as the reason for India's tardy, development and low standards of living. But in anxiety to use the essentials of development models of the west, it is forgotten that its manpower remains unutilised. Western technology continues to catch the imagination of our skilled manpower and technological solutions are not derived from the understanding of its own problems. It is mostly like knowing the medicine and trying to search the decease to which it can be applied.

Technological solutions found by the developed countries to improve upon their standards of living are not applicable as a package to India's condition due to its own Cultural heritage, social customs, traditions, geo-physical environment and the mix of natural resources available. It is thus necessary to find solutions to India's problems, taylor made to its own requirements. Content of scientific knowledge, giving us the basic interrelation-ships among relevant variables affecting energy policy, may be similar among different countries, but the new opportunities provided by the S&T can be exploited in its own unique manner by each country. The sole criteria in selecting technology for application cannot be based on its proved success elsewhere. Instead technology should grow with the help of science to solve local problems and should match the social system and local resources.

2.6 THE CONCEPTS AND RELEVANCE TO SCIENCE POLICY.

With large percentage of India's population livingin villages(70-80%) the targets of per capita consumption on which we havebeen planning to grow our energy supplies are not showing the realistic picture. Much higher percentage of commercial energy goes to the urban population. Further there is a talk of industrialisation and electrification in villages and more employment opportunities and standard of living comparable to that of cities there. While RE Schemes have been taken in abig way as a political objective, the energy economy of commercial forms like electricity and gas, which are in demand in cities remains to be worked out. Biswas S(1977) considers it important to tap some 'unorthodox' forms of energy in unelectrified villages, so that rural electrification may not become a permanent drag, on the power industry. High investments required in transmission and distribution and higher energy losses in RE, may make investments in other forms of energy justifiable. While searches like tapping solar energy and plants of the genus Euphoriba(growing so fast in desert climates and capable of supplying gasoline at competitive prices after processing as per Dr. Melvin Calvin, Nobel Prize-winning Chemist(1978)) continue in the hope of using them in near future in commercial forms, the potential of villages in themselves to meet their energy requirements with minimum commercial activity has not made much headway in tangible terms.

In view of the necessity to appreciate the energy needs in a rural society systematic and comprehensive study of the resources and requirements of the village community will be very useful. Such a study can reveal the areas where science and technology can play an effective role in rural community. The utility of such a study will depend on the extent to which the resources and needs of a village community and the variables which affect them - are identified to plan for future development. Energy requirements of any society, which grow over a period of time are influenced by a large number of factors. The complete mode of existance of human beings are involved in ascertaining energy requirements. The political subsidies, economic structure, past practices, new opportunities provided by S&T, and individual outlook in planning their future for better living, all play their own part in evolving choice of energy from and the level of consumption.

Limitation of resources due to the finite world and ever growing population has forced S&T to search for natural process which may provide the continuous supply of energy to meet the requirements of sustainable society. The practical way of finding the appropriate natural processes lies in originating the comprehensive survey of collective group of human being forming a sustainable unit of society. Study of a village community for its energy profiles was considered desirable with this background.

CHAPTER III

STATEMENT OF THE PROBLEM AND OBJECTIVES OF THE STUDY

3. LIMITED COAL AND OIL RESERVES

3.1 With thecommercial energy requirements growing and continued emphasis on the use of coal directly or in the form of electrical energy, most of the increased energy burden in India is taken by the coal. However, coal is not able to replace oil at the present level technology and economy. In spite of the high import bill (about 70% of 28 million tonnes of consumption in 1978-79 is imported at present) and only 130 m tons of deposits in India(16), oil consumption continues to grow due to its heavy consumption in transport sector and also its requirement for fertilisers and power utilities. Consumption of oil is also increasing due to its requirement for coal based thermal plants for initial firing and flame stabilisation. Already it is being suggested that oil production from coal (16) will be a profitable proposition in India, dueto the rising oil prices. With direct consumption of coal in urban domestic sector, industries and steel industry also increasing, there is a rising pressure on India's coal reserves. Coal reserves in India are only about 1.6% of the World's total estimated reserves of 5×10^{12} Tons against its population which is 15-16% of world's population.

3.2 USE OF AVAILABLE RESOURCES.

With consumption of coal growing fast and expected additional burden on it due to the shortage of oil in India, it is likely that India will be facing coal shortages not in far distant future, unless there is awareness and planning to conserve its energy deposits. Indiscriminate Electrification, Mechanised farming, use of chemical fertilisers and power based industrial processes overlooking other possible methods, shall have to be reviewed in view of the continuous depletion of deposits of coal, oil and gas. In this context it is necessary to think of those natural processes which can give renewable supply of our energy requirements on a continuous basis like food crops.

3.3 CRITERIA FOR ESTIMATES.

In order to arrive at its energy requirements to plan for renewable energy production, there are two possible ways of estimation. The first one can be based on the known consumption patterns of affluent societies and imposed consumption oriented estimates. The other alternative is based more on reality and requirements. It springs from the own requirements of population for better living. Here the political and economic system shall have to control the direction of growth of energy requirements based on the needs of the society as a whole for regulated standards of living, thus saving us from wasteful consumption of energy. It may happen today, inadvertantly though, that in order to prove that we have achieved higher standards of living and better state of economy (which is somewha known to be related to energy consumption), attempts are made to show that there is higher consumption of energy. This is not always correct as higher consumption may be at low efficiencies resulting in huge wastages.

3.4 NEEDS OF SOCIETY

It is thus necessary to study the aspirations and requirements of the rural population to give them better living condition in their own esteem, instead of harping on the provisions of some gadgets designed by S&T elites who propogate their use more for their commercial considerations than their concern for improving the quality of life of people. In this context it is proposed to study these requirements for a village community as a case study in the scope of the present study.

3.5 OBJECTIVES OF THE STUDY

The present study is thus conducted with thefollowing primary and secondary objectives in mind.

3.5.1 PRIMARY OBJECTIVES OF THE STUDY.

1. To understand the components of energy requirements of different sections of common village.

2. To explore the manner in which these energy requirements for the village as a whole could be met with minimum resources from outside the village.

3.5.2 SECONDARY OBJECTIVES OF THE STUDY

1. To identify the factors which affect the energy needs of man.
2. ~~The~~ To identify various forms of energy requirements.
3. To identify the alternative forms (energy carriers) through which above requirements could be met).
4. To explore the possibility of laying down criteria for assessing energy/electricity requirements in villages.
5. To explore the possibility of developing a new perspective of a stable society for future in harmony with nature.
6. Identity relationships between social, economic scientific and technological dimensions of society to suggest potential area for search.

CHAPTER IV

APPROACH TO THEPROBLEMS

4.1 **Selection of village.**

The case study is primarily concerned with the availability and use of various forms of energy relevant in a village economy. In a vast country with varying climatic conditions, terrain and social habits, to identify typical village itself is difficult. As studies of this nature were not conducted earlier in a rural society for the given purpose of identifying theenergy consumption pattern, to begin with any village with certain geographical conditions might serve the purpose. The intention is to study a village in which there is an awareness of the new possibilities provided by science and technology and at the same time which has not completely given away its traditional life style under theinfluence of S&T.

As it was intended to make the complete survey of village and not a sample survey, and also because study has been conducted by an individual its population, location, and approach to its people were also important. Keeping these factors in view the author considered a number of villages through his acquintemces to choose a village for survey. The following aspects were considered :-

a) State in which village is located - Haryana being 100% electrified was preferred.

b) Distance from headquarters Delhi, to be in a reasonable limit to facilitate visits whenever required.

c) Total number of families - Within reasonable limit to facilitate 100% survey due to constraint on time and effort required.

d) Estimated percentage of house-holds electrified - A suitable mix of both electrified and not-electrified households was desirable.

e) Estimated percentage of educated above 5th class- A suitable mix was desirable.

f) Estimated percentage of pakka houses - A mix of affluence was desirable.

All these aspects alongwith the type of population mix, agricultural practices etc. were discussed with concerned persons through whom theauthor had approached to the villages considered. Annexure I lists the villages considered and their main features. Village KHERITAGA in District Sonepat of Haryana State was selected for the study keeping in view its manageable population, location at a reasonable distance from Delhi, reasonable distance of about 10 kms from the nearest town Gannaur(Tehsil) and possibility of approaching thepopulation through one of its resident.

4.2 COLLECTION OF DATA

It was desired to conduct an extensive survey of the village to understand the living habits of the villages, the social environment in which they existed, their awareness of the possibilities provided by S&T and their own assessment of production and consumption required. All these assessments were aimed at relating their existing state of affairs with the fuel uses and techniques adopted by the population in meeting their energy requirements. The information required could be divided into two broad categories:-

a) Information to be collected from individual families to ascertain the production, consumption and requirements of villagers.

b) Information related to assessment of total resources, technologies used and assumptions made in estimates.

4.2.1 Information under (a) was to be obtained from every family, through family head or any other responsible member of the family. This information falls into following categories:-

i) Characterstics of the respondents/families.
ii) Type of energy forms required/available.
iii) Estimated quantities of energy forms utilised presently.
iv) Personal habits having relationship with energy requirements.
v) Level of exposure of respondents to the possibilities provided by S&T for confortable living.
vi) Expectations of villagers related to energy to improve their living conditions.

To obtain information under(a) above an 'Information Schedule for recording Data through interview' enclosed at Annexure II was designed keeping above categories in mind. Although information schedule was in English language due to bias of the author and because the study was to be finally described in English, the language was not allowed to hamper the collection of data. All village families were approached in person with the help of a well educated and respected resident of the village and were explained the objective of the study in their own language before putting questions to them. The author was helped by the said resident of the village in restoring confidence among villagers to give a realistically assessed replies to question put to them in Hindi during conversation. The information was recorded during the interviews of the family heads/family representatives on the information schedule forms itself. The filling up of the information was a time consuming job specially because every one interviewed was curious to know the mission for which the data was being collected. It required quite a bit of explanation to satisfy some inquisitive villagers. Not more than ten families could be interviewed in a day on an average.

4.2.2 Information under(b) was collected in a variety of ways which included :-

i) Tahsildar's office.

ii) Block Development Officer's office.

iii) Informal discussions with groups of villagers.

iv) Visits to the fields and comparing the information collected from more than one source.

v) Publications.

vi) Committee reports of government etc.

The information collected as above was required to make an independent assessment of the utility of various prevalent practices and gave an opportunity to know the real feelings of villagers through a few of them who were more vocal. Patience unassuming behaviour was required to establish rapport with village folk. The above information was intended to relate information collected from families in the whole village within systems approach.

4.3 FRAME WORK OF ANALYSIS

The data collected was intended to be used for analysing the village energy needs and resources, considering it as a unit of human habitation deriving its requirements from natural processes as far as possible. The analysis has to be carried out in the following steps. Year 1977-78 was used as the reference year for making the estimates.

4.3.1 ENERGY NEEDS OF THE VILLAGE.

These requirements can be viewed in two ways. First those needs which are already existing. These could be worked out by summingup the total requirements of the families under each category of requirement. It can be argued that the actual needs may be different from the existing pattern of energy consumption. It is true, but then if the needs differ from the existing manner of their existence, these have to be derived from their existence somewhere else to create the demand for them. Such needs can be considered in the second category where the present style of living is desired to be changed by using a different form of energy to substitute some existing form for a particular use.

From the data collected from families the above two forms can be distinguished. In the first, those energy forms now being used can be quantified. Then certain areas where substitution is feasible and desirable can be considered further.

4.3.2 ENERGY RESOURCES OF THE VILLAGE.

It is difficult to call energy available as a source without associating it with the form in which it has to be used. However, S&T enters the arena of energy problem to satisfy our demands by way of providing the means to transform these energy forms to our needs.

Keeping this in view, it is considered desirable to assess the sources of energy in the first instance. In order to assess even these, it was necessary to go by certain assumed yard sticks, either from books or from estimates of the experienced farmers/habitants of the village. It was consic more realistic to go by the estimates of village people, l ause of their constant experience in using their resources for their needs. A cross-check from amongst farmers themsel helped in refining the estimates. Further, because their estimates of resources are directly linked with their estimates of needs/consumption given by them, their estimates are reasonably adoptable.

4.3.3 POSSIBILITIES OF MEETING NEEDS FROM RESOURCES.

At this stage of analysis the forms in which the available energy sources can be used is required to be considered.

This will depend on the proved technologies available for conversion, economics of conversion in the existing socio-economic-political environment, and the type of requirements from the point of view of convinience.

Due to the large number of variables which may affect this analysis, assumptions will have to be made in this study on the type of requirements. Obviously it is more desirable to derive these assumptions from the requirements of those who have to use energy forms rather than imposing another view even if it is most scintific. In a democratic political system where individual preferences are given predominance over all other forms of decision making, this should be considered most reasonable by social reformists, who also aim at maximising the satisfaction level in the society.

It is with these assumptions that the various possibilities will be worked out, keeping in view the studies made and viewes expressed by the contemporary S&T Community.

4.3.4 FUTURE POSSIBILITIES.

Any scientific analysis will remain incomplete if it does not peep into the future, keeping in mind the present day possibilities and problems.

From the picture which emerges out of the resources and requirements of a geographically located community in regard to its energy requirements, it will be desirable to extend it to the future in order to find out if possibilities exist in the future to improve upon our present situation by planning out a strategy.

CHAPTER-V

ENERGY NEEDS

5. Energy needs of the village as per para 4.3.1 can be considered under two broad categories.

a) Present needs as defined by the modes of utilities.
b) Needs arising out of the desirable changes in the life styles.

Present needs are(a) already existing and have been assessed in the energy forms, which are under use. Needs under(b) are difficult to assess due to influence of socio-economic and political factors and can be some what deduced from the aspirations of the people themselves. However, resources, technological and economic possibilities, and feasibilities affect life styles and consequently the developing needs.

It may further be noted that when commercial fuels like diesel or energy in the form of electricity are introduced in the village economy, their consumption is mostly in addition to the traditional or non-commercial forms already in use. Thus new commercial formsdo not provide complete replacement of the traditional energy forms. Rather they tend to add to the energy needs existing traditionally.

5.1 PRESENT ENERGY NEEDS.

Energy needs can been classified by the modes of utilities in the following categories, which are broadly the sectors of energy utilisation.

a) Domestic Energy including cooking, heating, lighting and domestic work.
b) Agricultural applications.
c) Transportations.
d) Commercial and Industrial.
e) Energy content of Industrial products used.

Information schedule, Annexure XI, has been designed to assess all the above requirements except (e) as it was not practically feasible to quantify all these requirements within the scope of this study. The energy consumptions in each of the above categories, signifying the present energy needs have been evaluated below:-

5.1.1 DOMESTIC ENERGY

Domestic Energy requirements can be grouped into following categories:-

a) Cooking.
b) Lighting.
c) Fire in winter.
d) Hot water.
e) Domestic appliances.
f) Water pumping

All house holds were found using wood and cowdung as fuel for requirements a) c) and d). Domestic electrical appliances e) used included 22 fans, 19 radios, 4 transistors, 2 heaters and 9 electric irons, Hand pumps (116), characutting machines (112) and bicycles(141) were human power motored. Electricity, kerosene and rarely candles were being used for lighting b) purposes. Statements 1,2 and 3 giving the 'work profile' the 'consumption profile' and the 'Electrical Utility profile' respectively, some what describe the life styles of the village families. Hand pumps were used for water pumping (f).

Only 12 families were using commercial firewood and 35 families were using coal. Kerosine oil is stated to be consumed by 74 families only(Statement 2) but 107 families(Statement 3) are using it for lighting, indicating that some economically weak families are using very small quantities of kerosine borrowed from rich families for lighting purposes. One or two families having kerosine stoves were using kerosine for cooking, only during difficult rainy days when other fuels

STATEMENT - 1.

WORK PROFILE OF FAMILIES

1. Time spent by families per day

Sl. No.	Domestic Work	Total time spent daily Hrs.	Daily average time per family Hrs.
a)	Washing utensils/ cleaning house	277	1.63
b)	Washing clothes	149	0.88
c)	Cooking	465	2.74

2. Mode of transport used.

Sl. No.	Mode of Transport	Used by No.of families.
a.	Walking only	35
b.	Walking & bicycle	122
c.	Walking and motor bike	4
d.	Walking bicycle & motor bike	8
e.	Walking and baggi	1

3. Occupation of Families.

Sl.No.	Type of occupation	No.of families.
a.	Service	2
b.	Business in village	3
c.	Tailor	3
d.	Milk sale	2
e.	Flour mill	1
f.	Baggi service/tonga	7
g.	Agricultural work/labour	152

4. Total distance covered per day by working population for work, education etc. - 3583 Man kms.

5. Employment time ratio for family heads - 72.5%

(Total free time available to family heads 380 hrs. a day i.e. 2.2 hrs. per head in 8 hrs. a day)

STATEMENT- 2.

CONSUMPTION PROFILE OF THE VILLAGE

1. Eatables consumed per month.

Sl. No.	Eatables	Quantity kg.	Average consumption per head/month.
a)	Cereals (Wheat, Chana etc.).	30,595	18.65 kgs.
b)	Rice	507	0.31 kgs.
c)	Dal	682	0.42 kgs.
d)	Sabzi	6,766	4.12 kgs.
e)	Tea	15,043	9.2 cups.

2. Fuel used per month

Sl. No.	Fuel	Total quantity used Kg/month	Consumption kg/head/month	Coal replacement value Kg/head/month	% of total
a)	Collected wood	7157	4.37	4.15	29.0
b)	Cowdung (dry)	36798	22.40	8.96	62.6
c)	Commercial wood	395	0.24	0.23	1.6
d)	Coal	214	0.13	0.13	0.9
e)	Kerosine oil	217	0.13	0.84	5.9

3. Type of fuels used

Sl. No.	Type of fuel	Used by No. of families	Total no. of families	Used by % of families.
a)	Collected wood	170	170	100
b)	Cow dung	170	170	100
c)	Commercial wood	12	170	7
d)	Coal	35	170	20.6
e)	Kerosene oil	74	170	43.5

...2/-

4. <u>Milk Consumed.</u>

a) Total per day ... 527 litres

b) Consumed by ... 119 families

c) Average consumption ... 0.32 lit/day/head.

5. <u>Water Used.</u>

a) Total per day ... 28532 litres.

b) Average consumption ... 17.4 litres/day/head.

6. <u>Boiled water required.</u>

a) Total during winter per day ... 1646 litres.

b) Average consumption ... 1 lit/day/head

7. <u>Fire for heating in winter.</u>

a) Total no. of hrs./year(in terms of a single place) ... 7790 hrs.

b) Average use ... 45.8 hrs./year/family

8. <u>Total lighting hours per day.</u>

a) During winter (4 months) ... 438 hrs. -2.6 hrs./family.

b) During summer(8 months) ... 524.5 hrs. -3.1 hrs/family.

STATEMENT - 3.

ELECTRICAL UTILITY PROFILE OF THE VILLAGE

1. **Electrical appliances used.**

Sl. No.	Name of the appliance	Total No. of applicances in village.	No. of families possessing the appliance.
1.	Bulbs	207	67
2.	Fan	22	17
3.	Radio	19	18
4.	Transistor	4	4
5.	Heater	2	2
6.	Press	9	9

2. **Awareness with the use of the following Electrical Appliances.**

i) Electric-fan
ii) Radio
iii) Electric heater
iv) Electric press
v) Fridge
vi) Air cooler/conditioner.

(As per family head)

Sl. No.	No. of *EA	No. of families [illegible]	[illegible] only	No. of EA [illegible]	No. of Families
1	0	68	2	6	52
2	1	71	4	5	34
3	2	18	16	4	39
4	3	8	46	3	13
5	4	3	58	2	18
6	5	1	37	1	8
7	6	1	8	0	0

* Electrical Appliances

3. **Lighting method used.**

Sl. No.	Method of lighting	Used by No. of families.
a)	Electricity only	7
b)	Electricity and kerosene lamps	29
c)	Electricity, candle and kerosene lamp	27
d)	Kerosene lamp and candle	81
e)	Kerosene lamp	26

.....2/-

4. Reason for not applying for electrical connection.

(As per family head)

Sl. No.	Reason	No.of families.
1.	Satisfied without it	16
2.	Consider it costly	16
3.	Consider it accident hazard. prone .	71

5. Satisfaction with and status of domestic electrical connection.

Sl. No.	Status of Electrical connection.	No. of families.	No.of families not satisfied with lighting arrangement.	Percentage not satisfied.
1.	Having connection	67	21	31
2.	Not having connection	102	44	43
3.	Applied for connection	1	-	-

6. Satisfaction with lighting arrangement.

a) No. of family head satisfied ... 104

b) No. of family heads not satisfied ... 66

7. Wattage of Domestic Electrical appliances.

a) Total ... 10340 watts

b) Average(having electrical connection) ... 155 watts

c) Average (in general) (all families) ... 61 watts.

posed problems. Except for this kerosine was used either for initiating fire or for lighting.

The total quantities of various fuels used by households were estimated by family heads or responsible members of the family, from their current experience and represent their present energy needs in theexisting set up. This, however, does not include the electricity consumption. This information was collected from the office of the SDO Haryana State Electricity Board and Statement-4 gives the total electricity consumption of the village during the year 1977-78. Domestic electricity consumption during the year is 9100 kWh. This works out to 758 kWh per month. The total domestic energy consumption of the village for the present level and mode of use can thus be summarised as following.

TABLE- 5

DOMESTIC ENERGY CONSUMPTION.

Sl No.	Type of fuel/ Energy	Quantity used per year.	Consumption per head per year.	Per capita coal replacement value.	% of total in 5.
1.	Collected (kg)	85800	52.5	49.8	28.0
2.	Dung(kg)	442000	269.0	107.5	60.6
3.	Electricity(kWh)	9100	5.5	5.5	3.1%
4.	Commercial wood (kg)	4740	2.9	2.8	11.2%
5.	Coal(kg)	2570	1.6	1.6	
6.	Kerosine oil(litres)	2600	1.6	10.4	
	Total			177.6	

In order to express energy sources in the same unit to simplify

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STATEMENT - 7B

DISTRIBUTION OF LAND ON MAJOR CROPS IN THE VILLAGE

Sl. No.	Crop 1977	Land cultivated: Irrigated Hectare	Irrigated Bigha	Unirrigated Hectare	Unirrigated Bigha	Estimated chemical Fertilisers used in Kgs. DAP	NAP	Urea
1	2	3	4	5	6	7	8	9
	Kharif							
1.	Ganna	51	586	-	-	-	-	3520
2.	Makki	24	276	2	23	-	-	550
3.	Bajra	23	265	8	92	-	-	-
4.	Kapas	7	81	-	-	-	-	-
5.	Mirchi	11	227	-	-	-	-	-
6.	Dhan	70	805	-	-	-	-	2420
7.	Vegetables	14	161	-	-	-	-	-
8.	Gwar/Patson/ Urd/Arhar etc.	1.5	17	-	-	-	-	-
	Rabi							
9.	Wheat	260	3000	-	-	24,000	18,000	-
10.	Chana	-	-	22	254	-	-	-
11.	Wheat/chana/ Jaw.	26	300	-	-	1500	900	-
12.	Vegetables	32	368	-	-	-	-	-
13.	Others(Dals & vegetables).	3	35	-	-	-	-	-
	Total	522.5	*6221	32	369	25,500	18,900	6490

(Source : Office of Patwari - Tehsil Gannavi

*Land cultivated twice is counted again.

Columns 7, 8 and 9 are estimated based on enquiries

.....2/-

Total land in village - 558 Hectares.

Land under irrigation.	- 461 Hectares	Under cultivation.
Without Irrigation.	- 1 Hectare	

Uncultivated : -

Banjar Jadid	- 9 Hectares	(Two years without crops).
Banjar Kadim.	- 42 Hectares	(Four years without crops)
Gairmumkin	- 45 Hectares	(No crops at all includes Village Houses).

......

to serve cottage industries and increased skilled services, if new sources of energy are exploited.

5.2.5 INDUSTRIAL PRODUCTS USED.

Only the major energy requirement in chemical fertilisers has been considered in this category. Keeping in view the rate of growth in the use of fertilisers of the order of 7 to 10% in India and the fact that fertilisers are already in wide use in the village Kheritaga, an annual growth rate of 5% in the use of fertilisers is considered reasonable. Therefore, fertiliser consumption will increase by 27.5% over next five years.

5.3 PRESENT AND FUTURE LEVELS OF CONSUMPTION.

The energy consumption levels in the village, at the present level and after a period of 5 years as they may increase on the basis discussed in earlier paragraphs, are given in the table below. It may be seen that the energy consumption level may go up from the present 8,33,570 kgcr to 9,97,200 kgcrs. Out of the total increase in energy estimated energy consumption of about 1,63,600 kgcr(19.5% of the present level), 68000 kgcr(8.2%) is in domestic sector and 71000 kg.cr (8.5%) is on fertilisers. Increase in agricultural sector is of the order of 14500 kgcr(1.8%) and that in Industrial and Commercial Sector is 6080 kgcr(0.68%).

TABLE- 8

PRESENT AND ESTIMATED FUTURE LEVELS OF SECTORWISE ENERGY CONSUMPTION IN VILLAGE KHERITAGA ON YEARLY BASIS

Sl No.	Categories of energy requirements.	*Present consumption coal replacement. kg	Basis of increase.	*Estimated consumption after 5 years. Kgcr.	Remarks
1	2	3	4	5	6
1.	Domestic Energy				
a)	Cooking				

STATEMENT - 43

TOTAL ELECTRICAL ENERGY CONSUMED IN VILLAGE KHERITAGA (YEAR 1977 -78)

Sl. No.	Month	D.S.	C.S.	C.I.	S.P.	A.P.	S/Light	Total
1.	April,77	-	-	-	664	13750	-	14414
2.	May, 77	1700	-	-	592	12385	-	14677
3.	June, 77	-	-	-	684	9816	-	10500
4.	July, 77	1541	-	-	654	7536	-	9731
5.	August, 77	-	-	-	453	6316	-	6769
6.	Sept. 77	1675	-	-	436	12703	-	14814
7.	October 77	-	-	-	578	10872	-	11450
8.	November77	1624	-	-	580	13415	-	15619
9.	December77	-	-	-	436	11216	-	11652
10.	January 78	1325	-	-	308	14885	-	16518
11.	February 78	-	-	-	[illegible]5	11716	-	12051
12.	March 78	1235	-	-	200	11332	-	12767
	Total	9100	-	-	6020	135942	-	151062

(Source : Haryana State Electricity Board Records).

Average Domestic supply per month = $\frac{9100}{12}$ = 758 kWH

Average small power per month. = 502 KWH

Average Agricultural power per month. = 11320 KWH

Average total per month = 12580 KWH

Comparision and to utilise in energy forecasts the concept of 'coal replacement value' of various fuels was used by energy survey of India Committee, 1965(.). Coal replacement value of fuels represents the quantity of coal that would replace a given quantity of fuel to give the same service for a given application. Such replacement values of fuel in terms of coal will obviously change with the calorific value of coal considered and the application of fuel, because efficiency of utilisation of fuels varies with its application.

In such conversion of energy sources to the units of another source, the wide variation in the calorific value of coal is an important factor in deciding on the conversion rates. The conversion rate from coal to coal forchange in calorific value is not considered. Replacement value of oil is high due to much higher efficiency of, kerosine in cooking(compared to coal) and Diesel locomotives in railways. Taking into account these factors, although calorific value of oil is only 2-3 times that of coal, its coal replacement value was decided as 6.5 kg coal/kg of oil. Conversion factors used by Energy Survey of India Committee, 1965 were as following:-

Original Units.		Kg of coal replacement
1 kWh electricity	1953/4 to 1960/61	1
	1965/66 to 1980/81	0.7
1 kg of oil products.		6.5
1 kg of soft coke		1.5
1 M^3 manufactured gas.		0.83
1 kg of dry dung.		0.40
1 kg of fire wood or waste.		0.95

The conversion rates of electricity 1 kWh/0.7kg coal 1965-1981 was based on calorific value of coal 4400 kCal/kg, average ~~efficiency system losses of 12~~ %

efficiency of conversion of 35%, 6% auxiliary consumption in thermal plant and system losses of 12%. However, presently the low grade coals being utilised for power generation have calorific value in the rane of 3000-4000 k.cal/kg, and system losses are generally 15-20%. Therefore, the conversion rate of electricity to coal is maintained at 1 KWh/1 kg coal in this study.

It may be seen from table-5 that electricity consumption was only 3.1% of the total domestic energy consumption and total commercial energy consumption was only 11.2% of the total based on coal replacement value of the fuels. Further, out of the 67 families which were using electricity for domestic purposes 51 were regularly using kerosine oil also, indicating the poor dependability of electricity.

5.1.2 AGRICULTURAL APPLICATIONS.

Requirement of energy for agricultural purposes includes the following:-

a) Electrical energy used in Irrigation purposes.
b) Tilling of land and sowing.
c) Harvesting of crops and cutting grass.
d) drying of crops.
e) Threshing and processing of grains/ chara cutting

Except in emergencies families depended for irrigation (a) on natural rain water or electric pump sets. There were 62 electric pump sets in the village. Statement-5 'Resources with village population' details the capital wealth of the village.

For tilling of land and sowing (b) tractors and bullocks are used and sometimes buffaloes too. Three families were having 3 tractors which were also used for ploughing on hire by others. There were 24 pairs of bullocks, and 50 buffaloes mostly used

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STATEMENT - 5.

RESOURCES WITH VILLAGE POPULATION

Sl. No.	Article	Quantity
1.	Land	492 Hectares (5660 Bighas)
2.	House rooms	504 Pakka 285 Katcha Total - 789
3.	Cattle	78 Cows 280 Milk buffaloes 222 Padda - Bachiya. 50 Baggi - Buffaloes 48 Bullocks Total 678
4.	Hand Pumps	116
5.	Bicycles	141
6.	Chara cutting machine	112 Hand driven 25 Electric driven 2 Bullock driven
7.	Electric pump sets	62
8.	Threshers	41
9.	Baggi	45
10.	Tractor-trailer etc.	3
11.	Motor bikes(scooter)	4
12.	Flour Mill	1
13.	Tongas	3
14.	Industrial unit	1 (Intermittently running Khandsari Cooperative - 10 HP)

Notes:-

i) Electric deiven chara cutting/M/cs and Threshers are generally connected to the same motor which is used for Electric pump sets.

ii) Total 789 rooms i.e. 0.48 rooms per head on an average or 4.65 rooms per family.

iii) A number of Electric pump sets, threshers and Baggi's are jointly owned by families having smaller land holdings.

to draw baggies. According to an estimate by a group of villages about 70% of ploughing was done by tractors, 25% by bullocks and 5% by buffaloes.

Harvesting of crops and cutting of grass was almost completely done manually. There were no mechanised driers used for drying grains(d). Sun drying is a common practice.

Threshing and processing of grains was mostly done by electric driven threshing machines run by the same electric motors by which irrigation pump sets were run. Families having tractors sometimes used tractor engines for running threshers when it power requirement was more than the capacity of available irrigation pump set motor or during uncertainty of electric power supply.

Estimates of energy consumed in each of the above categories were not readily available from family heads. The energy needs can be assessed only on the basis of styles of operations carried out. Converting animal energy forms into coal replacement value of energy will depend upon the type of fuel/form of energy it replaces. If bullocks are used for ploughing, the energy used is less compared to a tractor. However the form of of energy it replaces is the diesel oil, which has high coal replacement value.

The comparisons of animal power against electrical energy and diesel(Tractor) are made below for typical agricultural applications in the village. These are based on the estimates worked out by few groups of villagers arrived at by a method similar to the Delphic technique.

The equivalents arrived at below cannot be used as conversion factors between one source of energy to the other for the reason evident below. The output due to any form of energy input varies with the application to which it is put. It is more of effectiveness rather than the efficiency of operation which makes the difference. The units of comparison are purely arbitrary because output of a process is unique for its particular application and any attempt at conversion of energy in the common units distorts the reality of the energy application. Even the scale of operation affects the comparative utility of energy in a given form. For example in transport, small loads can most efficiently and economically be handled by individuals upto 1500 kg and say 15-20 kms a buffalow run baggi is more suitable, and for heavier operation and longer distances a truck is most suitable. That the scale of operation is significant can be visualised in other applications also.

A. IRRIGATION.

Most of the families are using pumps sets with a 6 kW motor having a discharge capacity of about 120 M^3/hr irrigation water against 8 M head. This set costs about Rs 8000/-.

Using 2 bullocks and a man it takes about 1½ minutes to take out one round of 50 buckets each carrying about 5 kg of water from the same depth.

Thus output of waterusing bullocks per hour =

$$= \frac{50 \times 5}{1000} \times \frac{60}{1.5} = 10 M^3/hr$$

Therefore 12x2 bullocks will give 120 M^3/hr.

Hence 12x2 bullocks = 6 kW

Or 1 bullock = 0.25 kW

Or 1 bullock Hr = 0.25 kWhr.

B. PLOUGHING

A tractor with 38 kW engine takes about 160 minutes for one round of ploughing of one Hectare land. It also requires two men.

Ploughing	= 50 minutes.
Harrowing	= 50 minutes.
Sowing.	= 60 minutes.
Total	=160 minutes.

The tractor costs about Rs 60,000/- with cultivator Rs 1200/-, Harrower Rs 3000/-, sowing M/c Rs 1200/- and Trailer Rs 6000/-. It consumes about 5 litres diesel/hr and 100 gm mobile oil/hr. The time required for ploughing operation considered here takes into account the ploughing and harrowing carried out once before sowing and once alongwith sowing.

While using 2 bullocks and a man it takes about 40 hrs for above operations while ploughing one hectare land.

Therefore 40x2 bullocks = $\frac{160}{60}$ Tractor hours.

80 bullocks hrs = 2.66 tractor hours.

1 bullock hr. = 1.26 kWhr.

or 1 bullock hr = $\frac{5.1 \times 2.66}{80} \times 6.5$

= 1.1 kg coal replacement value.

On an average in a year 1000 Hectares of land is required to be ploughed and because more than one rounds of ploughing and harrowing are common, each hectare can be estimated to require about 4 tractor hours on an average.

Energy required per year for tilling and sowing of land in terms of diesel requirement thus works out to 20400 litres of oil or 132500 kg coal replacement value(kgCr).

C. WHEAT THRESHING

Dara automatic wheat thresher largest in thevillage, works with a 16 kW motor and requires 4 men forworking.
Machine without motors costed Rs 8000/-. 16 kW motor costs about Rs 7000/-.
Its wheat threshing capacity is about 550 kg wheat/hr.

Working with 2 bullocks and a man, extraction of 550 kg wheat takes 16 hrs.

Therefore 16x2 bullock hrs = 16 kWhr
or 1 bullock hr = 0.5 kWhr.

Most of the wheat threshing is done by threshers working on electrical motors and hence =
1 bullock hr = 0.5 kWhr = 0.5 kgCr.

D. Maize threshing.

A maize thresher with 8 kW motor and requiring 2 men forworking has a capacity of 200 kg Makki/hr.

Thresher costs about Rs 500/- and the 8 kW motor costs about Rs 4000/-.

Maize threshing can be done by men alone quite effectively. It takes 5 hr for a man to threshout 200 kg makki.

Therefore, 5 man hrs. = 8 kWhrs
1 man hr = 1.6 kWhr.

E. SUGAR CANE CRUSHING.

a) Small crusher with 6 kW motor has a capacity of 100 kg sugar cane juice/hr.

Costs Rs 2000/- and requires 2 men. Two bullocks with 2 men take 2 hrs to extract 100 kg sugar cane juice.

Therefore 2x2 bullock hrs = 6 kWhrs.
or 1 bullock hr = 1.5 kWhr.

b) Bigger crusher with a 8 kW motor has a capacity 200 kg sugar cane juice/hr., Costs Rs 5000/- and requires 3 men.
Hence 8 bullock hrs = 8 kWhr.
or 1 bullock hr = 1 kWhr.

Mostly electricity replaces animal power in sugar crane ~~crushe~~ crushers and hence = 1 bullock hr = 1kWhr = 1 kgCr.

The existing annual needs in Agricultural applications can thus be summarised as below:-

TABLE - 6

ENERGY IN AGRICULTURAL APPLICATIONS

Sl No.	Application.	Method used	Estimated requirement.	Estimated coal replacement Rs
1	2	3	4	5
1.	Irrigation pump sets.	Electric pump sets.	*136000 kWh	1,36,000
2.	Threshing and processing of gains.	- do -		
3.	Tilling and sowing.	Tractor Bullocks/ Buffaloes.	14400 lit oil. 39400 bullock hrs.	93,500 39,000
4.	Harvesting and cutting of crops.	Human labour	-	-
5.	Drying of crops	Solar energy	-	-

Note : 1. For other identifiable forms human labour is not indicated.

* Figure is based on information from SDO, Haryana State Electricity Board for1977-78(Ref. Statement-4)

5.1.3 TRANSPORTATION.

Transportation requirements in the village can be divided in the following categories.

a) Transportation of individuals to worksites, place of duties, School or to nearest township for purchases etc.

b) Transportation of fertilisers, charm for cattle or other material for day to day living in the village.

c) Transportation of agricultural produce to home or to commercial centres for selling.

The pattern of mode of transports used by families under category a) is given under Statement 3 para 3. There were only four families using motor bike also. Most of the energy consumed in this category was personal physical energy in walking or in cycling. For going to township either Tonga or cycle were used.

Under category b) the transportation was by physical labour when quantities to be carried were for short distances and of managable loads. On occassions the baggi pulled by buffalow was required when large quantities and long distance movements were required.

For the category (c) most of the transportation was by using Baggi's or the trailers with tractors.

Estimate of energy used in these categories were not readily available in quantifiable terms from family heads.

A comparison of typical transportation by animal traction (buffalo baggi) and a diesel truck is given below.

A. Truck Vs Baggi.

A truck run by diesel with an engine power of 80 KW having rated loading capacity of 5000 kg consumes 0.3 litres diesel/km truck costs Rs 1.2 lakhs.

A baggi pulled by a single buffalo having a loading capacity of 1500 kg can go upto 3 kms/hr. A baggi with buffalo costs about Rs 3000/-.

Comparing the above.

1 buffalo hr. $= \frac{1500 \times 3}{5000} \times 0.3$ litres diesel.

$= 0.27$ litres diesel.

$= 1.75$ kg cr.

The present energy needs in the above three categories of transportation can thus be summarised as follows on an yearly basis.

TABLE- 7

ENERGY NEEDS IN TRANSPORTATION.

Sl No.	Category of Transportation.	Type of Transport used.	Basis of Estimate.	Energy used in original units.	Energy in KgCr.
1	2	3	4	5	6
1.	Individual transport.	On foot bicycle, tonga & motorbike	10550 Kms	302 litres	1960
2.	Transport for daily living.	Human labour Beggi.	13000 Qtls for 5 kms.	1680 buffalo hrs.	2190
3.	Transport to commercial centres.	Baggi	17000 for 15 kms.	5660 buffalo hrs.	9900

5.1.4 COMMERCIAL AND INDUSTRIAL.

This energy need may be categorised into (a) industrial and (b) Commercial.

There was only one industrial unit in the village 'Kheritaga Gur Khandsari Cooperative society' having a crusher(sugarcane) and 2 M/cs for preparing Khand. An 8 kW motor was installed here and 5 men were employed for running it. This plantwas run only when sugar cane supply was available.

There was no significant commercial activity in the village. There were only 3 ordinary shops, 3 tailor shops, one flour mill and 3 tongas for hire. Except forthe electricity used no other external energy source were used for this purposes. It can be seen from Statement-4X that no electricity was used under the head of commercial supply. However small power in flour mill etc. to the tune of 6020 kWh were used in a year equivalent to 502 kWh per month. The consumption in crusher etc. is included in the agricultural power in the Statement-4 X.

5.1.5 INDUSTRIAL PRODUCTS USED.

The main Industrial products used by the families can be grouped into following categories.

a) Textiles.
b) Fertilisers.
c) Products and Appliances.
d) Food products.

No estimates of the cloth used by villagers were made in the study for (a) because the energy consumption is not localised in the village. An estimate of the quantities of fertilisers used in the villages based on their use as per the normal practice in village is given in the Statement 7.

In the case of fertilisers also, the consumption centres are located elsewhere. However, production technologies applied locally to produce fertilisers will reduce the burden on use of energy at other centres and shall also reduce dependence of the village on other centres. An estimate of the energy contents of the fertilisers used has been made from the information that could be gathered as given at Annexure VI. Each kg of fertiliser used in the village requires about 5 kgcr of fuel. About 51,000 kg of fertilisers are used every year in the village, which requires 2,55000 kgcr of fuel.

Electrical and agricultural and otherproducts used by villagers are produced in factories and consume electricity at the various stages of manufacture from raw materials. This energy content at (c) can be well accounted in the requirement of energy by various categories of industry and may not be a accounted here. Here again if the village can use its own products utilising human labour, the energy demand on centres of industrial production may be reduced.

The requirement of energy for food products under (d) is almost negligible in the village at present because tinned or processed food products or beverages were not used by familiess. These requirements at village level may be felt with change in living habits, if items like bread and biscuits are produced in the village. No such requirement is existing at present.

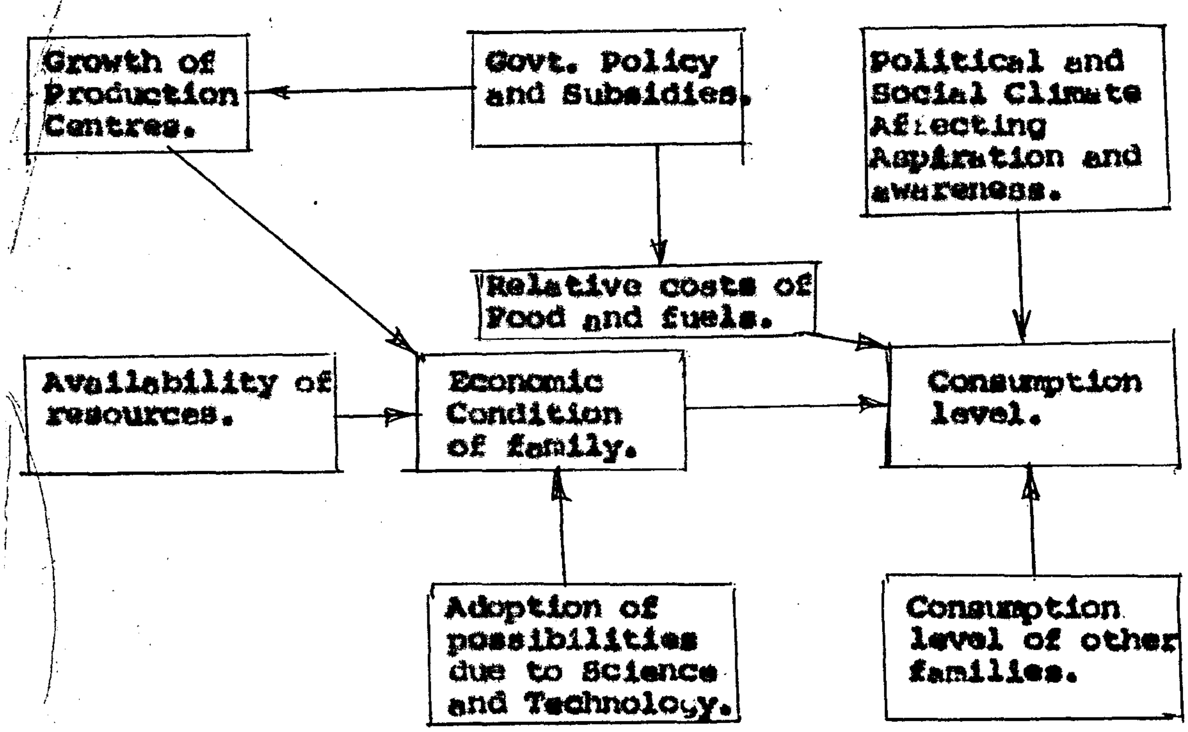
5.2 ENERGY CONSUMPTION WITH CHANGING LIFE STYLES.

The desired levels of consumption are always higher than the present levels. The basis of desired requirements can always be questioned because there is no limit to the level of the leisure attainable by the possibilities opened by Science and Technology. Political opposition in a democratic set up tends to raise the aspiration level of people and demands higher levels of consumption. However, capacity to buy limits the demand of each family, and feasibility of creating a facility at particular place limits aspirations. The demands of the families are diverse, even in a single village, and economy plays a vital role here.

Inspite of the claims of the political system about alround increase in demand(due to mass production made possible by science and equitable distribution of wealth ; the actual levels of consumption are determined by the following factors, the immediate surroundings & Technology.

a) Economic condition.
b) Local skills and availability of different foods and fuels.
c) Local production/economy of production.
d) Relative costs of different foods and fuels.
e) Factors motivating consumption
f) Govt. policy and subsidies.

Economic condition of families is again determined by the same factors. In av village economy which is dominated by food production theconsumption levels can increase either by higher rotative cost of food products, or by more scientific utilisation of land and skills to generateresources other than food also within thevillage. The schematic below shows how the new consumption levels are reached :-



Schematic - Consumption level of families.

It is extremely difficult to predict the actual consumption levels at a given point of time in future due to the dynamic nature of economic activity and many uncertainties. But from the detailed information collected about the village families, some indication of their future requirements is available from the areas of difficulty faced by the families. Further, allowance for increases in consumption has also been made for improving living standard, in areas like food and lighting. Without expecting any sharp departure from the present, the expected rise in energy consumption due to changes in life styles over a period of time, say five years, has been examined below:-

5.2.1 DOMESTIC ENERGY

Energy requirements in this category are likely to rise in (a) cooking (b) lighting and (d) hot water with better standard of living. However they are likely to reduce on account of (c) fire in winter due to better clothing.

In a village community,, with sufficient manpower(readily available for labour) energy requirements due to domestic electrical appliances is also not likely to increase in domestic work. Assuming that theincrease in energy requirements due to hot water will balance the decrease in heating required in winter due to better clothing, the energy requirements may rise in cooking and lighting only.

From statement-2 para 1 it may be seen that present level of consumption of Dal, Sabzi and Tea is very low, and hence an increase of say 1.5 times in the consumption of these articles is likely to result in total estimated increase in cooking fuel by about 1.2 times(estimated using statement-2 and Statement-6). Statement-6 gives an estimate of cooking time on gas burners with and without pressure cooker.

It is further assumed that from present level of total 207 bulbs for 789 pakka and katcha rooms the number of bulbs will increase to about 450 bulbs keeping a provision of about 150 bulbs for street lighting.

On the above basis by increasing the fuel consumption and electricity consumption proportionally the increased consumption for domestic purposes may go up to 3,58,000 kgcr.

5.2.2 AGRICULTURAL APPLIANCES.

It may be seen from Statement-7 'Distribution of land on major crops in village' that 461 hectares of land is under irrigated cultivation in the village. Thus out of 492 hectares of land normally under cultivation(as reported) only 6% is cultivated with rain fed water. Additional 3% i.e. 50% of the unirrigated land about

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STATEMENT- 6.

COOKING TIME ON GAS BURNER*

Sl. No.	Article cooked.	Quantity cooked.	Time taken without cooker minutes.	Time taken with pressure cooker minutes.	Time saved minutes.
1.	Dal Arhar	In about 1 Kg. water	25-30	15-20	10
2.	Dal Moong	-do-	20-25	10-15	10
3.	Dal Urd	-do-	45-50	25-30	20
4.	Dal Masoor	-do-	60-70	25-30	35
5.	Dal Chana	-do-	30-35	20-25	10
6.	Rajma	-do-	120-140	35-40	90
7.	Kabuli Chana	-do-	190-200	55-60	120
8.	Dry vegetable (Alu-Saim etc.)	About 1 kg.	15-20	10-12	5
9.	Loaki	About 1 Kg.	20-25	10-15	10
10.	Bagun	-do-	10-15	8-10	5
11.	Kathal	-do-	30-35	20-25	10
12.	Jimicand	-do-	40-50	25-30	15
13.	Kamal Kakri	-do-	40-50	25-30	15
14.	Chapati	One	25	-	

* Figures are based on the estimates of a group of house wives.

Notes:-

(i) Average cooking time saved due to pressure cooker excluding Rajma and Kabuli Chana = 13 minutes.

(ii) Average time of cooking without pressure cooker = 33.6 minutes.

(iii) Percentage fuel heat likely to be saved using pressure cooker = 38%

15 hectares may be assumed to be brought under irrigation during next five years. With this increase the energy consumption on Irrigation pumps and ploughing of land is also expected to increase in the same proportion i.e. 3%. The quantity of crops produced should, however, increase faster. Assuming an annual growth rate of 3% the total crops will increase by about 16% in five years. Assuming the ratio of energy consumption in 'Irrigation' to 'grain processing' as 2:1 thetotal increase in energy consumption for (a) irrigation and (e) processing of grains, together will be about 10,100 kgcr.

Energy consumption in harvesting of crops and drying of crops is not likely to increase because human labour and solar energy are available in abundance. Even of better methods of drying by solar heaters are developed no additional fuel will be required.

5.2.3 TRANSPORTATION.

With petroleum imports becoming costlier and indigenous production not picking up, the requirement of fuel for individual transportation (a) requirement requiring petrol is not likely to rise, unless some cheeper substitute is made available for the imported liquid fuel. However, an increase of 15% to keep pace with population may be assumed.

The requirement for transportation ofmaterial for daily living (b) and transport of grains to market(c) are both likely to rise in the production of food grains. However, the increase in population will largely consume the increase in production of grains, and for (b) more manpower will be available. For 16% increase in grain production over five years let us assume that the increase in energy required for transportation in the categories (b) and (c) will be of the order of 10%.

5.2.4 COMMERCIAL AND INDUSTRIAL.

Although no plans for setting up additional industrial or commercial unit were revealed during enquiries, doubling of energy requirements is being provided to cater to the future needs

1	2	3	4	5	6
1.	**Domestic Energy**				
	a) Cooking b) Lighting c) Fire in winter	281,900 fuel	Fuel increase 1.2 times.	3,38000	
	d) Hot water e) Home work	9100 electricity.	Electricity increase 2.2 times.	20000	
	f) water pumping	Human labour			
2.	**Agricultural Applications.**				
	a) Irrigation pump sets.	136000 (includes (e)).	3% increase on 90,000 kgCr.	146100	
	b) Tilling and sowing.	132500 (estimated)	3% increase	137000	
	c) Harvesting of crops.	Human labour	-	Human labour.	
	d) Drying of crops.	Direct solar energy	-	Solar energy.	
	e) Processing of crops./ chara cutting	Included in (a) except where animal power or tractor engine is used.	16% increase.	Included in (a).	
3.	**Transportation.**				
	a) Individuals	1960 (estimated).	15% increase	2260	
	b) For daily living.	2190	10% increase.	2400	
	c) Grains Transport Commercial centres.	9900	10% increase.	11000	
4.	**Commercial and Industrial**				
	a) Industrial	6020	Doubling	12100	
	b) Commercial	-		12100	

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1	2	3	4	5	6
5.	Industrial Products used.				
	a) Textiles.	-			
	b) Fertilisers.	255000	27.5% increase.	3,26,000	
	c) Products and appliances.	-	-	-	
	d) Food products.	-	-	-	
	Total	833570		9,97,200	

Figures do not include manpower used and are estimated as given herein.

Notes : i) Total No. of families. - 170
ii) Total population. - 1640

5.4 END USES OF ENERGY AND RESOURCES.

Apart from the Sector wise classification of energy needs by the purpose of utilisation, another classification of energy needs could be based on the form in which energy is required for various applications. In this way energy applications could be classified as follows:-

a) Thermal energy.
b) Mechanical energy.
c) Chemical energy.
d) Electrical energy.

One of the above forms may be convertible into the other, but the efficient utilisation of energy resources demands that it is used with least conversion in its natural forms of existance. Further improving the efficiency of utilisation can also bring down the energy demands. Identifying the energy needs in the village with the above categories of energy and possible sources from which these could be met can form a basis for optimising energy usage.

5.4.1 THERMAL ENERGY

The energy usage in this form relates to the use of heat energy for various purposes. The Statement below broadly gives such end usages and the possible sources from which these could be met. It has to be remembered that quantity of energy needed will appreciably depend on the efficiency of utilisation.

TABLE - 9

Thermal energy needs.	Presently used resources.	Resources proposed.	Technology needed.
Cooking	Dung	Gobbargas	Cheap gobar gas plants. Gas burners, pipes and valves.
Milk boiling, Tea preparation	Wood	Wood	
Water heating	Solar heat	Solar heat	G
Space heating in winter.			
Light from burning flame.	Kerosene	Bagasse	Local production of suitable crops to give oil.
		Coal	
For medical purposes.		Local veg. oil.	Efficient designs of wood and coal Chulha's and gas burning.
Crop drying	Agricultural waste.		
Gur preparation.			Development of Economic solar Cookers.
Brick preparation.		Agricultural, waste.	

5.4.2 MECHANICAL ENERGY

The energy usage in mechanical form is used wherever motion has to be given to any object using mechanical force. The table below gives the variety of end usages.

TABLE - 10

No.	Mechanical Energy needs	Presently used resources.	Resources proposed	Technology needed.
1	2	3	4	5
1.	Personal Transport.	Human energy.	Human Energy	Production of ethanol.
2.	Material Transport.			
3.	Ploughing.			Combustion Engines suitable for ethanol,
4.	Cutting of crops.	Animal Power.	Animal power.	
5.	Processing of grains.			
6.	Lifting water for irrigation.	Ethanol Diesel. Petrol, Diesel (engines)	Ethanol Diesel	Gobar gas etc. (mixed fuel engines)
7.	Hand pumps of water.			
8.	Chara cutting.			
9.	Grass cutting.			
10.	Utencils and house cleaning.		Wind (Mills)	Cheap wind mills and gobar gas plants.
11.	Cloth washing and ironing.			
12.	House construction.		Gobar gas/ Ethanol (engines).	
13.	Road construction.	Electricity.		More efficient utilisation of animal power through mechanical devices.
14.	Flour milling.			
15.	Oil extraction.			

5.4.3 CHEMICAL ENERGY

The chemical energy is used where the process of production is chemical in manufacturing useful chemicals, products. Usage of energy in such a process may either be used directly during a chemical reaction or may be costituted of the energy content of the raw materials used in such a process. End usages include:

TABLE - 11.

No.	Chemical energy needs.	Presently used resources	Resources proposed.	Technology needed.
	Fertilisers.	Dung	Digested dung.	Gobar gas plants biological control.techniues
	Pesticides.	Coking.and non coking coal		
	Textiles.		Coal	Ethanol and gobar gas based products.
		Electricity	Petroleum Products.	Petroleum products.
	Conversion of raw materials into useful metal etc.	Petroleum products.	Wood and vegetable waste.	Use of wood and vegetable waste in some processes.

5.4.4 ELECTRICAL ENERGY

Electrical Energy being cleanest andmost easily convertable form of energy has very wide application potential. Its use should however, be restricted to these uses where the end use cannot be satisfied by energy forms closest to the naturally available forms. Electricity is produced by first converting heat into mechanical and then mechanical into electrical energy. The efficiency of conversion of energy though the route of electrical energy into useful forms need be fully analysed before deciding the uses to which electrical energy can be put more economically. Some uses are indicated below:

TABLE - 12

S. No.	Electrical energy needs.	Presently used resources.	Resources proposed.	Technology needed.
1	Electrical lighting.	Coal	Gobar gas	Gobar gas plant.
2.	Electric fans		Wood	Use of wood ethanol, gobar gas for electricity generation.
	Radio/transistor.	Fuel oil.		
	Electrical pump sets(when mechanical forms fail).		Ethanol.	
		Natural Gas.		wind mills
	Small machine tools.		Wind power	Photo voltaic cells.
			Solar energy.	

5.4.5 General

The above classification of energy end usage, the proposed resources to be used for those uses and the technology needed may not come out strictly feasible when tested for adoption of technology. However, they are fairly indicative possibilities of energy usage for energy needs in a village economy. Instead of thinking in terms of centralised and large scale energy sources, the decentralised approach and required R&D to develope suitable technologies to make this approach feasible will be a worthwhile component of our Science and Technology plan.

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CHAPTER - VI

ENERGY RESOURCES OF THE VILLAGE

Energy resources of the village can be grouped into two main categories :-

a) Energy resources which are available and used at present in some form.

b) Energy resources which need fresh exploitation by the village to be useful.

6.1 USED ENERGY RESOURCES.

Energy is available in the village in the following forms:-

a) Agricultural waste.

b) Wood.

c) Dung cakes.

d) Solar energy (for drying).

e) Cattle and horse.

Yearly production of agricultural waste is given in Statement-8, para 2. Number of various types of trees in the village and their estimated growth rate are given in Statement-9. Dung produced can be estimated from the number of cattle in the village. Estimated yearly availability of energy in these forms is given below.

Table - 13

AVAILABLE ENERGY SOURCES

Sl No.	Type of resource.	Quantity per year.	Coal replacement factor.	Coal replacement value, kgCr.
i.	(Dry)			
1.	Agricultural waste.	1596000 kg	0.95	1516000
2.	Wood.	90000 kg	0.95	85500
3.	Dung (a)	994000 kg	0.4	397000
4.	Working cattle (b)	98000 kWh	1.0	98000
5.	Solar energy.	Not estimated.	-	-

a) 456 cattle @ 5 kg/day and 222 cattle @ 2 kg/day.
b) 98 working cattle @ 0.5 kW each, working 8 hours a day for 250 days in a year.

Note : Agricultural waste quantity above may not include some quantity of green chara produced only for the cattle in the village. Also dung can be produced only when cattle

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STATEMENT -8.

AGRICULTURAL PROFILE OF THE VILLAGE

1. Total Land

Sl. No.	Category	Land in bighas	No. of families.
1.	Land ploughed by owners	5075	116
2.	Land ploughed by Non-owners.	585	13 (Possessing no land) 32 (Possessing land)
3.	Owners giving land to others	-	14

Total land for cultivation 5560 bighas or 492 Hectares.

2. Total Agricultural produce of main yields(during 1977-78).

Sl. No.	Item produced.	Quantity produced Quintals.	Approximate wastes (dry basis) Quintals.
1.	Wheat	6170	7880
2.	Rice	3010	1100
3.	Gur	633	1500 chara + 2300 Bagasse.
4.	Ganna	3600	700 chara + 1100 bagasse.
5.	Bajra	136	230
6.	Makka	128	160
7.	Channa	68	70
8.	Jwar	50	400+600 chara only.
	Total		12560 Q wastes + 3400 Q Bagasse.

Note:-

1. These figures are based on the information on production furnished by the Kissans themselves and are likely to be on the lower side of actual production.

2. Apart from the above main crops the village produces many vegetable and dals etc. Production during 1977-78 included Kapas, Arhar, Urd, Masoor, Mirch, Sarson among general crops and Singara, Kaddu, Torai, Lohia, Bhindi, Kakri, Gajar, Tomato, Lahsun, Alu etc. among vegetables.

STATEMENT-9.

TREE POPULATION AND GROWING RATES

Sl. No.	Type of tree.	No. of trees.	Approx. Average Wt. kg.	Total wt. Quintals	Growing period years.	Approx. Wt** after growing period kg.
1.	Mango	50	250	125	5	200
2.	Jamun	30	500	150	5	400
3.	Jamoa	40	500	200	5	400
4.	Babul*	200	200	400	5	200
5.	Neem*	500	250	1250	3	200
6.	Kaskar*	100	300	300	1	150
7.	Shahtut	150	250	375	2	100
8.	Amrud	100	100	100	5	100
9.	Sheesham	50	400	200	3	300
10.	Peepal*	30	250	75	2	100
11.	Bada*	10	200	20	3	100
12.	Anar	10	50	5	5	50
13.	Gular*	10	500	50	5	500
14.	Neebu	50	50	25	5	50
15.	Kela*	50	70	35	1	70
16.	Papeeta*	50	60	30	3	100
17.	Khajur	10	200	20	8	300
18.	Sondhana*	10	300	30	3	300
19.	Umra*	5	100	5	5	100
20.	France*	10	200	20	3	150
21.	Kait	5	200	10	5	200
22.	Labhera	10	250	25	2	150
23.	Mahua*	5	250	12	3	200
24.	Adhu	10	100	10	5	100
25.	Bakanrh*	2	200	4	5	200
26.	Imli	2	150	3	5	150
27.	Dhak*	2	100	2	5	100
28.	Katchnar	5	150	7	5	150
	Total	1506 Trees		3488 Quintals		

** Weight is on dry basis and figures are based on estimates of a group of villagers.

* 14 varieties of trees 984 Trees 2233 Quintals

STATEMENT - 10

CONNECTED ELECTRICAL LOAD TO BEGA FEEDER FEEDING TWELVE VILLAGES INCLUDING KHERITAGA VILLAGE

Sl No.	Name of Village	SP	% of Total	AP	% of Total
1.	Bega	28.375	17.1	266.565	10.75
2.	Rakshera	35.090	21.2	348.780	14.05
3.	Chirsmi	5.695	3.4	167.538	6.75
4.	Morvati	28.375	17.1	568.630	23.00
5.	Haldana	-	-	86.630	3.50
6.	Bakhurpur	-	-	29.150	1.17
7.	Datoli	28.510	17.2	206.765	8.33
8.	Ghasoli	18.850	11.4	478.680	19.30
9.	Kheritaga	13.255	8.0	195.350	7.88
10.	Baraut	-	-	38.670	1.57
11.	Bain	7.560	4.6	52.980	2.13
12.	Roshnapur	-	-	39.150	1.57
Total		165.710	100.0	2478.888	100.00

(Source : Haryana State Electricity Board records)

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est chara or agricultural waste. Sl. No. 1 and 3 can be considered as resources exclusive of each other only except that some agricultural waste may already be in use as fuel.

Strictly speaking solar energy is the only source available on earth and all other forms follow from it. But utilisation in any of the available forms depends on the grasp of knowledge relevant to the form of energy available.

The resources indicated above as 'Agricultural waste' and 'Dung are not available separately as an energy source in the village. Agricultural waste can either be used as a fuel itself by burning it or by using it as a feed stock for cattle. Out of the total adult cattle population of 456, the cattle for milk numbers 358, which comes to 78.5%. The other 98, ie 21.5% of cattle are useful for transportation and ploughing work. As such it is clear that the village can ill afford using agricultural waste as a fuel unless it is surplus over the requirement of cattle. Information revealed that the village produces almost as much'agricultural wastes' as is required for'cattle feedstock' in the village. The real energy source which can be utilised in the village is 'dung' only. This excludes those wastes which can not be used as chara.

In the present utilisation of the above energy sources of the village, agricultural waste is fully used by cattle except that some bagasse, about 3400 quintals per year is under use as fuel for processing gur from sugarcane or as a light fuel. Dung is used partly as fuel and partly as fertiliser. Cattle work force is partially utilised to the extent required and firewood is fully used as a fuel. Solar energy is exclusively used for drying grains and warming water.

6.2 Exploitable Energy Resources.

Apart from the used energy resources there is scope for exploiting some additional energy from nature, if need be. There are natural resources available in the form of (a) solar energy (b) water (c) soil (d) Biological activity. These resources if properly utilised are capable of generating fuels for different uses in appropriate forms. Growth of vegetable matter, the production of biogas, animal power, wood, direct solar energy etc. are all derived from the same natural resources. There is scope for devising natural cycles utilising above resources to meet energy requirements of the village. Energy sources which have not attracted the imagination of village population for scintific exploitation can be grouped as follows:-

1. Wind power.
2. Solar energy for direct use.
3. Growth of wood as a continuous source of energy.

Apart from the above, proper storage and management of water resources from rains can reduce the power consumption in electrical pump sets for irrigation.

6.2.1 WIND POWER

Application of wind mill is a potential area for exploiting natural energy source. National Aeronautical Laboratory has developed a wind mill (2 kW) with rotor diameter of 5.5 M which starts working when wind speed exceeds 8 KMPH. When used for pumping water this wind mill can pump water at a rate of 2 M^3/hr. at a wind speed of 12 KMPH, 10 M^3/hr at 20 KMPH and 45 M^3/hr at 32 KMPH, from a depth of 10 M. Thus if cheap and simple designs of wind mills can be developed such that they can be produced with the surplus labour available in villages, it is possible to reduce the dependence of electrical pump sets. However duration of winds in various seasons need to be studied for assessing actual potential. According to one estimate (35) there were 65 lakhs wind mills in America during 1880-1930. The possibility of exploiting this resource thus, cannot be overemphasised. Pumping water with wind mills continuously to higher levels and utilising this water for various crops according to requirements can also be considered. Wind mills can also be used to give direct power to threshers, chara cutting machines, flour mills etc. in order to reduce the electrical load.

6.2.2 SOLAR ENERGY

Unlike wind power, which needs experimentation and development of tools and technology, solar energy is already in use in a number of ways in village economy. Drying of agricultural produce and dung cakes, warm water for bath and growth of trees are already existing applications of solar energy. However, with new developments in science and technology, there are very useful areas for village application where tapping of solar energy needs perfection for economical development of villages. These are :-

1. Water pumping (solar pumps).
2. ~~Low voltage~~ Electricity for transistors.
3. Solar dryers for grains.

Water for irrigation can be pumped by solar pumps when its technology becomes techno-economically viable. In India efforts are being made to develope rankine cycle based vapour turbine type prime mover for power generation and a 1 kW solar water pump jointly with W.Germany. The successful application of any such device to our rural economy will largely depend on the possibility of manufacture at low costs and the level of skill required for their O&M being within the means of villagers.

Directex solar energy conversion to electricity using photo voltaic cells has be n a subject matter of research and they have been able to bring down the cost of conversion device from Rs. 1600/- to Rs.550/- per watt. If cheaper devices are developed as aimed by R&D effort to bring it down to Rat 4/watt, solar energy can well serve the energy requirement of radio receivers. Here again tremendous R&D effort is required to bring it to the realm of village economy.

Although field drying is presently in use in the village and solar dryers mean cost, solar dryers which can be locally produced can be considered a potential area of solar heat utilisation in village. This may not sound attractive initially because it involves cost, but in the long run it quickens the grain processing and many times can result in saving grains from rains and deterioration.

6.2.3 WOOD RESOURCE

Growth of wood which also derives energy from solar light and heat is also an area which can promise rich dividends. Large areas in villages are lying open and unutilised. Residential areas and space around them can be further utilised for growing trees. Planned drive to exhaust all avenues of wood growth can solve the energy problem of villages to a large extent.

Statement - 9 gives the present tree population and the growth rate of various varieties of trees in the village estimated by a group of villagers. To assume that all the trees grown can be used for producing wood as fuel is untenable because they are to be used for fruits and fo wood applications. Accordingly only fourteen varieties of trees which can be used as a fuel yearly have been considered for fuel separately.

Existing firewood potential of the village is 2233 quintals. The rate at which this can be used as fuel should depend on how fast it can be replenished by growing new trees. A potential of 900 quintals/ year is not difficult to attain.

6.2.4 WATER MANAGEMENT

Water management can also serve as an area of energy substitution, although it is not a direct source of energy. Proper storage of rain water and reduction in pumping head can lead to enormous savings in agricultural power consumption. This area has sufficient scope for study and improvement, because not much has been done so far. This new discipline is finding increasing importance, due to the necessity of reducing energy consumption in agriculture, with rising prices of liquid fuels, among the industrially advanced nations, Dedrick, Replogle and Erie (1979) have suggested level basin irrigation, requiring accurately levelled field and piped water supply. Such techniques are basically meant for energy intensive agriculture and mechanised farming, not having much scope for application in India.

Here the farming is still based on major contribution by man and it is necessary to adopt such techniques, which may halt the increasing energy requirements for irrigation. Tyagi, Singh and Narayana (1979) have evaluated the water management of tubewell irrigated farm. They have pleaded to improve efficiency of water pumping water conveyance and application efficiency of water. These aspects should be given due importance in the village to reduce energy requirements for irrigation.

6.2.5 DIGESTED DUNG AND ETHANOL

Dung which is now used only as a direct fuel or direct manure can prove to be a rich source of energy if completely untapped gobar gas is produced from the dung. The digested dung can serve a rich substitute for chemical fertilisers. In addition to dung human waste is also having appreciable potential forse giving bio gas and rich manure after digestion, like dung. Public latrines if provided in village can serve as a source to recover this form of energy.

The most difficult area on energy front is the availability of liquid fuels, which are extensively used in combustion engines and are required for ploughing and transportation in village. In the absence of electricity these fuels can also be used for irrigation. India is having limited reserves of petroleum and cannot affort costly imports for long.

'Ethanol' is an alcoholic liquid fuel which could be produced from wide range of raw materials including vegetable matter, waste organic matter, and molasses. Ethanol has high latent heat of vaporisation, calorific value about two-thirds of gasoline and produces less carbon deposits. Due to its changed characteristics it may not be feasible to use 'ethanol neat' as a fuel in present day automobiles. It could, however, be utilised as a blend constituent in ethanol-gasoline blend. Their mixing properties are however, important for commercial application of the blend. Mathur HB(1979) considers ethanol as a promising liquid fuel.

Efforts to replace most of the energy requirements in village, presently based on electricity and diesel, by ethanol and gobar gas, are likely to result in very little dependence of the village on out-side sources of energy.

6.3 ESTIMATED ENERGY POTENTIAL

Keeping in view the various energy sources discussed in preceding para and taking into account the potential of the village as a whole the energy potential of the village at present is estimated as given in Table below:-

TABLE - 14

PRESENT FEASIBLE ENERGY POTENTIAL

Sl. No.	Type of resource	Potential per year in original unit	Coal Replacement factor	Coal replacement value Kg/cr.
1.	Wood	90000 kgs.	0.95	85,500
2.	Gobar gas (from 994000 kgs dung only).	248000 Cum	1.0	2,48,000
3.	Working cattle	98 cattle	1000	98,000
4.	Ethanol (from 10,80,000 kg Ganna).	36000 litres.	4.35	1,57,000
5.	Biogas (based on 1350 adult persons @ 1 Cuft/day/person).	14100 CuM	1.0	14,100
6.	Wet dung manure (from digested dung)	2980 tons.	125	3,72,000
7.	Wind power (based on 20 mills each 2 kW for 2000 hrs/year.	80000 kWh.	1.0	80,000
8.	Solar energy	Not quantified for water heating, drying and plantation.		
	Total			10,54,600

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CHAPTER VII

MEETING ENERGY NEEDS FROM RESOURCES

Having studied the energy needs for prevailing life styles and the village energy resources, it may be reasonable to indicate how best the needs can be met from the internal resources of the village so that its demands can be met most economically.

For arriving at the most optimal relationship between energy resources and energy forms used we may have to start either form:

(i) Resources available to study their possible conversions and utilisation to the needed forms.

(ii) Needed energy forms to study the possible resources from which they can be derived.

However, changes in the traditional forms of resources used and energy forms needed requires suitable institutional changes and changes in life styles.

7.1 Technology link between Resources and Needs:

Energy forms now in use in the village depend mainly on the resources available and the knowledge to utilise these resources for the required needs. Naturally the utility of those resources which are in constant use, is restricted by the knowledge given by science and technology and available to village population. The utility is further restricted by the living habits developed in the village over a long period of time and any change in the form of energy use will naturally require adjustment in living habits.

Changes proposed due to the availability of new technology, claimed to be economical, and promising desirable changes in villagers life styles, may demand more manual labour from villagers. The acceptance of the new technology for use in village will therefore depend on the marginal benefits perceived to be derived by the change compared to the marginal labour input required by the villager. The other alternative under which the villager will be willing to accept the technological change is the possibility of monetary gain.

While dealing with the natural resources to maximise the yield per unit of land, most of the village activity doesn't enter the commercial field. The services a family renders to itself or to another family on a barter system do not enter the commercial accounting. The village population, barring few big landlords, cannot think of investing any capital for utilising new technology because it involves payment towards commercial profits which are difficult to meet from meagre production of individual families. The advantages of new technology can flow to villagers provided the new technology is exploited at the village level only and the villager has not to depend on the services of highly paid urban scientist or technician. For making available the benefits of science and technology to the rural population it will be necessary to devise suitable institutional forms to serve them, modify the technology to become village resource oriented, and to make village economy self dependent to the maximum extent possible including skills.

7.2 Existing and Proposed forms of Energy Consumption:

In the first analysis of meeting energy needs from the internal resources to the maximum extent, it is intended to use the energy in the same form for various category of requirements, as it is presently being used. Keeping this in view, the energy forms used in various categories by Sector applications, can be grouped as follows:

a) Wood and agricultural waste used directly as fuel
b) Coal as fuel
c) Agricultural waste eaten by animals and available as: i) Dung as fuel and manure;
ii) Animal muscle power
d) Electricity used for: (i) Lighting and small power
(ii) Agriculture
e) Petroleum products used: i) Kerosine for lighting and ignition
ii) Petrol in motor cycles
iii) Diesel for tractors or Diesel engines.
f) Energy component of chemical fertilisers.

7.2.1 Wood and Coal as Fuel

About 90,000 Kg of fire wood can be generated from the village resources. The small quantities of commercial fire wood and coal being used in the village at present can easily be substituted by fire wood and gobar gas if produced. About 3,40,000 Kg of bagasse produced from the crop of Ganna has not been accounted as it may be consumed in producing Gur and Sugar. Wood is necessary for fire in winter. But fire wood can be replaced by gobar gas for cooking when its production is started. Wood can be put to better uses in making houses and producing furniture.

7.2.2 Dung and Animal Power

Presently about 4,42,000 Kg out of an estimated 9,94,000 Kg of dry dung produced in the village is used directly as fuel. The remaining dung about 5,52,000 Kg. is being used as a manure. According to an estimate by a group of villages, 8000 Kg of wet dung manure can replace about 200 Kg of chemical fertilisers. To replace the total 52,500 Kg. of fertilisers to be used per year in the village, wet dung manure required will be of the order of 21,00,000 Kg. Dry dung which is presently being used as a fuel is 4,42,000 Kg. which can yield about 13,20,000 Kg of wet dung manure in addition to that being used now, if all dung is digested to produce gobar gas. This additional wet digested dung manure can replace about 33,000 Kg of chemical fertilisers. With demand going up to 65,000 Kg in 1983-84, 32,000 Kg of fertilisers will be required from out side the village.

The dung, now being used as manure or used as a fuel, is not being used to produce gobar gas. According to one estimate dung has the potential of yielding 3 cuft. gobar gas per pound of dry dung at low temps (15°C) and 6 cuft/lbs at high temps (27°C) (14). Even if we assume a yield of 4 cuft/lbs on an average throughout the year, about 4 Kg. of dry dung will give 1 cum of gobar gas. Thus from an estimated quantity of 9,94,000 Kg of dry dung about 2.48×10^5 cu M ofgobar gas can be produced each year with a calorific value of more than 5000 K cal/cu M. It may be added that there is scope to investigate the possibilities of increasing the output of gobar gas per unit of dung by improving the fermentation process at suitable temperatures. Out put of gobar gas can be substantiallly enhanced by using solar energy for the purpose.

Annual power dependent on the availability of feed stock for the cattle, is also available in the village in plenty. Against total availability of 98 cattle in the village, only about 28 are being fully utilised at present. Although actual replacement value of animal power varies with its application as shown in para 5.1.2, each cattle is considered equivalent to 0.5 KW power (25). If each animal can be put to work 250 days a year and 8 hr. a day, it is capable of giving about 1000 Kwh energy eavery year.

7.2.3 Electricity Potential

Electiricty is being used presently in the village on quite a large scale for agricultural purposes and in a small way for lighting and small power (flour mill etc.). Street lighting is not provided in the village. Village Khentage is connected with 8% small power and 7.88% Agriculture of power of the total loads connected to Bega feeder to which twelve villages are connected as seen from statement 10. Assuming that Domestic supply load of Khentage is also 8% of the total of other villages, its D.S. consumption comes to 4,264 Kwh, S.P. consumption to 6,260 Kwh and A.P. consumption to 162408 Kwh from statement-10 and statement-11 by assuming consumption proportional to load. Actual consumption figures of village Khentage(Statement-4) in DS are more but in A.P. they are less by about 26000 Kwh. As the figures in statement-4 are based on the bills of the village and statement-11 on the energy distribution station at Gannaur, it is evident that Villages have been overbooked on D.S. (may be due to frequent interruptions) and under booked on A.P. The A.P. consumption being much higher, extra energy of the order of 26000 Kwh, consumed in the system can be accounted for either in transmission losses or in way losses. If an effort is made to utilise the gobar gas by developing suitable technologies in a bid to replace electrical power requirements, much of the electricity requirements of the village can be met in different ways.

Gas can be used in suitable burners for lighting. It can also be used to run combustion engines in blending with Diesel or ethanol to meet irrigation pumpting requirements. Even if gas is used to generate electrical power in blend with Deisel or ethanol the cost of power generating equipment is expected to be competitive cheaper. About 2,48,000 cu M gobar gas/year available in the village can replace electric power to the extent of 2,48,000 Kwh either by direct use

STATEMENT - 10

CONNECTED ELECTRICAL LOAD TO BEGA FEEDER FEEDING TWELVE VILLAGES (INCLUDING KHERITAGA VILLAGE)

Sl No.	Name of Village	SP kw	% of Total	AP kw	% of Total
1.	Bega	28.375	17.1	266.565	10.75
2.	Rakshera	35.090	21.2	348.780	14.05
3.	Ghirsmi	5.695	3.4	167.538	6.75
4.	Morwati	28.375	17.1	568.630	23.00
5.	Haldana	-	-	86.630	3.50
6.	Bakhurpur	-	-	29.150	1.17
7.	Datoli	28.510	17.2	206.765	8.33
8.	Gheoali	18.850	11.4	478.680	19.30
9.	Kheritaga	13.255	8.0	195.350	7.88
10.	Bazant	-	-	38.670	1.57
11.	Rain	7.560	4.6	52.980	2.13
12.	Roshnapur	-	-	39.150	1.57
Total		165.710	100.0	2478.888	100.00

(Source : Haryana State Electricity Board records)

STATEMENT - 11

TOTAL ELECTRICAL ENERGY CONSUMED BY THE BEGGA FEEDER IN RESPECT OF GANNAUR SUB-DIVISION FOR THE YEAR 1977-78 (Monthwise)

S No.	Name of villages covered.	Month	D/S	C/S Commercial	Cottage Industry	S.P. less than 20KW	M.S. more than 20KW	Agricultural Power.	S/ Light	Grand Total
1.	Begga	4/77	1715	-	3333	3696	2660	212647	91	224142
2.	Raksera	5/77	7625	1078	5702	6743	-	202385	32	223565
3.	Chirasmi	6/77	1288	-	4627	7527	-	218558	20	232020
4.	Mohti	7/77	7576	1408	4837	7300	-	130692	358	152171
5.	Naldaha	8/77	2069	-	3886	5621	-	79155	51	90782
6.	Bhakarpur	9/77	7439	764	3428	5539	-	132010	174	149354
7.	Dattelli.	10/77	1685	-	3713	6062	-	195245	204	206909
8.	Ghasolli	11/77	9993	1501	4524	5115	10	242735	95	263971
9.	Kheri Tagga	12/77	2269	-	3919	8505	1990	209695	128	226506
10.	Roshanpur	1/78	11117	2075	4198	10671	4975	155889	174	189099
11.	Barwant	2/78	2452	-	3334	8667	2528	162822	143	179926
12.	Rain	3/78	10347	1961	2288	5812	4400	119159	103	144070
	Total		[illegible]355	8787	47789	78258	16563	2061020	1575	2279545
	% of the Grand Total		2.876	0.385	2.096	3.435	0.727	90.414	0.069	

(Source : Haryana State Electricity Board Records)

Statement - 11

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or by generating electricity. To start with, production of fuel, from biological wastes may not have the desired efficiency but with suitable R&D efforts and development of the infrastructure for their regular production, it may prove to have advantages in the long run.

Any system which is fully village based for meeting is energy requirements, in resources, installation skills and O&M skills has inbuilt merits. These include

a) Planning work to suit energy availability
b) Optimum generation or power capability to save capital investment.
c) Savings in electricity distribution net works.
d) ~~Savings in more~~ Fuller utilisation of cattle as a source of energy.
e) Creation of employment for local population.
f) Development of a scientific approach among village population.

7.2.4 Petroleum Products

Diesel is mainly used for running tractors and petrol for running motor bykes. Kerosine is used for lighting purposes. Use of small quantities of kerosine is considered as a necessity for ignition purposes. This is required even as a substitute for electricity whenever it fails. About 1500 litres of kerosine is required annually.

Recently some experiments have been conducted to use ethanol (an alcoholic product produced from molasses) in petrol engines at technical university, Guindy, Madras. Ethanol can be produced in sufficient quantities from the molasses produced in sugar factories to replace petrol totally and to replace diesel oil to an appreciable degree, if R&D efforts are intensified in this area. It is considered a technological feasible and an economically viable proposition at present (42). With around 950 quintals of Gur producing capacity of ganna produced within the village, if whole of it is processed to be converted to sugar, it is estimated that about 36,000 litres of ethanol can be produced. This can replace about 24,000 litres of petrol and diesel oil requirements of the village. According to one estimate 1 litre of ethanol can be produced for each 30 Kg of sugar cane processed to sugar at a cost of about Rs.1/-. Ethanol has been used successfully in multicylinder diesel engines in a mixture of 50% with diesel. It has also been found successful in petrol engines as such.

7.2.5 Fertilisers

Energy components of the chemical fertilisers used in the village is also quite large. We have already seen under para 7.2.2 that the requirement of chemical fertilisers can be drastically reduced provided the whole dung available in the village is converted in manure and is distributed properly. Even though the requirements of energy for chemical fertilisers can be totally met from the resources of the village in the long run, dung manure has been considered to replace 51% of the total requirements of chemical fertilisers in addition to the part it is already playing. This will keep the fields optimally fertilised taking help of chemical fertilisers where required. The requirements of chemical fertilisers can has been reduced to only 32,000 Kg per annum.

7.3 Existing and proposed forms of Energy consumption

Keeping in view the strategy discussed above in meeting the energy requirement of the village from the energy resources of the village, the table-15 given below has been prepared. It gives the existing and proposed forms of energy requirements in the villages. It may be seen that there can be balance energy in certain forms available in the village after meeting all its requirement, where as some other forms will be required to be imported into village. Over all analysis reveals that village can become surplus in energy needs. The surplus animal power, gobar gas and ethanol are more than the diesel imports required by the village. However, to make the above plan feasible, it is necessary to reduce induce the utilisation of new technologies in the village by adopting suitable science and technology policy.

Except for radio, electric power in the village can be replaced by gobar gas and alchohol (ethanol) by putting in adequate R&D efforts and by taking suitable measures to develope institutional forms which may accelerate the process of change in technologies adopted at village level.

TABLE - 15

EXISTING AND PROPOSED FORMS OF ENERGY CONSUMPTION

(BASIS - YEARLY)

Sl. No.	Category of requirement	Existing forms used for desired consumption level needs.	Proposed forms for desired consumption level needs.	Total consumption in proposed forms	Remarks
1	2	3	4	5	6
1.	**Domestic Energy**				
	a) Cooking b) Hot water	100,000 Kg wood 550,000 Kg dung	34000 Kg wood 15000 cu.M. Gobar Gas 44000 cu.M.G.G.	50000 Kg wood 59000 cu.M. Gobar Gas	Assumed %8 burning dung - 10% wood - 12% gas - 50%
	c) Fire in Winter	16000 Kg wood			Fire in winter @ 2 Kg wood/hr for 8000 hrs.
	d) Domestic Appliances	Manual	Manual	1,80,100 KWH Electricity	
	e) Lighting	22,000 KWH 1500 Litres Kerosine	22,000 Kwh 1500 Litres Kerosine	9900 litres ethanol	
2.	**Agricultural Appliances**				
	a) Irrigation Pump sets b) Processing of grains & chara cutting	146,100 Kwh	146,100 Kwh 9450 litres ethanol	8100 litres Diesel 28 Cattle	
	c) Tilling & sowing	14,400 litres oil 18 Cattle	8100 litres Diesel 18 cattle	Solar energy (not quantified)	Cattle working 8 hrs. a day for 250 days/year
	d) Cutting of crops	Manual	Manual	Manual labour (not quantified)	
	e) Drying of Crops	Solar	Solar	29,80,000 Kg wet dung Manure	
3.	**Transportation:**				
	a) Individuals	300 Litres Petrol	450 litres ethanol	32,000 Kg Chemical Fertiliser.	Baggi working 4 hrs. a day for 250 days/year.
	b) For daily hiring	2 Baggis	[illegible] Baggis		
	c) Transport to Market	6 Baggis	8 Baggis		

contd.....

(Table-15 contd)

1	2	3	4	5	6
4.	Commercial and Industrial	12,100 Kwh	12,100 Kwh		
5.	Fertilisers	65,000 Kg Chemical Fertilisers. 10,55,000 Kg Wet dung Manure.	32,000 Kg Chemical Fertiliser 29,80,000 Kg Wet dung manure.		

* Electrical energy has to be used mostly as mechanical energy or light. This may slowly be substituted by combustion engines and gas light.

NOTE:

(i) From the total yearly resources of 90,000 kg. wood and 2,40,000 Cu.M. gobar gas, total electricity needs can be replaced in the village itself after allowing for wood and gobar gas used in cooking. It will also leave surplus.

(ii) Fuel needed from outside the village is 1500 litres kerosine, 8100 litres diesel and 32,000 kg. of chemical fertilisers which totals 2,22,400 kg. Cr. of fuel.

(iii) Ethanol quantity of 26,000 litres, equal to 64,500 kg. Cr. is also available surplus over consumption.

(iv) Shortage of [illegible]0,400 Kg. Cr. of energy can be more or less balanced by 70 cattle power also available surplus.

(v) Consumption is made as near to the existing form as possible. Whereas consumption is made at 1983-84 level in the above proposal energy resources considered are at the present level only without allowing for efforts to increase them.

CHAPTER VIII

SOCIAL AND ECONOMIC FACTORS RELEVANT TO ENERGY PROFILES

Location of village Kheritaga with respect to New Delhi and adjoining areas is given in Annexure III. It is located in Haryana, District Sonepat, in the Tehsil of Gannaur. The location and proportional dimension of village Kheritaga in relation to other villages in Gannaur Development Block are given at Annexure IV.

From the information available regarding families of the village, effort has been made to identify the characteristics of the families which affect their energy consumption profiles. Annexure V a gives the consolidated statement of important facts about all the families of the village. The code numbers used in Annexure Va to define various categories under each head are given in Annexure Vb.

8.1 General Appraisal

Statement-12 summarises the population characteristics of the village. There were total 170 families in the village as per the actual survey, with a total population of 1640 which indicates an average family size of 9.65. Working population has been considered in the age group of 12-55 years based on the actual assessment of working group through enquiries and observation. There were 54 families which were dependent on business, labour or skill alone as they were without land. There were 1147 illiterate people in the village constituting 69.8% of the total population.

Major resources of the village as a whole are summarised in Statement-5. These include land, houses, cattle, Electric pump sets, Threshers, Baggi, Chara cutting machine, bicycle and hand pumps. The biggest (only one) threshing machine was a 'Dara Automatic Wheat Thresher' with 20 HP electric motor, capable of cleaning about 14 maunds (521 Kg) wheat per hour as per the estimates of the owner. Tractors with trailer and agricultural implements (3 Nos.) having 38 KW engine were

STATEMENT -12

POPULATION PROFILE OF THE VILLAGE

Sl. No.	Indicator	Strength
1.	Total No. of Families	170
2.	Total population	1640
3.	Average size of family	9.65
4.	Working population 12-55 yrs. age:	
	a) Male	478
	b) Female	401
5.	Child population below 12 years age:	
	a) Male	299
	b) Female	298
6.	Old population above 55 years age:	
	a) Male	100
	b) Female	66
7.	Education level:	
	a) No. education	1147
	b) Below 5th standard	302
	c) Between 5th and 10th standard	169
	d) Between 10th and Graduation	19
	e) Post graduation	3
8.	Families owning land	116
9.	Families dependent on labour and other occupations	54

Notes: i) Caste wise almost all sections were represented in the village.

ii) Tyagi's, Brahmins and Baniyas, Scheduled Castes and backward classes were concentrated in four residential sections of the village.

iii) Educated individuals were mostly serving outside village.

owned by three families. Many electric pump sets were having threshers and chara cutting machines connected to the same electric motor. Some electric pump sets and Baggis were jointly owned by families. The number of land owners and pakka house owners along with their interrelationship are depicted in Statement-13 'House and land Profile'. As many as 10 families were not owning both, the land and pakka house, constituting 22.3% of the families.

8.3 <u>Families without Electricity</u>

Statement 14 analyses the characteristics of families not having domestic electrical connections. Although the village is electrified for about a decade, more than 60% of the families i.e. 103 families out of 170 were not having domestic electrical connection. It was found that 69% of the 103 families still consider electricity to be an accident hazard and advanced it as the reason for not having electrical connection. However 54 of the 71 families considering electricity as an accident hazard had maximum education level between 5th and 10th standard, showing that education has not been able to dispel the fears of electricity. Further it may be seen that most of these families have either seen or used at least 3 of the six electrical appliances mentioned to them, indicating that their awareness of the usefulness of electricity was quite good. Although only 16 families have indicated that they do not have electrical connection due to cost reasons, possibility of this being the main reason cannot be ruled out. However 16 families of which 5 were having land holdings were satisfied without electricity inspite of their good awareness of electricity applications for domestic comfort. The lighting application of electricity was considered to improve their living conditions only marginally in their own esteem due to the interrupted supply of electricity. Interestingly percentage of families not satisfied with lighting arrangement was of the same order among the families 'having electrical connection' and those 'not having electrical connection'.

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STATEMENT -13.

HOUSE AND LAND PROFILE

Sl. No.	Characteristic of family.	No. of families.	
1.	Not owning land	54	
2.	Having house (Katcha) only.	62	
3.	Not owning land having pakka house	16	
4.	Owning land and having katcha house only.	24	Possessing land upto: 10 Bighas - 6 20 Bighas - 7 40 Bighas - 6 Above 40 Bighas - 5
5.	Not owning land and not having pakka house	38	
6.	Owning land and having pakka house	92	

Note:

Out of the 24 families owning land and having katcha house only (Sl.No.4) the break up with the size of land holding was as follows:

i)	Upto 10 Bighas	.. 6
ii)	10 - 20 Bighas	.. 7
iii)	20 - 40 Bighas	.. 6
iv)	Above 40 Bighas	.. 5
	Total:	24 families.

STATEMENT - 14.

FAMILY PROFILES HAVING NO DOMESTIC ELECTRICAL CONNECTIONS

1. Related to land holding and education level.

Sl. No.	Reason for not having connection.	No. of families.	Percentage of the total No. of families.	Subdivisive characteristics of families.	No. of families.
(a)	Satisfied without it.	16	15.5	i) Having Land	5
				ii) Having no land	11
(b)	Consider it costly.	16	15.5	i) Having land	5
				ii) Not having land	11
(c)	Consider it an accident hazard.	71	69.0	i) Maximum education below 5th	12
				ii) Max. education between 5th & 10th	54
				iii) Max. education above 10th	5
	Total	103	100		103

2. Related to the knowledge of electrical applicances.

Sl. No.	Reason for not having connection.	Total no. of families.	Number of electrical appliances seen or used out of 6 by how many family heads.		
			Upto 2 Appliances.	2-4 Appliances.	4-6 Appliances.
a)	Satisfied without it	16	2	8	6
b)	Consider it costly	16	3	7	6
c)	Consider it an accident hazard	71	4	31	36
	Total	103	9	46	48

8.3 Agricultural Profile

The agricultural profile of the village is given in Statement-8. There are 116 families constituting 68% of the total havin at least some land of their own. Out of these at least ~~xxxx~~ fourteen families give their land for cultivation to others. About 11.9% of total land is given by these 8% families for cultivation to about 45 (26% of the total) other families. Of these 32 families (19% of the total) have their own small land holding and cultivate other's land on rent in addition to their own. Families having no land represented 28% of the total population of the village (54 families with 451 persons).

Sixteen families not owning land were having pakka house to live whereas twenty four families owning land were havin Katcha house only (see Statement 13). Sixty two families (37% of the total) were owning katcha house only. Out of 24 families owning land and having katcha house only, 11 families possessed more than 20 bigas of land including 5 families holding more than 40 bighas.

8.4 Family size and Resources

Majority of the families, 53% of the total (90 families) have family strength falling between five and ten. Statement-15 categorises families according to level of possession of land and cattle with reference to the family strength. There were nine families holding no land but having family strength of more than 10. Three of them did not possess cattle also. 18 families not owning land had family strength of less than 5. Against 54 families not having land, 14 families did not possess any cattle.

8.5 Family Difficulties:

The expression of difficulties experienced by the family heads revealed that 57 (33.5% of the total) of them did not feel any kind of difficulty in a routine way. Statement-16 summarises various kinds of difficulties as

STATEMENT -15.

FAMILY CHARACTERISTICS RELATED TO SIZE.

Sl. No.	Family strength No.	No. of families.	Land holding among these families.						Cattle possession among these families.				
			Nil	Upto 10 Bighas	10-20 Bighas	20-40 Bighas	40-80 Bighas	Above 80 Bighas	Nil	Upto 2	2-4	4-8	Above 8
1.	Less than 5	26	18	1	3	1	3	-	4	15	6	1	-
2.	5-10	90	27	10	13	21	14	4	7	30	40	13	-
3.	10-15	30	3	5	4	2	10	6	2	6	9	10	3
4.	15-20	16	4	1	4	1	1	5	1	-	6	4	5
5.	20-25	8	2	2	1	2	1	-	-	-	3	4	1
	Total	170	54	20	25	27	29	15	14	51	64	32	9

Notes:-

(i) Largest size of family - 25

(ii) Biggest land holding - 330 Bighas

(iii) Maximum No. of cattle with single family. - 20

STATEMENT -16.

DIFFICULTIES FACED AND SUGGESTIONS MADE.

1. Difficulties experienced.

Sl. No.	Area of difficulty	No. of family heads experiencing the difficulty.
1.	No difficulty	57
2.	Lighting	12
3.	Cooking	13
4.	Moving around/fields/way not proper in rainy season.	48
5.	Agriculture/working	3
6.	Electricity/Street light	8
7.	House work	14
8.	Unemployment/poverty	14
9.	Others	11

2. Suggestion for improvement.

Sl. No.	Suggestion	No. of family heads.
1.	No suggestion	114
2.	Construction of streets	19
3.	Boundary of school/temple should be constructed.	8
4.	Waste collection should be arranged	5
5.	Light in street/regular supply of electricity should be provided	5
6.	Drainage should be provided	4
7.	Bund around village	4
8.	Arrangement of training medial service etc.	3

expressed by number of family heads. It may be seen that the most widely felt difficulty was related to the slippery walk ways around the village during rainy season. Difficulty in cooking was also expressed during rainy season. Difficulty in lighting was mostly due to the frequent interruptions of electricity. Unemployment and poverty also bothered many families. Most of the suggestions for improving living environment related to walk ways and hygienic conditions of living. Only five families suggested street lighting or were concerned about regular supply of electricity.

8.6 Satisfaction Level

The indices showing the satisfaction level of the village population are given in Statement-17. Only 6 families, say 4% considered their social life in the village as bad. Inspite of large number of members in many families there was little difficulty expressed on account of privacy. Incidence of theft/crime was reported against 4% families only.

However unemployment and desire for change of occupation were quite evident. Most families wanted at least one member to get some service in cities to provide regular source of income. A number of families reported disturbance in living. As there was no frequent rail or road traffic in the village, this disturbance can be attributed to the neighbours because houses are constructed side by side in an unplanned manner. Incidence of illness is not very high. Only 1.8 days per head per year are lost due to illness. Difficulties experienced by individuals are more due to poverty and living environment, rather than energy problems, except that cooking with their conventional fuels posed problems during rainy season.

8.7 Families with Electricity

In Statement-18 the characteristics of families having domestic Electricity connection have been analysed. When categorised by the size of land holdings, in all categories of land holdings, the families are well distributed except that two families not having land had domestic electric

STATEMENT -17.

SOCIAL INDICES OF THE VILLAGE
(Based on villagers responses)

1. **Problems faced.**

Sl. No.	Problem faced	No.of families.	
		Yes	No
1.	Incidence of theft/crime	6	164
2.	Desire change in occupation.	21	149
3.	Noise or disturbance	30	140

2. **Difficulty in Privacy.**

Sl. No.	Category	No.of families.
1.	Nil times	128
2.	Upto 25% times	26
3.	25-50% times	14
4.	More than 50% times	2

3. **Area of Difficulty.**

Sl.No.	Difficulty	No.of families.
1.	No difficulty	57
2.	Moving around in rains	48
3.	Cooking, lighting etc.	25
4.	Others	50

4. **Suggested areas of improvements.**

Sl.No.	Suggestion area	No. of families.
1.	No. suggestion	114
2.	Construction of streets	19
3.	Waste collection/drainage	9
4.	Street lighting and others	28

.....2/-

5. Quality of Social Life.

Sl.No.	Response	No. of families.
1.	Good	92
2.	So-So	72
3.	Bad	6

6. Incidence of illness.

Total days in a year 2943 Men days
Average in family 17.3 Men days/year/family.
Average per head 1.8 Men days/year/head.

7. Unemployment.

Total number of unemployed .. 95
Average in family .. 0.56/family.

STATEMENT -18.

CHARACTERISTICS OF FAMILIES HAVING ELECTRICITY CONNECTIONS.

Sl. No.	No.of families by size of land holding				No.of families by type of house				No. of families by level of education.				No. of families by size of cattle population.			
	Category.	No. of families			Category.	No.of families			Category	No.of families			Category	No.of families		
		TF	EC	% of total		TF	EC	% of total		TF	EC	% of total		TF	EC	% of total
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.
1.	No land	54	2	3.7	KH upto 3 rooms	48	3	6.25	Nil	21	2	9.5	Nil	14	1	7.1
2.	LH upto 20 Bighas	45	19	42.2	KH more than 3 rooms.	15	4	26.7	Upto 5th	54	14	26.0	Upto 2	51	14	27.4
3.	LH 20-40 Bighas	27	17	63.0	PKH upto 3 rooms	2	-	0	5th to 10th	79	40	50.6	2 to 4	64	28	43.8
4.	LH 40-80 Bighas	29	15	51.7	PKH above 3 rooms	44	21	47.7	10th to Graduate	15	10	66.7	4 - 8	32	19	59.4
5.	LH more than 80 Bighas	15	14	93.4	PH above 3 rooms	61	39	64.0	Post Graduate	1	1	100	Above 8	9	5	55.6
Total			67				67				67				67	

KH- Katcha House, PKH- Palkka-Katcha House, PH- Pakka House, NL - No land, LH -Land holding,
TF- Total no. of families, EC- Electrical Connections, % of Total.

- 100 -
Statement -18

correction also. When type of house is used as a criteria, it is found that families having pakka houses tend to have electrical connections. Only 7 families having katcha house were having electrical connections (10.4% of those having electrical connection).

By education level, educated families are more likely to have electrical connection. More number of cattle possessed by families, also has a positive correlation with electrical connection.

It may be seen that in all the categories of land holding, type of house, education level and size of cattle population, the percentage of total number of families having electrical connection increases with the higher level, indicating a positive correlation in level of possession with the electrical connection. Thus financial and economic conditions of the villager can be considered to be the main factor in favour of using electricity in domestic application.

8.8 <u>Fuel Consumption and Family Characteristics</u>

Pattern of fuel consumption in families of different characteristics have been analysed in Statement-19. Families have been categorised in two ways. First based on land holdings and second based on cattle possession.

It may be seen that per head consumption of collected wood which is the wood from their own trees for well-to-do villagers, increases in families having large land holdings. The consumption in these families having large land holdings (above 80 bighas) is almost double of other families. This shows that possession of trees tends to increase the reliance on this fuel. Trend is similar in other fuels also. However, one interesting phenomina is notable. Families having land holdings upto 20 Bighas have higher rate of fuel consumption per head compared to the families having land holdings between 20-80 Bighas, except for kerosine. This is possible only when the availability of these fuels is more to the families having smaller but some land holding. This can perhaps be

STATEMENT - 19

CHARACTERISTICS OF FAMILIES - ENERGY FORMS USED FOR DOMESTIC PURPOSES 1971 - [illegible]

Sl. No.	Characteristic of the families.	No. of famili-es.	Total popula-tion in category.	Quantities of fuel used per month in kgs. 1	2	3	4	5 (litres)	Remarks
1	2	3	4	5	6	7	8	9	10
A.	Based on land holding.								
1.	No land holding.	56	524	1647	8225	-	38	29	Cph - Consumption per head/ month.
	Consumption ph.			3.14	15.70		0.07	0.06	
2.	Land holding upto 20 Bighas.	45	392	1506	10005	245	77	30	
	Cph.			3.84	25.50	0.63	0.20	0.08	
3.	Land holding 20-80 Bighas.	55	555	2035	13078	60	60	80	
	Cph			3.66	23.56	0.11	0.11	0.14	
4.	Land holdings above 80 Bighas.	15	195	1420	6150	90	34	33	
	Cph			7.36	31.87	0.47	0.18	0.17	
B.	Based on cattle possession								
5.	No cattle	14	108	285	1680	60	24	6	
	Cph			2.62	15.56	0.56	0.22	0.056	
6.	Cattle population upto 2.	51	356	1511	7325	-	37	38	
	Cph			4.50	21.80	-	0.11	0.11	

Remarks:

Cph - Consumption per head/ month.

Fuels:-
1. Collected wood.
2. Cowdung(dry).
3. Commercial wood.
4. Coal.
5. Kerosine oil.

....2/-

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Statement - 19

1	2	3	4	5	6	7	8	9	10
7.	Cattle population 3-8.	97	1054	4325	23093	375	123	171	
	[illegible]			4.10	22.46	0.36	0.12	0.16	
8.	Cattle population more than 8.	8	136	963	4000	60	10	24	
	[illegible]			7.08	29.41	0.44	0.07	0.17	

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explained by proportionately more surplus dung with these families and absence of self esteem in collecting wood. Commercial fuel consumption in the form of wood and coal is obviously higher in these families having less resources of their own.

In the categorisation based on cattle population also the consumption of wood in families having cattle population of more than 8, is almost double of the others. These families are the ones having higher land holdings also. In other fuels also there is an increasing trend with higher cattle possession. There is a positive correlation between size of cattle population and the per head consumption of dung as fuel.

8.9 Electricity for Agriculture

The characteristics of families having electric pump sets have been identified in Statement-20. Here again the positive correlation between higher levels of category and possession of electric pump set is evident by size of land, type of house, level of education and cattle population. However, in the category of ploughing, those who fully cultivate their own land (category 2) and those who own more than they can cultivate (category 1) and hence give a portion to others for cultivation on rent, possess pump sets in large proportion. Sufficient number of pump sets to irrigate the whole cultivable land are available in the village.

It is seen that unlike domestic electricity connection which had relationship with pakka house and economic conditions, families in almost all categories possessed electric irrigation pump sets in a fairly distributed manner. However all families having big land holdings tended to have electric pump sets. Agricultural tariffs being lower than domestic electricity tariffs, it was a great incent to possess electric pump sets.

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STATEMENT -20.

CHARACTERISTICS OF FAMILIES HAVING ELECTRIC PUMP SETS.

Sl. No.	By size of land holding: Category	No. of families: TF	EPS	PCT	By type of House: Category	No. of families: TF	EPS	PcT	By level of education: Category	No. of families: TF	EPS	PcT	By cattle population owned: Category	No. of families: TF	EPS	PcT	By Category* of ploughing: Category	No. of families: TF	EPS	PcT
1.	Land up-to 10 Bighas	70	1	1.4	KH up-to 3 rooms.	48	4	8.3	Nil	21	2	9.5	Nil	14	1	7.1	1	15	12	80
2.	10-20 Bighas	29	8	27.6	KH more than 3 rooms.	15	5	33.3	Upto 5th class	54	21	39	Upto 2	51	10	19.6	2	70	38	54.
3.	20-40 Bighas	27	17	63.0	PKH upto 3 rooms	2	-	0	5th to 10th	79	28	36	2-4	64	22	34.4	3	29	9	31
4.	40-80 Bighas	29	19	65.5	PKH above 3 rooms	44	20	45.5	Above 10th	16	8	50	4 - 8	32	19	59.4	4	13	-	0
5.	Above 80 Bighas	15	14	93.4	PH above 3 rooms	61	30	49.1			-		Above 8	9	7	77.8	-		-	

* For definition of category, see Annexure V(b).

KH - Katcha House, PKH- Pakka-Katcha House, PH- Pakka House,
TF - Total no. of families.
EPS - Having Electric Pump Set.
PcT - Percentage of Total.

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STATEMENT-21

RISE IN ANIMAL POWER OF VILLAGE

Sl. No.	Type of Cattle	*Strength in 1950 Nos.	Strength in 1978 Nos.
1.	Camel	30	Nil
2.	Bullocks	100	48
3.	Buffalows(working)	50	50
4.	Buffalows(Milk)	20	280
5.	Cows	50	78
6.	Calfs	150	222
7.	Total	400	678
8.	Village population	1100	1640
9.	Ratio of cattle to population	0.364	0.413

* Figures in this column are based on estimates of a group of old villagers.

CHAPTER - IX

RELEVANCE TO PLANNING AND SCIENCE POLICY

The case study of village, describing its social environment, economic conditions, and the fuel and energy resources and consumption profiles of the village, is meant to understand the requirements of thevillage as perceived by those living in the village themselves. It tends to convert many of the assumptions made in estimation and planning of power and energy into known facts at village level, thus indicating the important areas of concern in planning for rural development, fuel use and technology.

9.1 VILLAGE COMMUNITY, THE BASIC SOURCE

Village usually refers to a consolidated agricultural community and consists of a group of persons larger than a single family occupying a number of dwelling and cultimating a number of fields spread to the boundaries of an adjuscent community. This community derives most of its needs from its natural environment. An Indian village used to be a complete unit providing all resources and services including food clothing, transport, medicines and dwellings in finally. Its little needs met from outside included only products like salt, matches, sugar and better quality cloth. Interestingly most of the services provided by the habitants to each other are paid up by barter system.

Whereas now the resources flowing from outside into village have increased as a result of improvements in agricultural technology (needing fertilisers and electricity) and transport facilities, the villages continue to sell surplus crop yields to feed city's population. In fact they are the permanent exporters of food and import in its place clothing and other industrial goods considered useful by them and feasible within their economic limitations.

Study of such dwellings which are closet to nature is important in the context of our search for economical and renewable source of energy which is the primary need of a sustainable society. It provides an opportunity to identify the typical requirements of the vast population living in rural India and the probable ways in which these requirements can be met from natural sources and natural processes. The importance of such a study lies more in viewing the demand and supply of a village community without getting coloured by the forces of free market economy which aims at reducing the demand of scarce commodities by increasing their price and vice-versa.

Village community, unlike the suppliers to free market economy who have many ways to increase their profits, have to depend on maximising the production of the crop they decide to grow in their fields at minimum expenses. The government plans to give subsidies to economically weaker sections in the village to provide monetary costs. The villagers also have an option to grow which ever crop they may like to grow, but even this option they cannot freely exercise due to the specific quality of their land, irrigation facilities available to them, fertilisers they can afford, desirable cropping pattern and the market value of the produce. While government helps these people in keeping down their expenses, it has also to come to their rescue in getting reasonable price for their produce to give them atleast marginal reward for higher production. Industrial manufacturer on the other hand can manipulate supply always lagging behind the demand. Village community as such have few alternatives to improve their economic conditions which can be classified into three broad approaches.

a) Maximising the yeld from their land of those crops which can give them higher prices.

b) Utilise their own production for meeting their own requirements to the maximum extent possible and

c) Minimise their own consumption of the commodities which can get them proportionately higher prices.

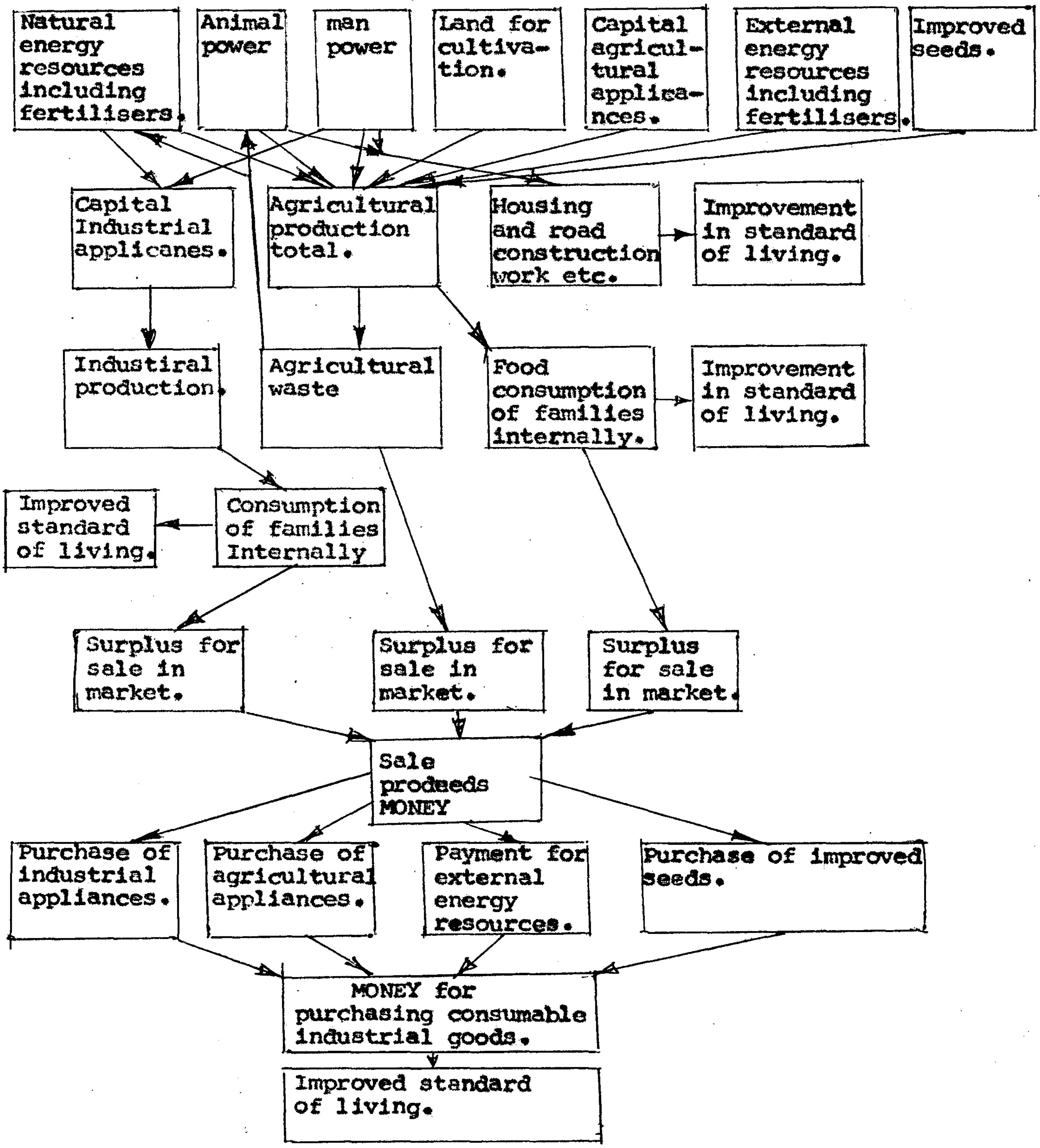
When we consider the improvement in standard of living of the village community, the approach (c) above goes contrary to the accompanied increase in consumption expected with the better standard of living.

Paradoxically there is a tendency among the village community ~~can improve their standard of living by~~ to cutt~~ing~~ down their own food consumption, the first basic necessity of life in order to buy other necessities of life. From the returns they get from this surplus over their own consumption in grains, dairy products and poultry products, can they buy other requirements, ie clothing and other amenities of life, made possible by science and technology?

The other way (b) available to them to improve their living standards is more attractive. First they should utilise their own production to the maximum extent, not only to meet their requirements of food but whatever other requirements they have, like input to agriculture and production of articles within their means. It is to emphasise this approach, that the maximum exploitation of their own energy resources to meet their energy requirements most of which are in the form of agricultural inputs, can go a long way in improving the economic condition and standard of living of village community.

9.2 VILLAGE ECONOMY.

Assuming that their consumption will not be curtailed below the level of requirement in harmony with the proper standard of living, village community will also be required to maximise the yield from their land which in turn will increase the inputs (consumption) required. Energy consumption and man power inputs are thus expected to rise. To what extent science and technology can help exploiting the natural resources so that the difference of their production and consumption can be utilised towards improving their standard of living to the maximum extent? This is the most relevant question the science policy makers should answer while planning for rural development.



RESOURCE FLOW IN VILLAGE ECONOMY

The schematic 'Resources flow in village economy' represents the interrelationship between resources and the economic activity of the village which determines the standard of living of village. It explains the structural relationships within which the improvements in standard of living are to be achieved by the village community in the existing set up.

Agricultural activity the predominant source of income, is carried out with two types of resources. ~~National~~ Natural resources of energy, animal power, manpower and land are natural resources which can be generated within the village without outside commercial activity. ~~with~~ Outside industrial products in agricultural appliances and fertilisers and improved seeds need commercial activity and money ~~power~~ resource to use them in increasing measure to increase the out put of their lands. A set up for industrial production also requires capital investment and money ~~power~~ resource

Agricultural and little industrial production is first utilised in the villae to meet the needs of village population and surplus is sold in commercial markets outside village. The money received in return is further utilised to repeat the cycle of agricultural and industri l production and to purchase other industrial goods to improve their standard of living. The real improvement in standard of living can come only when either (a) more goods other than food are produced within the village., (b) More surplus money is generated by sale proceeds to purchase goods from outside.

The real contribution of science and technology in improving the condition of living in villages can thus be made ~~in~~ by its cotribution in village activities to increase their ~~power of~~ capacity of production, not only of agricultural goods but other goods of utility as well. The share of energy contribution, from the village itself should be maximised to achieve better results, in this effort for increasing production.

Maximum use of internal resources to produce capital goods, minimum dependence on outside resources for which payment has to be made in the form of money, purchasing goods through minimum commercial transactions and substitution of external energy resources by renewable forms available in the village (including animal and man) can best serve the village communicty.

While planning for development the task before the planners is to invest the government funds in such a manner that its benefits reach everyone and more so to the poorest. Presently the emphasis in our planning is on providing electrical power to the villages for irrigation, chemical fertilisers for fertility of land and Diesel (Tractor) power for cultivation. By their very nature they percolate to a small fraction of the village community, which further aggrevates disparties and deprivation of the poor section.s Whether diverting to villages a portion of massive investments now being made in the projects of power sector, fertilisers and petroleum products, will be more effective in improving the standard of living in rural India with more equitable distribution of wealth?

9.3 CRITERIAL IN RURAL INVESTMENTS

Preliminary estimates considering the cost of large sized gobar gas plant even on the pro-rata basis of 1974-75 cost of small sized plants (by JJ patel of K&VIC), indicate that the cost of a 140 CuMe (5000 cuft) per day plant will cost about Rs. 1,000,000 for installation. Five such plants will be required to utilise all the dung of the village for conversion into gobar gas yeilding about 2,48,000 CuM of gas and 4,10,000 Kg nitrogen equivalent of compost per year (14).

Capital investment needed for meeting each kW of electricity at the consumer end on estimates of mid seventies is of the order of Rs. 9000/kW. (SVS Raghavan Ex-Chairman BHEL). For meeting 1,80,100 KWh electricity requirements of the village per year an installation of the order of 35 kW costing about Rs. 3,20,000 will be required.

Investments in gobar gas plants with decentralised electricity generation and distribution system of the same order will cost (Rs. 3,50,000 for gobar gas plant + Rs.1,40,000 for electricity generation and supply) about Rs. 4,90,000 for meeting above requirements. Capital Cost of the additional investment of Rs. 1,70,000 by the government will be of the order of Rs. 17,000 per annum. This has to be weighed against the cost of coal saved and fertiliser replacement value of the manure.

The above analysis is only an indicator of the alternatives available to the government. With more R&D it may be possible to arrive at such investment decisions which may not look attractive in a short run but which may prove to bring more returns and prosperity alongwith equitable distribution of wealth. If the facts revealed by the study are utilised to systematically search for the alternatives to divert some funds in each five year plan to some suitable capital intensive schemes in the rural sector, and government takes the responsibility for these schemes on its own shoulders, higher standard of living in rural India is likely to become a reality. It may take some time but if we focus our attention on R&D in such areas of rural technology which are unique to our resources, it is not difficult to achieve. It requires constant effort by the government to create such institutional forms which may encourage the use of such technology which aims at maximising the use of local resources, manpower and skills available to a village community.

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CHAPTER - X

LIMITATIONS OF THE STUDY AND SUGGESTIONS

This study has been carried out in a single village and the information collected is mostly based on the estimates of individuals or groups of villagers. The main crops produced, agricultural waste, number of various types of trees, growth rate of these trees, quantity of dung produced, fertilisers used, and fuels burnt by families are all based more or less on estimates and cannot be considered accurate quantities. Accurate quantities can be worked out only on the basis of constant observation and habit of accounting among the village population. However, most of these quantities are expected to be near accurate on an aggregate basis. This is more likely for such quantities which are related with commercial dealings, such as agricultural production and agricultural wastex.

10.1 COAL REPLACEMENT AND EFFICIENCY OF UTILISATION

The concepts of coal equivalent/coal replacement values of fuels used are also based on certain assumptions on the use to which the fuels can be put, the efficiency of heat utilisation, and the heat value of these fuels. Although these concepts are helpful in comparing the total energy resources, irrespective of the forms in which they are available, the values represented by them are liable for significant alterations depending on the manner of utilisation of these energy forms.

The following table gives the heating value and efficiency of certain fuels for domestic application :

TABLE - 16

HEATING VALUE AND EFFICIENCY OF USE FOR CERTAIN FUELS

Sl. No.	Fuel	*Heating value	**Efficiency of utilisation for domestic purposes%
1	2	3	4
1.	Kerosine oil	8500 kcal/litre	50.8
2.	Firewood	3300 kcal/kg	13.7
3.	Charcokal	3950 kcal/kg	16.3
4.	Liquid petroleum gas.	12000 kcal/kg	57.4
5.	Biogas	5680 kcal/M^3 (650 BTU/cuft).	52
6.	Electricity	860 kcal/kWh	60.1
7.	Codung	1800 kcal/kg**	11.2

* From NH Qureshi (Ministry of Fuel, Power and Natural Resources) 'Development of Bio-gas in Pakistan' presented at workshop on Biogas technology and utilisation (28th July-2nd Aug 75 at New Delhi.

**Figures from different sources.

The estimates of fuel requirements will undergo an appreciable change if the heating value of the efficiency of utilisation of these fuels undergo any change. Not much R&D has gone in to improve the efficiency of utilisation of domestic fuels, because much of it is still in the non-commercial form and ~~they~~ those concerned are not conscious of energy economics to the required extent.

10.2 DISSEMINATION OF SCIENTIFIC KNOWLEDGE SMOKELESS CHULHA

10.2.1 Mahendni RG (1978) has mentioned the development of smokeless domestic coal-fired chulha (Raju's chulha) by CMPDI. In this chulha, the coal is first devolatilised in a carbonisation chamber and the products of devolatilised coal (coke) from previous firing is used in the fuel bed. Carbonisation chamber size can be designed to produce sufficient coke for next burning.

This chulha utilises heat value of the otherwise wasted escaping gases and increases the efficiency of utilisation of coal. The additional cost of the smokeless chulha over the conventional domestic chulha for burning coal is negligible. The attempts to popularise this chulha since 1976 have not been pursued and the development is merely seen as a commercial problem for marketing the new type of chulha. The problem is that village community and coal users may not be interested in purchasing a commercial smokeless chulha, but given to understand the little modification in their conventional chulha they can easily practice it.

The above example highlights the gap which exists in the scientific knowledge and its dissemination among thousands of its possible users, preventing the benefits of knowledge from reaching the society. The government has to decide whether it should remain a party to the commercial utilisation of such S&T developments which can give rich dividends to society if practiced by individuals using local resources and skills? Identification of such areas of scientific knowledge and their dissemination through suitable organisational forms remains one of the most potential R&D areas for the government.

10.2.2 PRESSURE COOKER

The pressure cooker used on gas chulha's has been found to very useful in saving fuel costs. In the village only one family was found to be having a pressure cooker and using it. Most of those families who use dung cakes as fuel may not find it useful because of their slow rate of burning. But the point under consideration is the absence of the scientific approach among villagers to economise on their fuel used. Government while concerned with the economy in energy consumption has left most of the energy technologies for commercial developements, and has not made determined effort to popularise little science for exploitation by the villagers.

10.2.3 SOLAR ENERGY FOR DOMESTIC USE

Another potential area which can be made commercially viable for rural population is the exploitation of solar energy for cooking and keeping house warm during night in winter. The present approach of expecting the solar gadgets becoming commercially viable in technoeconomic comparison to other sources of energy may take long or such an event may never occur. The only way of giving a decisive direction to our energy policy lies in developing the tools and techniques which are relevant to the mode of life and economy in the villages and itegrate them in their work.

10.2.4 INVOLVEMENT OF SCIENCE AND TECHNOLOGY

Science and technology has played much limited role in the improvement of life in an village community. Much against the general impression, the approach of an ordinary farmer in carrying out his work is scientific, of course within the limitations of his scientific knowledge. The form in which the scientific knowledge reaches the villager, has much to do with the utilization of this knowledge by him. If the knowledge is related to some commercially marketed products which can increase the returns on their investments, the content of knowledge is narrow and it has limited applications.

It is necessary to disseminate knowledge to farmers, not necessarily in a written form because large number of them are illetrate, such that they can interpret it in their own environment for selecting its application. The knowledge of 'what is feasible' with certain applications should be reinforced with 'why it is so'. This need not be put in the language of a scientist or a scholar but in simpler ways, purely to equip the villager to make his own judgement to sebct alternatives relavant to his own environment.

The main characteristics of various crops, various soils, components of fertilisers and their relation to crops and effect of weather on crops are important. Techniques and skills to handle the operation and maintenance of their own implements and production of some of these implements using local resources can help the village community to integrate the scientific knowledge with their economy.

10.3 RELEVANT AREAS OF R&D

R&D effort relevant to village community has to be guided, not only by the concern for satisfying an increasing energy demand, but also for providing adequate energy forms to meet the requirements of the society from its own resources potential. In order to provide a sustained and stable social structure in most of these cases R&D efforts should aim at maintaining renewable supplies of energy.

10.3.1 ORGANIC MATTER FROM PHOTOSYNTHESIS

Land and water plants, grasses and algae represent a rich source of raw material, with good possiblities in villages. Conversion of these materials into synthetic fuels or fertilisers through biological and chemical processes can solve the outstanding shortage of petroleum and liquid fuels. In a country where sun and water are available in large measure it should not be difficult to attain higher plant-solar conversion rate of the order of 3% against an average of 1% at present, by selecting proper plants. Absorption of solar radiations is higher for plants like sugar cane, corn, water plants and algae. New methods in plant genetics and economy in water supply harvesting and transportation are called for in this area.

10.3.2 CONVERSION PROCESSES

Conversion of photosynthetic production and of organic waste into fuel appears promising today. Technology for extracting oil, methane, other fuels and manure is progressing.

'Distructive distillation', where organic materials are shredded and heated in a closed vessel, in an oxygen free atmosphere, at temperature ranging from 500° to 900°C, is developing into a promising technique for producing oil and char.

'Hydrogenation'(chemical reduction), requires organic materials to be heated at high temperatures(300 to 350°C) and high pressures in the presence of water, carbon monoxide and a catalyst. Heavy paraffinic oil has been produced in a laboratory scale plant at a rate of 200 lit/ton of dry waste.

Anaerobic fermentation, a relatively simple process, in which organic materials areplaced in a moist environment in an oxygen free fermentation tank equipped with a stirring mechanism is being widely used for producing methane and organic manure in gobar and sewage gas plants. Some problems like economy, disposal, storage and smell of sludge produced have been persisting. Possibility of using cheaper plastic materials in their construction, clubbing public latrines in villages to bio-gas plants and constructing above ground plants to facilitate manual feeding of gobar and gravity disposal may be worth studyingin the Indian context. Perfection of the processes for production of ethanol from molasses is another potential area of R&D to replace diesel and petrol. Conditions under which fermentation processes can yield maximum production offuel and creation of those conditions should be studied.

10.3.3 <u>ENERGY FROM OTHER SOURCES.</u>

Villager can tap large quantities of soalr and wind power if simple and economical technologies for practice in villages are developed.

Resources of wood and minerals which can be locally tapped in villages should be tapped to develope technology which can be developed into cottage industry to harness above sources for village community.

10.4 ORGANISATION AND CHANGE

There are some important problems, organisational, procedural and regulatory, which come in the way of any political and administrative will to organise such a transformation. The existing infrastructure of manufacturing capacities, the current emphasis on use of electricity which is considered to be the prime-mover of industrial economy, the convinience with existing forms of liquid fuels and the economics of scale all are factors resisting the change. The hidden cost of distributing the centralised production and commercial costs added to this distribution are the factors affecting equitable distribution of the fruits of our economic growth. Any political system committed to create a more equitable society will have to recognise the need to widely distribute the centres of technology use and production to ensure equitable distribution of wealth. This, however, does not mean that a conflict is sought to be created between centralisation and decentralisation. Centralised assessment, policy formulation and large scale production is equally important. The difference lies in making decentralisation a part of centralised stretegy in which villages, far flung geographically, are encouraged to use their own resources scientifically. They should not be allowed to be crushed under double economic disadvantage being furthest from the centres of economic activity both for selling and buying.

Within the village itself, any solution to the problem suggested on a macrolevel in this study is not capable of solving it at the micro-level unless government finds a way to make the benefits reach those who do not own cattle or land. Even in the existing situation those who do not own land or cattle are using non-commercial forms of energy i.e. wood and dung by collecting it from the far flung areas of the village. Some system in which the poor section of population can get the benefit of new forms of energy by investing their labour at a premium may solve this problem.

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CHAPTER XI

C O N C L U S I O N

Aggregate fuel consumption in the village in domestic sector was not much, only about 15 kg coal replacement value per head per month or 180 kg. Cr per capita per anum. This included about 6 kWh per capita consumption of electricity.

Large amounts of electrical power was however being used for irrigation. About 83 kWh per capita consumption was found in electric pump sets. Another 4 kWh per capita was used in small power, i.e., flour mills etc.

Other large consumer of energy were the Tractors used for cultivation. About 23000 liters of Diesel, equivalent to about 14 litres per capita diesel consumption or 91 kg Cr was being used again by a small number of tractor owners.

Chemical fertilisers under use were another major energy form under use in the village. About 51000 kg. of various types of fertilisers equivalent to 2,55,000 kg. cr. accounted for about 190 kg Cr per capita energy consumption in fertilisers.

The total population of village was 1640 distributed among 170 families. Total land in the village was 558 Hectares (6420 Bighas) of which about 462 Hectares (5310 Bighas) was under active cultivation and 30 Hectares (345 Bighas) was under semi cultivation. There were 54 families without any land holdings and 103 families without domestic electric connections. Sixty two families were in possession of katcha house only. The general ~~satisfaction~~ contentment level in the village was high compared to the fact that most of the families were consuming food at low levels and were not properly clothed. Those who were wholly dependent on kerosine for lighting and those using frequently interrupting electric lighting were both living without grudge. With the present levels of consumption and living conditions few of them villagers desired any appreciable change in their life styles and looked contented. Some of them indicated the desire that if one member of their (joint) family got some salaried job, the regular source of family income in the form of money, will provide them much needed security to lead satisfactory life.

Most of their energy consumption was for the agriculture to produce more food with very little consumption for their convenience not to talk of comforts. Immediate difficulties faced by them in their daily life included difficult walkways and wet fuel during rainy season, unhygienic conditions and absence of street lighting. Their energy requirements were likely to rise significantly in domestic sector, in ~~assuming~~ providing reasonable fuels for cooking and lighting, and for meeting fertilisers requirements.

The energy resources of the village in use included wood, agricultural waste, dung, animal power and man himself. Solar energy though unaccounted was in use for drying. Wind power was not in use at all. Fuels being imported into the village were in the form of Diesel oil, Kerosine, petrol and electricity.

Projection of future energy demand based on the trend of requirements indicated by villagers showed over 19.0% increase over present level of consumption in 5 years. The problem of meeting energy requirements of the village has both, short range and long range aspects. The short range problems include a) Continuity of electricity supply with increase in demand b) Increasing requirement of chemical fertilisers, c) Increasing requirement of liquid fuels for mechanised farming and d) depletion of wood resources due to slow rate of replenishment. The long range problems are concerned with a) Fast depleting oil reserves of the world. World is expected to run short of oil between 1985-95 as per recent estimates of OECD countires, when prices may considerably rise, b) Depleting coal reserves in India and the difficulties in its mining and transportation to meet the growing demands, c) Highly capital intensive and energy losses-prone nature of centralised electricity supply, d) Dependence of village community on the scientific knowledge of highly paid industrial workers and e) Uneconomical uses of higher energy forms and low efficiency of utilisation of energy. Where as short term problems shall have to be tackled within the frame work of presently used energy forms to maintain continuity, the long range problems shall have to be solved by developing new technologies and suitable socio-economic systems to adopt them to replace or substitute the presently used various applications of energy by desirable forms. Attemps should be made to produce gas or liquid fuels from the resources in village, use wind power and find means of generating electricity also within the village, at the same time avoiding the need for capital investments.

Presently, the dung being burnt as fuel is not available as manure and that used for manure is not available for burning. Bio-gas plants can tap both, gas as a fuel and digested sludge as a manure. To gether they can account for reducing energy component in fertilisers and can replace wood and dung as fuel. The difficulties experienced in rainy season due to wet fuel can also be overcome to a large extent by using gobar gas. Human waste can also be used in gas plants to increase the output of gas.

Bio-gas can also be considered for lighting purposes provided safe gas lamps can be developed. Molasses generated during production of sugar from sugar-cane produced in the village can give large quantities of ethanol which is capable of replacing both diesel and petrol in the long run. Dual fuel engines, using bio-gas with ethanol can be considered for development to replace most of electricity requirements for mechanical drives. Decentralised generation of electricity is also possible using gas and ethanol, if considered essential. However, with the existing electricity distribution system already available, the advantages of decentralised electricity production are only marginal.

Animal power is not fully exploited at present. Some portion of diesel import can be reduced by fully utilising the animal power. This will also need added manpower, which is available in plenty. There is scope for increasing wood production in the village. Small solar gadgets produced in the village itself for water heating and cooking can also replace some wood/dung at present. Introduction of use of wind power by locally produced wind mills will be equally useful.

Requirements to improve the standard of living in village can be arranged by villages themselves. Construction of roads, better houses, and drinking water facilities are main requirements in this area. Presently, most of the families 60% of the total own hand pumps. If sufficient attention is given to prevent pollution of water table, the hand pumps can serve the water requirements of the village satisfactorily. Providing municipal, filtered water supply, if envisaged for the village will only be marginally better at much cost and energy consumption. Standard and cheap designs of houses and provision of some road construction material for village by the government can solve the road and house problem of the village which has enough manpower to carry out the above works. Some of these requirements may not be directly related to the energy consumption profile of the village, but they do affect the total energy requirements in providing the desired facilities in the village.

While considering the development plans and allocating resources for rural development schemes, the government should consider the utility of the funds in improving the way of living of village population as they themselves regard it. Huge investments considered for investment in rural electrification, adult education, family planning and now the filtered water supply under consideration should be weighed against the total benefits reaching the rural community itself. It happens in most of the schemes that in relation to investments little benefits reach the rural population. Finally, it should be mentioned that exploitation of small energy resources and their decentralised production should not be viewed as running away from the past and bringing back the cart-age. The point under consideration is that a proper mix of energy forms to be used for different purposes should depend on the energy forms naturally available to village community. The more we use the naturally available energy, tapped from the natural cycles at suitable points with new science and technology, the less we will be dependent on the depletable sources of energy. Science and Technology should not necessarily aim at controlling natural processes and changing their direction in order to meet our needs. Processes developed by Science and Technology in harmony with nature are likely to be less energy intensive and may ensure more equitable distribution of wealth to the human society.

Annexure I

VILLAGE CONSIDERED FOR CASE STUDY OF ENERGY REQUIREMENTS

(Information as recorded before taking up the case study)

Sl No.	Name of the Village.	District and State.	Distance from Delhi/Near to city kms.	Estimated No. of families.	Estimated % of houses electrified	Estimated % of Pakka houses.	Estimated % of population educated above 9th class
1.	BAGLI	GURGAON HARYANA	130/2	175	40	50	-
2.	BUNDAHSRA	GURGAON HARYANA	25/2	200	50	75	-
3.	MAKDOLA	GURGAON HARYANA	45/3	200	20	20	-
4.	DAULTABAD	GURGAON HARYANA	30/3	450	60	75	-
5.	RAJIPPUR SABOLI	SONEPAT HARYANA	25/5	250	65	80	-
6.	JAKHODA	ROHTAK HARYANA	40/6	250	50	70	-
7.	KHERITAGA	SONEPAT HARYANA	60/10	200	50	50	15
8.	BEHEWAL	HOSHIARPUR PUNJAB	400/15	450	-	25	-
9.	DASPUR	BULANDSHAHAR U.P.	65/6	500	5	-	-

Information Schedule for recording Data through Interviews:

(A case study to assess energy requirements and quality of life of a village KHERITAGA)

1. Family Sl.No.

2. Members of Family No.

Sl. No.	Relation	Sex M/F	Age	Education level	Occupation.

Education Level: 1) Nil 2) Upto 5th 3) Upto Matric 4) After matric to graduation

b) Graduating to Post graduation.

Occupation: 1) Owner. 2) Profession. 3) Labour

4) Business 5) Education.

3. Property/Belongings: Quantity

a) Land 31 Yes — Bighas
32 No.

b) House 33 Yes — Sq.yards
34 No. — No. of rooms

c) Tractor 35 Yes — No.
36 No.

d) Bullocks 37 yes — No.
38 No.

e) Cow/Buffalow 39 Yes — No.
40 No.

f) Electric Pump Set 41 Yes — No.
42 No.

g) Cart 43 Yes No.
44 No.

h) Bicycle 45 Yes No.
46 No.

4. Do you have domestic electric connection:

1. Yes
2. No.

5. If 'No' above, do you want to apply for electric connection:

1. Yes
2. No.

6. If 'No' above, what is the reason for not applying:

1. Satisfied without it.
2. Consider it costly.
3. It is a accident hazard.
4. Any other.

7. What electrical appliances do you have.

			Nos.	Watts.
(a) Electric Bulbs	(71) Yes			
	(72) No.			
(b) Electric Fans	(73) Yes			
	(74) No.			
(c) Radio	(75) Yes			
	(76) No.			
(d) Transistor	(77) Yes			
	(78) No.			
(e) Electric Heater	(79) Yes			
	(80) No.			
(f) Electric Press	(81) Yes			
	(82) No.			
(g) Fridge	(83) Yes			
	(84) No.			
(h) Any other	(85) Yes			
	(86) No.			

8. What do you use for lighting in house.

(a) Candle	(1) Yes	
	(2) No.	
(b) Keresene Lamp	(3) Yes	
	(4) No.	
(c) Electric bulb	(5) Yes	
	(6) No.	
(d) Any other	(7) Yes	
	(8) No.	

9. Are you satisfied with the lighting arrnagement (1) Yes
(2) No.

10. How many hours you require artificial lighting

(a) Winter 4 months	(1) Morning	Hrs.
	(2) Evening	Hrs.
(b) Summer 8 months	(3) Morning	Hrs.
	(4) Evening	Hrs.

11. What fuels you use for cooking.

		Qty per month.
1. Collected wood	(01) Yes	Kg.
	(02) No.	
2. Cow dung	(03) Yes	Kg.(dry.)
	(04) No.	
3. Commercial wood	(05) Yes	Kg
	(06) No.	
4. Coal	(07) Yes	Kg.
	(08) No.	
5. Keresene oil	(09) Yes	Litres
	(10) No.	
6. Electric heater	(11) Yes	KWH
	(12) No.	
7. Cooking gas	(13) Yes	Cuft.
	(14) No.	
8. Any other	(15) Yes	
	(16) No.	

12. Do you use a pressure Cooker (1) Yes
(2) No.

P.T.O.

13. How much milk is consumed by the family per day

1. ½ kg.
2. 1 kg.
3. 1½ kg.
4. 2 kg.
5. 2½ kg.
6. More.

14. How much is your consumption per month

1. Dals — Moong, Urd, Masur, Chana, Arhar — Kg.
2. Sabzis — Kg.
3. Cereals — Floor, Rice — Kg.
4. Tea — Cups
5. Any other.

15. How much water does the family consume per day — Litres.

16. How much water do you boil in winter per day — Litres.

17. How many hours per day you burn fire for heating during Winter.

(1) One hour (2) Two Hours.
(3) Three Hours (4) Four hours.
(5) More.

18. How many days in a year you require the fire

(1) 10-20 (2) 20-30
(3) 30-40 (4) 40-50
(5) 50-60

19. How much time is spent in washing utencils and house cleaning per day on an average. ..... Minutes.

20. How much time is spent in washing clothes per day on an average ..... Minutes.

21. How much total distance is covered every day by the family members to attend to their daily work ...... Kms.

22. What modes of transport the family members use.

a)	Walking	(01) Yes	(02) No.
b)	Bicycle	(03) Yes	(04) No.
c)	Cart	(05) Yes	(06) No.
d)	Tractor	(07) Yes	(08) No.
e)	Motor bike/ scooter	(09) Yes	(10) No.
f)	Any other	(11) Yes	

23. How much land does your family plough last year -

1) Your own .. .. Bighas
2) Others .. .. Bighas

24. How much of your land was ploughed by others.

.... Bighas.

25. How much of the land ploughed by your family was irrigated by -

1. Electric Pumps Set/Tube Wells .... Bighas
2. From Irrigation wells by bullocks......... Bighas
3. Any other means .... Bighas

26. How much water is required on an average per Bigha of land per year in your village with usual crops and average rain .... Cu. M.

27. What was the total agricultural produce in last one years crops in the land ploughed by your family -

Quintals/Kg.

Wheat
Chana
Gur
Jwar
Bajra
Makka
Urd
Moong
Masur
Arhar
Rice

28. If you did not have sufficient produce of chara for your cattle last year, how much did you purchase from outside the village .

..... Quintals/kg.

29. If you run any commercial plant/machine/shop, what is your power requirement.

1. HP/KW
2. Manpower

30. How many hours a day the family members have to work on an average (those working on field)

During the lean season .....hrs. for days in a year
During the harvesting season... hrs. for days in a year

31. What mechanical/other appliances do you have to aid your work.

1.
2.
3.
4.

32. Have your seen or used any of the following appliance anywhere -

a) Electric fan	01) Used 02) Seen only 03) Not seen
b) Radio	04) Used 05) Seen only 06) Not seen
c) Electric heater	07) Used 08) Seen only 09) Not seen
d) Electric Press	10) Used 11) Seen only 12) Not used.
e) Fridge	13) Used 14) Seen only 15) Not seen
f) Air cooler/Air conditioner	16) Used 17) Seen only. 18) Not seen.

33. Do you find difficulty, if any by your family in the following areas -

1. Lighting 2. Cooking. 3. Moving around.
4. Other house work. 5. Agriculture. 6. Any other area
7. Working/ploughing.

34. How much time can you find daily, over the duties you already have, involving physical labour .... Minutes.

35. What, if anything, in your surroundings needs improvement to improve your living ....

36. Is there noise nuisance experienced by you any time.

1. Yes
2 No.

37. How many percentage of times you find it difficult to get money.

......%

38. Do you find your social life generally good -

1. Good 2. Bad 3. So - So

39. How many days in last year you could not work due to ill health.

——— days.

40. How many are unemployed in the family .... Nos.

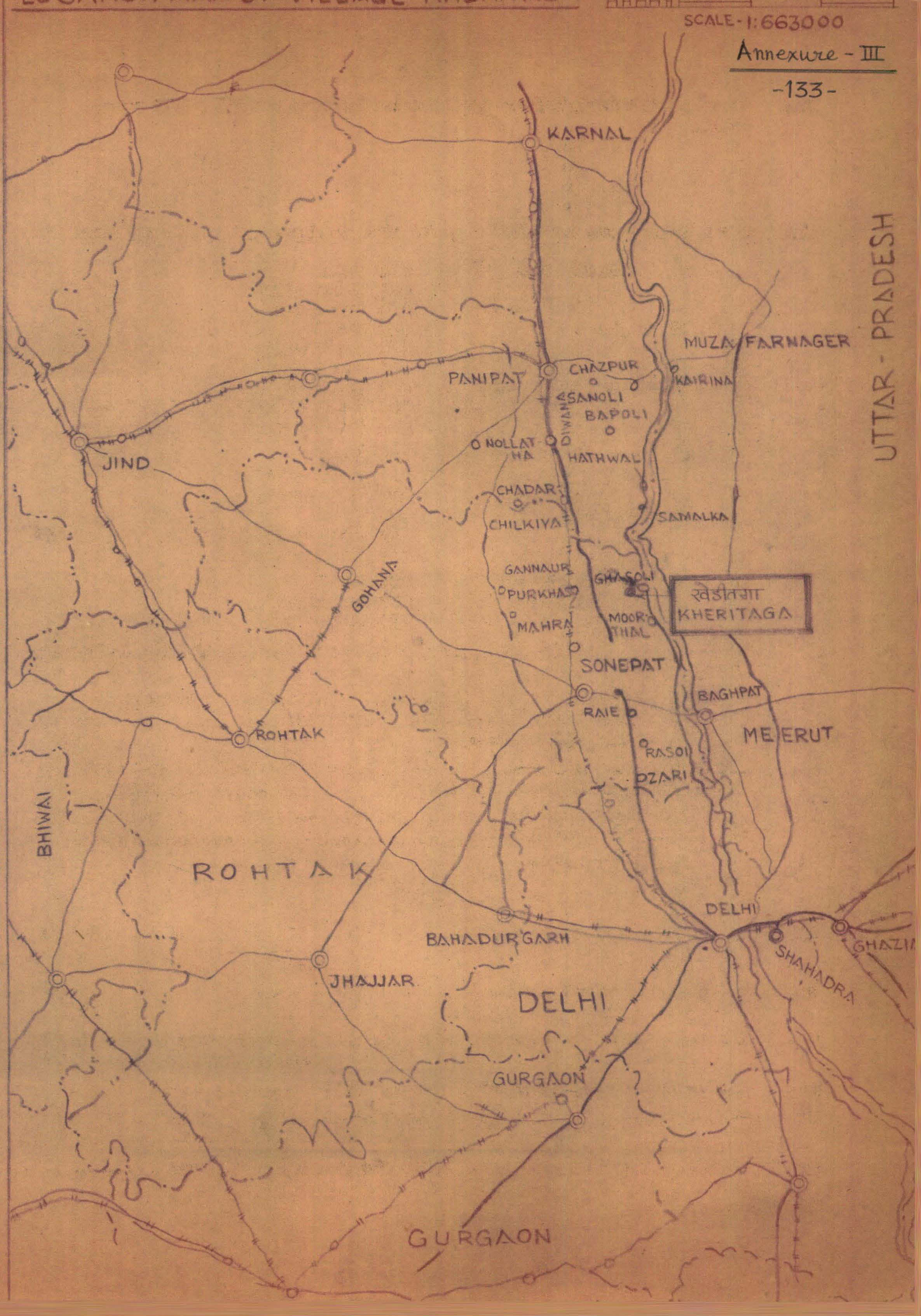
41. Do you want to change your job/occupation 1) Yes
2) No.

42. Is there any incidence of theft/crime against your family.

1) Yes
2) No.

LOCATION MAP OF VILLAGE KHERITAGA

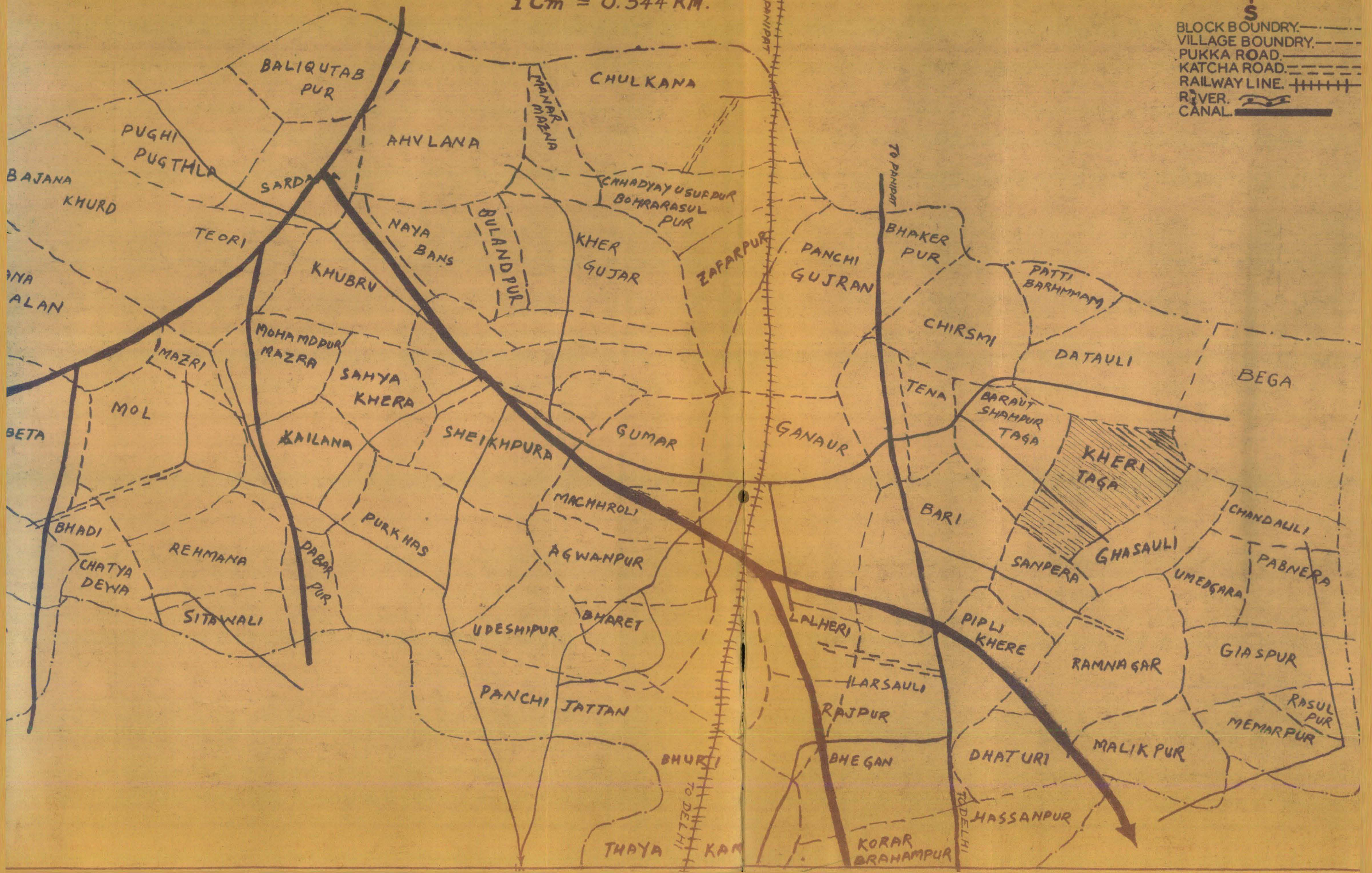
Annexure - III



MAP OF DEVELOPMENT BLOCK GANAUR

Annexure-IV

SCALE :- 1 INCH = 1 MILE.
1 Cm = 0.544 KM.



ANNEXURE Va

IMPORTANT FACTS REGARDING FAMILIES OF VILLAGE KHERITAGA

Family Sl No.	Total strength	12-55 yrs male	12-55 yrs Female	Numbers at Education level 11	12	13	Land owned.	@ No. of cattle	Belongings * 1,2,3,4,5,6,7	Electrical appliances 1,2,3,4,5,6,7	Fuel used 1,2,3,4,5,6,7	No. of Electrical of six Used	Seen only	Reason for not using Elecy.	Category of ploughing	Areas of difficulty for family 1,2,3,4,5,6,7	REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	10	2	2	3	4	3	15	2	1,2,3,	1,2, 6	1,2, 4,5	3	2	-	1	1,	
2.	21	8	5	17	4	0	3	3	2,3, 5	-------	1,2 5	1	1	3	2	4	
3.	7	1	1	6	1	0	-	-	-------	-------	1,2	0	2	2	-	4	
4.	13	6	6	6	7	0	80	4	1,2,3,4,5,6	-------	1,2	-	5	2	1	2, 4	
5	7	3	3	2	5	0	45	5	1, 3, 5	1	1,2,	2	3	-	2	4,5	
6.	11	5	2	5	5	1	150	3	1,2,3,4,5,6,7	1,2,3, 6	1,2, 5	2,	4	-	2	2,3,	
7.	10	3	5	4	6	0	18	4	1,2,3,4,5	-------	1,2,3, 5	1	4	-	2	7	
8.	18	7	3	8	9	1	12	4	1,2,3, 5, 7	1,2, 4	1,2,3, 5	2	4	-	3	5	
9.	13	3	4	7	6	0	60	3	1,2,3,4,5, 7	-------	1,2	2	3	2	1	5	
10.	20	4	6	13	7	0	185	11	1,2,3,4,5,6,7	1,2,3	1,2,3, 5	2	2	-	2	5	
11.	6	1	4	2	4	0	60	4	1 3 5	1,2,3,	1,2, 5	6	-	-	2	1,	
12.	11	4	5	8	3	0	10	1	1,2,3, 7	-------	1,2 5	1	1	2	2	2,3	
13	4	1	1	3	1	0	-	3	-------	-------	1,2 5	-	2	1	-	3 5	
14.	4	1	1	4	0	0	-	1	4 -------	~~4,6,~~	1,2, 5	-	2	1	-	3,4, 5	
15.	11	3	5	9	2	0	70	7	1,2,3,4,5,6,7	-------	1,2 5	2	2	3	2	4, 5	
16.	4	2	1	3	1	0	17	3	2,3,4,5,6	1, 3	1,2 5	3	3	-	2	4	
17.	6	1	1	4	2	0	23	3	1,2, 4,5,6,7	1	1,2, 5	1	3	-	2	4	
18.	8	3	3	5	3	0	35	3	- - 3,4,5,6	1,	1,2 5	-	3	-	2	4	
19.	11	2	2	6	5	0	250	20	1,2,3,4,5,6,7	1,2,3,4 6	1,2, 5	1	3	-	2	2, 4	
20.	6	2	1	5	1	0	80	2	1,2,3,4,5,6,7	1, 4	1,2, 4 5	1	2	-	1	2, 4	
21.	13	5	3	3	10	0	10	4	1 3 5	-------	1,2,3, 5	-	4	3	3	1,	
22.	8	5	2	4	4	0	60	8	1,2,3,4,5,6	1, 4,5,	1,2,3,4,	1	5	-	2	1,	
23.	7	3	1	3	3	1	5	-	1,2,3,4, 6	1, 3	1,2,3,4,5	3	1	-	3	2,	
24.	11	5	3	7	4	0	140	8	1,2,3,4,5,6,7	1 3	1,2,4 5	1	3	-	2	4	
25.	14	4	3	7	7	0	125	7	1,2, 4,5,6,7	1	1,2,3,4,5	-	4	-	1	2,	
26.	7	2	1	4	3	0	105	5	1,2,3,4,5,6,7	1	1,2, 5	-	4	-	2	2,	
27.	8	2	2	7	1	0	28	2	5	-------	1,2 5	-	4	3	1	5	
28.	6	1	4	6	0	0	23	4	1,2, 4,5,6,7	1	1,2, 4	-	4	-	2	4	
29.	17	7	5	8	6	3	12	5	1,2,3, 5	1,2,3, 6	1,2,3,4,5,	4	1	-	2	7	
30	7	3	1	3	4	0	60	2	1 - -4,5,6	1	1,2, 5	-	4	-	1	4	
31.	6	1	1	5	1	0	30	3	2 4,5	1,	1,2, 5	-	4	-	1	4	
32.	6	2	2	4	2	0	25	1	1, 3,4,5,6	1	1,2, 5	-	3	-	1,3	3,	
33.	9	4	2	4	5	0	20	2	1,2,3,4,5,6	1	1,2, 5	-	5	-	3	4	
34	4	1	1	3	1	0	18	2	1, 4,5,6	1	1,2,	-	4	-	2	1,	
35.	6	1	1	4	2	0	18	2	1 3,4, 6	1	1,2, 5	1	3	-	1	1,	
36.	10	4	5	6	3	1	30	3	1,2,3,4,5,6	1, 3	1,2, 4	1	3	-	2	1,	
37	5	4	1	1	4	0	18	2	1,2,3,4,5,6	1, 6	1,2, 4	4	2		2	1,	
38.	6	2	1	2	4	0	5	1	1,3,5,	1,2,3,	1,2, 5	4	2	-	3	2,	
39.	7	1	1	4	3	0	27	1	1, 4,5,6	1,	1,2, 5	-	4	-	2	1,	

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
									1,2,3,4,5,6,7	1,2,3,4,5,6,7	1,2,3,4,5,6,7					1,2,3,4,5,6,7	
4 0	11	4	3	7	3	1	60	7	1,2,3,4,5,6,7	1, 3,	1,2	-	3	-	2	5	
41	11	4	3	4	7	0	5	1	1,2,3, 5	1,2,3	1,2, 4	2	2	-	2	1,	
42	9	2	3	6	3	0	28	5	3 5	~~6,6,~~	1,2	-	3	1	3	3,5	
43	12	4	3	7	4	1	30	5	1,2,3,4,5,6,7	1,2,3, 6	1,2,3,	3	3	-	3	4,5,	
44.	7	1	2	5	2	0	11	3	1,2,3,4,5 7	———	1,2, 4,5,	-	4	-	3	4,5	
45	6	1	1	4	2	0	11	5	1,2,3, 5	1	1,2, 5	1	4	-	3	5	
46	7	2	1	6	1	0	6	2	———	———	1,2,	-	3	1	2	2	
47	5	2	2	0	2	0	42	3	5	———	1,2,	-	3	3	2	5	
48	9	3	3	6	3	0	108	6	1,2,3,4,5,6,7	1	1,2,	1	3	-	2	4	
49.	10	3	2	6	3	1	25	2	1,2,3, 5 7	———	1,2,	2	2	3	3	5	
50	17	7	4	11	6	0	130	9	-,2,3,4,5,6,7	1,	1,2,	-	4	-	1	4,5,	
51.	6	3	1	3	4	0	20	2	1,2,3, 5	———	1,2,	-	4	3	2	1,	
52	13	6	2	7	5	1	50	3	1,2,3,4,5,6,7	~~4,6,~~	1,2	1	3	3	3	1,	
53	11	4	2	8	3	0	80	2	1,2,3,4,5,6,7	1,	1,2,	1	4	-	2	1,	
54	6	1	2	4	2	0	35	4	1,2,4,5, 6,7	1	1,2,	-	5	-	2	1,	
55	18	7	4	14	4	0	80	3	1,2,3,4,5,6,7	1,	1,2,	1	3	-	2	1,	
56	3	1	1	3	0	0	0	0	1, 3	———	1,2	1	1	2	-	1,	
57	4	1	1	3	1	0	0	0	———	———	1,2	0	2	3	-	1	
58	5	2	1	5	0	0	0	1	———	———	1,2,	-	2	3	-	6	
59	7	1	1	7	0	0	0	0	3	———	1,2,	-	4	3	-	5	
60	3	1	1	3	0	0	0	1	———	———	1,2	-	3	1	-	6	
61	4	1	1	4	0	0	0	0	———	———	1,2,	-	3	2	-	2,4, 5	
62	2	1	1	7	0	0	4	1	5, 7	———	1,2,	1	2	3	-	1,	
63	3	1	1	3	0	0	0	0	———	———	1,2	-	2	3	-	6	
64	11	4	5	10	1	0	0	0	3	———	1,2,	0	4	3	-	4	
65	8	3	1	7	1	0	0	2	3, 5	———	1,2	1	3	2	-	6	
66	13	5	3	12	1	0	0	4	—— 3,—5	———	1,2,	1	3	3	-	4	
67	25	8	8	23	2	0	0	3	1,2,3, 5	———	1,2	1	3	3	-	1,	
68	8	2	2	8	0	0	0	1	3 5	———	1,2,	-	4	3	-	1,	
69	7	1	2	7	0	0	0	1	———	———	1,2,	-	4	3	4	6	
70	10	2	3	9	1	0	0	2	5	———	1,2,	1	3	3	-	4	
71	5	2	1	5	0	0	0	1	——5	———	1,2,	-	4	3	-	4	
72	12	5	3	10	2	0	0	4	5	———	1,2	-	4	2	-	1,	
73	5	1	2	5	0	0	0	7	3, 5, 7	———	1,2,	-	3	3	4	5	
74	18	3	4	18	0	0	0	0	———	———	1,2,	1	3	3	-	1,	
75	7	2	0	7	0	0	0	0	3	———	1,2	-	3	2	-	7	
76	5	1	2	4	1	0	0	1	———	———	1,2,	-	3	3	-	4	
77	6	1	2	5	1	0	0	1	3	———	1,2,	-	4	3	-	1,	
78	9	4	1	9	0	0	0	1	3, 5	- ——— - -	1,2,	-	4	2	-	1,	
79	6	2	1	4	2	0	50	5	1, 4,5,6	1	1,2,	1	3	-	2	1,	
80	6	1	1	4	1	0	20	3	1,2,3, 5	1	1,2,	1	3	-	3	2,	
81	8	2	1	7	1	0	0	2	3 5	———	1,2	-	4	-	-	4	
82	7	1	2	5	2	0	20	3	5	———	1,2,3,	1	3	3	3	1,	
83	10	2	3	9	1	0	0	2	3 5	———	1,2,	1,2	4	3	-	6	
84	6	2	2	6	0	0	45	3	1,2,3,4,5 7	1	1,2,	1	3	-	2	2	
85	8	3	1	5	3	0	10	2	1,2, 5	———	1,2,	1	5	3	2	6	
86	10	3	2	6	4	0	23	3	2,4, 5, 7	1— - - -	1,2,	-	5	-	3	1,	
87	2	-	0	2	0	0	65	2	1,2, 5	———	1,2,	-	4	3	2	4	
88	3	1	1	2	1	0	50	2	1,2,3,4, 5,6	1	1,2,	1	4	-	2	5	

12 (1,2,3,4,5,6,7)		13	14	15	16	17 (1,2,3,4,5,6,7)		18
1,2,		1	4	3	3		4	
1,2,	3	-	6	-	2	1,		
1,2,		1	5	-	2		4,5	
1,2,	3	1	3	-	2		3	
1,2,	4,5	3,8	3	-	2	1,		
1,2,		-	6	3	2	3	4,5	
1,2,	4,3	1	5	-	-	1,		
1,2,		1	4	3	3		4	
1,2,	4,5	2	3	3	-	1,		
1,2,4	5	2	4	3	-	1,		
1,2,	4,5	2	4	1	-		4	
1,2,	4,5	3	3	-	2		4	
1,2,	5	-	6	-	2	6		
1,2,	45	1	4	3	2	1,		
1,2,		-	4	3	2	1		
1,2,	4,5,	2,	3	-	2	3		
1,2,	4	-	3	3	2	1,		
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1,2,	4,5	3	3	-	2		7	
1,2,	4,5	1	3	3	2	1,		
1,2,	4,5	2	4	-	2	3,	4 5	
1,2,	4,5	1	3	-	2		4	
1,2,	5	1	4	3	2	1,		
1,2	5	-	4	3	2		5	
1,2,	[illegible]	-	4	3	3		[illegible]	
[illegible]	[illegible]	[illegible]	4	-	1	[illegible]	[illegible]	
[illegible]	[illegible]	-	6	3	2		[illegible]	
[illegible]	[illegible]	[illegible]	4	3	1		[illegible]	
[illegible]	[illegible]	[illegible]	5	-	2		[illegible]	
[illegible]	[illegible]	[illegible]	5	1	4		[illegible]	
[illegible]	[illegible]	-	5	1	4		[illegible]	
[illegible]	[illegible]	-	6	3	4	4	[illegible]	
[illegible]	[illegible]	-	4	2	3		[illegible]	
[illegible]	[illegible]	-	6	[illegible]	-		4	7
[illegible]	[illegible]	2	4	-	[illegible]	1,		
[illegible]	[illegible]	-	[illegible]	3	[illegible]		4	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7
[illegible]	[illegible]	-	4	-	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	3	3	-	1,	[illegible]	
[illegible]	[illegible]	[illegible]	3	[illegible]	4		4	
[illegible]	[illegible]	[illegible]	3	[illegible]	3	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	3	3	3	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	3	3	3	3,4		

-4-

7	12 1,2,3,4,5,6,7	13	14	15	16	17 1,2,3,4,5,6,7	18
—	1,2 5	1	5	3	3	4	
—	1,2,	—	4	1	—	4	
—	1,2,	—	3	3	3	4	
	1,2,	1	4	—	3	4 7	
—	1,2,	—	4	2	2	2, 3,4	
—	1,2,	1	5	3	2	4	
—	1,2,	1	5	3	2	3,4	
—	1,2,	1	5	3	2	4	
—	1,2	2	4	1	—	4	
	1,2,	1	5	—	3	4	
—	1,2,	1	5	2	—	1,	
—	1,2,	1	4	3	—	4	
—	1,2,	1	5	3	3	4	
—	1,2,3,4	1	5	1	2	2,3,	
—	1,2,	1	3	1	2	4	
—	1,2,	1	5	3	—	6	
—	1,2,	—	6	2	—	4	
—	1,2,	1	4	3	—	6,7	
—	1,2,	1	4	3	4	1,	
—	1,2,	—	4	1	4	6	
—	1,2, 4	—	5	2	4	3,	
—	1,2,	—	4	1	—	2,3,	
—	1,2	1	3	1	—	4	
—	1,2,	—	4	3	3	4, 6	
—	1,2,	1	5	3	4	1	
—	1,2, 4	—	4	3	—	4	
—	1,2, 4	1	5	3	3	4	
6	1,2,3,	4	3	—	2	4	
6	1,2, 4	3	3	[illegible]	2	4	
—	0,2	—	5	3	4	4	

ure V b for the description of code number used for categories
include bullocks.

1	2	3	4	5	6	7	8	9	10 (1,2,3,4,5,6,7)	11 (1,2,3,4,5,6,7)
89	7	2	1	6	1	0	8	3	5	—
90	10	4	2	9	1	0	225	4	1,2,3,4,5,6	1
91	15	3	3	10	5	0	[illegible]	10	1,2,3,4,5,6,7	1
92	9	2	3	6	3	0	115	3	1,2,3,4,5,6,7	1
93	10	2	3	4	5	1	[illegible]	4	1,2,3,4,5,6,7	1,2, 5
94	1	–	0	0	1	0	[illegible]	3	3,4,5	—
95	7	2	2	4	3	0	0	3	1,2,3, 5	1, 3
96	9	4	3	4	5	0	15	6	3 5	—
97	20	8	4	11	9	0	0	4	1,2,3, 5	—
98	5	1	1	3	2	0	0	2	1,2,3, 5	—
99	10	2	4	5	5	0	0	3	1,2,3, 5	—
100	12	4	5	5	6	1	65	6	2,3,4,5 7	1,2,
101	10	4	2	3	7	0	45	4	1,2,3,[illegible]	1
102	13	2	3	7	4	2	50	0	1 5	—
103	7	–	0	5	2	0	40	0	1	—
104	20	4	4	12	8	0	120	7	1,2,3, 4,5	1,2,
105	13	5	3	8	4	0	50	2	1,2,3, 5	—
106	19	5	4	15	4	0	105	4	1,2,3,4,5 7	1
107	6	1	1	4	2	0	40	2	1,2,3 5	1,2,
108	10	3	3	3	5	2	15	4	1,2,3, 5	1,2,3,
109	9	3	2	4	4	1	42	0	1 3	—
110	7	1	1	4	3	0	[illegible]	3	1,2, 5	1
111	9	3	5	6	3	0	[illegible]	4	1,2,3, 5	—
112	22	5	5	16	6	0	[illegible]	6	1,2,3, 5	—
113	6	2	3	4	2	0	[illegible]	[illegible]	1,2, 5	—
114	6	1	[illegible]	4	2	0	[illegible]	[illegible]	5	—
115	7	[illegible]	[illegible]	4	3	0	[illegible]	[illegible]	1,2, 4,5	1
116	10	[illegible]	[illegible]	[illegible]	5	0	[illegible]	[illegible]	1,2, 3, 5	1,
117	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	2 5	—
118	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	1,2,3,4,5,6	—
119	22	[illegible]	5	17	[illegible]	0	[illegible]	[illegible]	1,2,3,4,5,6	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	5 7	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	2,3, 5	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	0	[illegible]	[illegible]	1 3, 5	—
[illegible]	4	1	[illegible]	[illegible]	0	0	[illegible]	[illegible]	1 5	—
[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible] 5	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible],4,5,6	—
[illegible]	13	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible],4,5,6,	1
128	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	—
[illegible]	14	[illegible]	[illegible]	10	[illegible]	0	[illegible]	[illegible]	[illegible],4,5,6,7	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	40	[illegible]	1,2,3,	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	40	[illegible]	3,4,5,6,7	1
[illegible]	17	[illegible]	[illegible]	13	[illegible]	0	[illegible]	–	1,2,3,4,5,6,7	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible] 5	—
[illegible]	21	[illegible]	[illegible]	18	[illegible]	0	[illegible]	13	[illegible],4,5,6	1
[illegible]	18	[illegible]	4	13	[illegible]	0	[illegible]	[illegible]	[illegible] 5	—
[illegible]	10	[illegible]	2	[illegible]	[illegible]	0	[illegible]	[illegible]	1,[illegible]	—
[illegible]	3	[illegible]	0	[illegible]	1	0	0	[illegible]	[illegible]	—
[illegible]	15	[illegible]	3	12	3	0	40	[illegible]	2,3,4,5,6,8	—
[illegible]	9	[illegible]	4	4	[illegible]	0	30	[illegible]	2,3,4,5,6,7	1
140	12	3	2	10	2	0	16	[illegible]	1 5 7	—

1	2	3	4	5	6	7	8	9	10 1,2,3,4,5,6,7	11 1,2,3,4,5,
141	11	4	3	10	1	0	20	2	3, 5 7	—
142	10	1	3	9	1	0	0	2	1,2, 5	—
143	17	5	5	14	3	0	20	9	1,2, 5	—
144	18	7	5	13	5	0	20	6	1,2,3,4,5,6,7	1
145	9	4	1	9	0	0	15	2	5	—
146	8	1	1	6	2	0	20	4	1,2,3, 5	—
147	24	9	7	23	1	0	18	4	1 3 5 7	—
148	16	5	4	12	4	0	10	4	2,3, 5	—
149	10	3	2	7	3	0	0	3	3 5	—
150	12	3	4	10	2	0	15	4	1,2,3, 5 7	1 3
151	4	2	1	2	2	0	0	1	2,3,	—
152	23	7	5	21	2	0	0	6	1,2,3, 5	—
153	21	5	7	16	5	0	25	5	1,2,3,5 7	—
154	11	4	3	8	3	0	2	3	3, 5	—
155	13	4	4	13	0	0	15	3	3, 5	—
156	4	1	1	5	1	0	0	2	2,3,5	—
157	3	1	2	2	1	0	0	2	3,5	—
158	4	2	1	3	1	0	0	1	3, 5	—
159	16	3	3	11	5	0	0	3	1, 3, 5	—
160	11	3	2	9	2	0	0	2	3,5	—
161	6	2	1	4	2	0	0	3	1, 3,5	—
162	6	1	1	5	1	0	0	1	3,5	—
163	6	2	1	5	1	;	0	2	—	—
164	8	4	1	4	4	0	10	3	1 5	—
165	8	3	2	7	1	0	0	3	1,2, 5	—
166	8	2	1	7	1	0	0	0	3	—
167	8	1	1	6	1	1	10	3	1,2,3, 5	—
168	11	2	2	6	5	0	350	6	1,2,3,4,5,6,7	1,2,3,
169	20	4	6	12	8	0	260	11	1,2,3,4,5,6,7	1,2,3,
170	7	2	1	5	2	0	0	2	1 5	—

* Please refer to Ann

@ No. of cattle does'n

Annexure V b.

B. Description of the Code numbers used in Annexure V
(In the table of facts about village)

a. Educational level

1. Without education.
2. Studied below Matric level.
3. Studied abve matric level.

b. Belongings

1. Pucca house.
2. Hand pump
3. Bicycle,
4. Electrical pumpset.
5. Chara cutting machine.
6. Thresher
7. Baggi

c. Electric Appliances possessed.

1. Bulbs
2. Fans
3. Radio
4. Transister.
5. Heater
6. Press.

d. Fuel used.

1. Collected wood.
2. Cow dung.
3. Commercial wood.
4. Coal
5. Kerosene oil.

e. Use of Electrical Appliances

1. Fan
2. Radio
3. Heater
4. Press
5. Fridge
6. Aircooler/air conditioner.

f. Reason for not using electricity.

1. [illegible] it.
2. Consider it costly.
3. It is a accident hazard.

g. Category of Ploughing land.

1. Own land partially/not ploughed.
2. Own land fully ploughed.
3. Own fully and others' land ploughed.
4. Only others land ploughed.

h. Areas of difficulty.

1. No difficulty.
2. Lighting/Electricity shortage(or streets).
3. Cooking.
4. Streets/Rainy season.
5. Agriculturer/working.
6. Poverty/unemployment.
7. Waste collection/dirty drainage.

....

ANNEXURE-VI.

ENERGY CONTENT OF FERTILISERS.

The following table gives the estimates of targets of production of fertilisers - and energy consumption for the production.

Energy for Fertiliser Production.

Sl. No.	Year	Type of fertiliser	Target of production million tonnes.	Estimates of Energy Consumption(1) million tonnes of Coal replacement.			
				Coking coal	Non-coking coal	Oil(2)	Electricity.
1.	1960-61	Nitrogenous	0.10(N)	0.3	-	-	0.5
		Phosphatic	0.05 (P_2O_5)				
2.	1970-71	Nitrogenous	1.75	0.3	1.6	7.8	4.6
		Phosphatic	0.88				
3.	1975-76	Nitrogenous	3.00	0.3	2.4	15.6	7.4
		Phosphatic	1.70				
4.	1980-81	Nitrogenous	5.40	0.3	3.3	34.4	12.5
		Phosphatic	2.80				

(1) Excluding surplus coal gas from Coke -ovens and excluding 0.5 m tonnes coal replacement of lignite.

(2) Mainly Naphtha.

Source: Report of the Energy Survey of India Committee, 1965(2)

In the absence of the break up of energy requirements for two types of fertilisers, taking the energy consumed per unit of total production of fertilisers in 1980-81, 50.5 mt cr is required for 8.2 mt of fertilisers. This works out to 6.15 Kg. cr./kg of fertiliser.

According to one estimate by village users about 8000 kg. of wet dung manure fed to 1 hectare of land once in two years gives almost same fertility as 100 kg. of fertiliser once each year.

Estimates of energy consumption for production of Nitrogenous and Phosphatic fertilisers are available for European and Latin American countries as given below.

In the village higher quantity of phosphereous fertiliser is used for which energy consumption is low. Therefore a figure of 5 kg. cr. /kg. of fertiliser will be used.

....2/-

Energy for Nitrogenous Fertilisers Production

Sl. No.	Production per year in Europe Tons of N	Energy materials required. Naphta Tons	Fuel oil Tons.	Natural gas 1000M^3	Coal replacement value of fuelmt cr.*
(1)	(2)	(3)	(4)	(5)	(6)
1.	123,000	88000	142,000	-	14,90,000 (a)
2.	123,000	-	-	290,000	-
3.	246,000	176,000	220,000		23,75,000
4.	246,000	-	-	488,000	-

* Col.6 has been computed.
(a) for replacement/T.oil = 6.5 T Coal b) 12.1 Kg.Cr/Kg. fertiliser from (1) c) 10.45 Kg.Cr/Kg fertiliser from 3.

Source: Development centre of the OECD, Supply and Demand prospects for fertilisers in developing countries, Paries, The Author, 1968, p.186, 187.

Energy for Phosphate Fertiliser Production.

Sl. No.	Product	Energy materials required. Electric Power KWH	Fuel oil Kg.	Coal replacement value. Kg.cr.	Remarks.
1.	Phospheric Acid (54% P2O5) one Ton	320	-	320	54000 T of Phosphoric acid yields 7100 tonns of Trisuper phosphate equivalent of P2O5.
2.	Trisuperphosphate one Ton	27	15	(27+97) = 124	
3.	Trisuperphosphate* equivalent to one Ton P2 O5	250	11.5	(250+75) =325	

* Trisuperphosphate is produced from phosphate rock with phospheric acid as intermediate product. Figures for 3 are computed from first two.

Source: Same as above p.195.

Taking weighted average for proportions of Nitrogenous and phospatic fertilisers targetted for production in India.

$$\text{Kg.Cr. of Energy/Kg.fertiliser} = \frac{11.275 \times 5.40 + .325 \times 2.80}{5.40 + 2.80} = \frac{61.7}{8.20} = 7.5$$

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