CHAPTER IX

PROBLEMS AND PROSPECTS OF ENERGY USE AND SUMMARY OF CONCLUSIONS

9.1 GENERAL

This chapter briefly examines the problems and prospects of energy use in both household and agriculture sectors. The major findings of the present study are summarised and conclusions are drawn in the light of foregoing discussions. Policy recommendations for household and agriculture sectors are also made for future policy formulation and research. Finally, the areas of further research have been identified and presented in this chapter.

9.2 PROBLEMS AND PROSPECTS OF ENERGY USE

Economic growth and development have been accompanied by a sharp increase in the use of energy and by a change from animate energy to inanimate energy, largely fossil fuels. The realisation that fossil fuel availability is finite has made it necessary for many countries to critically examine present energy use efficiencies and long-term alternatives. It has become necessary to initiate conscious energy planning, and
develop new sources to sustain economic growth. Interest in energy-related studies have grown in both developed and developing parts of the world. India also has shown keen interest in energy related issues. The Government of India launched a number of programmes such as financing research on development of additional resources, demonstration, extension, conservation and support for policy research. Measures are also being evolved to provide financial support for purchase and use of appliances. Improved designs of chulas and kerosene stoves have been evolved by some organisations. But, they are yet to be popularised.

One of the relatively weak areas has been studies relating to research on the actual energy use pattern and its problems. The following sections are devoted to develop more precise understanding of the present energy problems and build future scenarios of the household and agriculture sectors in the study area.

9.2.1 Household Sector:

The energy use pattern of the study area indicates that the major part of energy was used in the household sector while the remaining was taken up by the

agricultural sector and a meagre quantity was left for other sectors. Taking into account the household energy consumption in terms of fuel source, firewood is the predominant fuel and accounts for nearly 70 per cent of the total fuel used in the study area. Next, in importance is diesel and then agricultural waste followed by electricity and kerosene. The other sources used are negligible. In this context, the problems and prospects of energy use in household sector are discussed.

9.2.1.1 Problem of Fuelwood Depletion:

In rural areas, supplies of commercial fuels are much more limited and the increased energy demands has resulted in rapid degradation and depletion of bio-mass resources. This has caused what is known as the "Second Energy Crisis", namely the firewood shortage. Looking at the growing rural energy crisis, it is rightly expressed by G.V.K. Rao, "A time may come when we may die not due to lack of food but due to the lack of wood to cook that food".

Excess damage and depletion of trees is already causing ecological concern, besides making the

-------------------
availability of firewood quite scarce. Moreover, because of population growth, more and more firewood is required for fuel, whereas the area under orchards and forests is declining. This leads to acute shortage of fuel in rural areas, and its non-commercial character is slowly changing. In recent years, firewood is now being sold in quite a few rural areas. Therefore, in order to meet the growing energy needs, the government has to initiate social forestry scheme and tree planting scheme with people's active participation.

9.2.1.2 Problem of inefficient Energy Gadgets:

In the household sector, the fuel efficiency of the 'chula' and 'stoves' is very poor. Although improved designs of 'chula' have been evolved by some organisations, they are yet to be popularised. Kerosene stoves which could substantially reduce fuel consumption have recently been introduced in the market, but efforts are required to encourage its widespread adoption in the rural areas.

Thus, on the one hand there is acute shortage of supply of energy in rural areas and on the other hand there is huge wastage of available energy due to inefficient energy gadgets used by our rural folk and enormous mis-use of energy due to ignorance. In order to
prevent this huge waste, it is necessary to motivate the rural people to choose more fuel efficient heating and cooking devices than the devices presently used by them. It is also important to make the rural folk become aware of the dwindling energy sources and educate them to conserve this precious source of energy.

9.2.1.3 Future Prospects of Energy Use in Household Sector:

In planning for the future, the focus of attention needs to be changed from supply management to demand in respect of energy.

1. An improved chula is estimated to save 8.4 kg of firewood per annum. In the study area, there are 8,969 residential households. If each household is given an improved chula, it is estimated that an annual saving of 75 tons of firewood valued at Rs.49.5 thousands in a year can be made.

2. The present study also indicates that substantial areas of waste land are available which could be used for energy purposes.

---


be effectively used for bio-mass production. In the study area, there are about 625 hectares of waste land. If this waste lands are used for bio-mass production, it is possible to produce about 1.6 lakh tons of bio-mass every year (at the rate of 25 dry tons per year per hectare). The present consumption of wood is nearly 1.7 lakh tons per year for household purposes in the study area.

3. Bio-gas is produced by subjecting organic matter like cattle dung to anaerobic fermentation in a unit popularly known as bio-gas plant (gobar gas plant). If a bio-gas plant is installed in a household, the cattle slurry already available would save almost 25 per cent of the firewood used for cooking energy. The material that is left after fermentation will be a fully matured organic manure rich in nitrogen and humus. In addition, atmospheric pollution would be reduced. The pressure on rural forest and ecological imbalance would also be reduced.

4. Solar Cookers:

It is observed that most of the households are cooking rice as the main dish in the study area. So, more attention has to be paid to the popularisation of

solar cookers among the rural masses. It is estimated that for a family of five it is possible to cook for about 250 days in a year. Though the time taken for cooking will depend on the weather, type of food and its quantity, this technique of cooking needs no fuel, is simple to use and does not cause pollution. It is also suggested that all the nutritious-meal centres and public health centres be supplied with solar cookers and water heaters to bring in confidence among the people and only their success give an impetus to its use in the domestic sector. Solar cookers can be fabricated easily using locally available materials and used on all sunny days.

9.2.2 Agriculture Sector:

It is clearly understood from the present study that non-renewable commercial energy has replaced the renewable energy to a significant extent. This has resulted in the escalation of cost of production in agriculture. So, there is a need to look into the possibilities of energy conservation or saving without affecting agricultural productivity. In this context, this section of the present chapter is aimed at analysing the problems of energy use and developing the technologies for energy conservation in crop production of the study area.
9.2.2.1 Problem of Over use of Chemical Fertilizers:

It is observed from the present study that farmers are using chemical fertilizers exceedingly or improperly in the production process. The farmers are unaware of the guidelines prescribed by the Agricultural Department regarding the standard use of fertilizers, manures and pesticides.

9.2.2.2 Lack of using Improved Agricultural Implements:

Several improved agricultural implements like improved ploughs and improved digging tools have been field-tested and proved their worth in our country but they are seldom available in the market to the local farmers who need them. Agricultural Department can play a greater role in popularising or marketing these energy-saving implements.

9.2.2.3 Problem of Price of Energy Inputs:

The farmers are unaware of the future implications of energy intensive agriculture such as scarcity of energy which may further increase energy prices and environmental pollution which they will have to face individually or collectively. Moreover, farmers in Tamil Nadu are now
enjoying free electricity for agricultural farming. It leads to over use of electricity and hence electricity may be distributed to the farmers at a subsidised price rather than free of cost.

9.2.2.4 Prospects of Energy use in Agriculture Sector:

Energy shortages and cost escalations will impede the growth of agriculture and its impact will be severe on crop production in the short run. In this context, efficient management of scarce energy resources can play an important role in maintaining the growth in agriculture. This calls for energy conservation with a view to minimise energy use without affecting the crop production. The following are some of the possible solutions to the problems of energy use in agriculture:

1. In the study area, paddy and banana are the two major crops cultivated by the farmers. The actual use of chemical energy for cultivating one hectare under paddy is 17,301.52 MJ. But the standard use of chemical energy prescribed by the Agricultural Department is 9,889.59 MJ. Now, it is clear that farmers are using chemical energy exceedingly. They can very well save 7,411.93 MJ/ha. of chemical energy without affecting the production of paddy.
Moreover, farmers under banana cultivation are using 60,836.36 MJ/ha. of chemical energy as against the recommended use of 28,084.5 MJ/ha. Nearly, 50 per cent of the chemical energy can be minimised by the farmers.

2. The chemical fertilizers demand more fossil fuels for their manufacture and moreover, continuous use of such chemicals without balancing them with bio-fertilizers, in turn affects the soil quality and fertility. So, in order to preserve the soil quality and fertility and maximise the crop output, the farmers can increase the present use of 2506.71 MJ/ha. of bio-energy to 6199.2 MJ/ha. as prescribed by the Agricultural Department in the case of paddy cultivation. With regard to banana cultivation, farmers can increase the present use of bio-energy from 15,763.22 MJ/ha. to 32,100.00 MJ/ha. as recommended by the Agricultural Department.

3. The improved agricultural implements, such as improved ploughs, improved digging tools, seed-cum-fertilizer drills, and manually operated wheel hoes (for weeding and hoeing) are expected to save 30-50 per cent of energy inputs. Since most of the energy used in Bullock Operated Farms are in the form of human or draught power, these implements can reduce the time involved in various agricultural operations.
9.3 SUMMARY OF FINDINGS

This section summarises the findings of the present study. With the spread of new agricultural technology requiring increased use of mechanical power and high-pay off inputs, the demand for the use of non-conventional energy sources such as diesel, petrol and electricity steadily increases in rural areas. Paradoxically, at the same time, the supply of these sources of energy is becoming scarce and it threatens to grow into a crisis proportion. Result is high cost of production of crops with its chain reaction to ultimately affect the consumers.

Therefore, it is important and urgent to find out a way out for the problems of rural households in their energy use in both household and agriculture sectors. This need is met by this study which aims at evaluating the present status in the energy use of household and agriculture sectors; options available to them and the economics of those options. The results of this study will be useful for resource use planning for the villages. Therefore, the overall objective of this study is to understand the present patterns of energy use in household and agriculture sectors and to give policy suggestions for better perspective in future. More specific objectives are:
1. To understand the present pattern of energy use in rural households; covering both their domestic and agricultural activities.

2. To estimate the productivity, intensity and efficiency of the energy in paddy and banana production.

3. To identify the determinants of energy consumption in household and agriculture sectors.

4. To examine the specific problems of the households in the use of energy and the future prospects.

5. To offer policy suggestions to improve the existing energy use pattern.

The nature of the study was such that it required primary data. Srivaikuntam block in Chidambaranar district of Tamil Nadu State was chosen as the study area. Following multi-stage random sampling technique, sample size of 200 was taken. Interview schedules designed for the purpose of data collection, were administered to randomly selected sample units. The time reference of the data was 1992-1993. Different forms of energy were converted into Mega Joules (MJ) and Giga Joules (GJ) following earlier studies. Different statistical techniques like tabular analysis and multiple regression were applied to analyse the data and the results were interpreted accordingly.
9.3.1 Findings of the Study:

1. The annual fuel-wise energy consumption of the sample households shows that the share of firewood is maximum, viz., 68.6 per cent and the share of dungcake is minimum, just 0.01 per cent of the total energy consumption.

2. Out of the total energy consumed, commercial sources of energy shared 23.35 per cent and non-commercial sources 76.33 per cent.

3. On an average a household used firewood (5.10 kg.), agricultural waste (0.80 kg), electricity (0.76 kwh), kerosene (0.17 litre), diesel (0.20 litre), petrol (0.04 litre), and L.P. Gas (0.02 kg) on per day basis.

4. Among the different farm size groups, the large farm group consumed the maximum of 6007.38 MJ of fossil fuels at a cost of about Rs.839.99. The small farm group consumed a maximum of 7,260.08 MJ of bio-fuels at a cost of about Rs.286.45 and the non-farm group consumed the maximum of 786.42 MJ of electricity at a cost of Rs.65.42 on per household per year basis.

5. While considering income groups, income group I (monthly income upto Rs.1000) was the top consumer of bio-fuels and the income group IV (monthly income Rs.5001 or above) was the top consumer of fossil fuels and electricity.
6. Out of the occupational groups, agricultural labour household consumed maximum bio-fuels as against the salaried group which consumed fossil fuels and electricity to the maximum. This showed the second hypothesis that 'the salaried employee households are using less amount of bio-fuels and more amount of commercial conventional fuels than their other occupational counterparts' holds true.

7. The regression model for household energy consumption showed the following results:

(a) The results of the overall regression model revealed that family size, cooking frequency, and cost of oven were the predominant variables determining the household energy consumption. This proved the third hypothesis that 'the use of energy in households is strongly influenced by cooking frequency and size of households'.

(b) The results show that energy consumption can be reduced considerably by making use of more efficient heating and cooking ovens. This showed the first hypothesis that 'greater the use of improved heating and cooking ovens, lesser is the energy consumption in households and vice versa' holds true.
(c) The results in most of the farm size groups show that the factors like cooking frequency and cost of oven are the major determinants of energy consumption.

(d) Overall results of income groups show that cooking frequency and family size are the major determinants of energy consumption, and energy conservation can be achieved by the use of better heating and cooking ovens.

(e) The major determinants of energy consumption for various occupational groups are again cooking frequency, family size and cost of oven.

8. Energy consumption in paddy and banana cultivation has been estimated on per hectare basis as 27,989.86 MJ for paddy and 1,05,136.4 MJ for banana.

9. Among the various energy inputs, fertilizer was found to be a much required source and its share was 68.7 per cent by the small farm and 74.3 per cent by the large farm to the source-wise energy consumption of paddy cultivation.

10. The share of fertilizers of the large farm was high (73.2 per cent) in comparison with the small farm (55.7 per cent) to the total energy consumption of banana cultivation.
11. Energy outputs were calculated as 50,201.82 MJ/ha. for paddy (main products) and 10,058.63 MJ/ha. for paddy straw (by-products) and as 4,50,085.63 MJ/ha. for banana output.

12. Energy productivity was higher (0.122 kg/MJ) for small farm as against large farm (0.117 kg/MJ) for paddy crop.

13. Energy intensity was higher for the large farm in both the crops and vice versa for the small farm.

14. Large farm was more energy efficient than small farm in paddy cultivation, but in banana cultivation small farm was more energy efficient than large farm.

15. There are higher energy productivity and energy efficiency in both paddy and banana cultivation, but energy intensity was lower in banana cultivation as against paddy cultivation. This has proved the fourth hypothesis of the present study.

16. The total cost of paddy cultivation worked out for farm as a whole was Rs.12,465.90 per hectare. The cost of human labour was the highest for paddy followed by fuel and fertilizers in both farm groups.
17. The total cost of banana cultivation worked out for the farm as a whole was Rs.41,033.63 per hectare. For banana crop, the amount spent on fuel was the highest for the small farm and the amount spent on fertilizers was the highest for the large farm.

18. While analysing the cost and returns of various farm groups, small farm maintained higher production subject to the use of more energy sources compared to large farm group for both baddy and banana.

19. The regression model for paddy and banana showed the following results:

(a) The results of the regression analysis show that bio-energy and animal energy have great potential to increase output of paddy in the study area.

(b) The small farms under paddy cultivation are using chemical energy exceedingly or improperly, and the output will not change even if the chemical energy is reduced to a marginal extent.

(c) The results of banana crop show that there is scope for using renewable sources of energy like bio-energy and animal energy to increase the output of banana.

(d) On the whole, bio-energy has great potential for increasing crop output in agriculture. This showed
the fifth hypothesis that 'there is more scope for using bio-energy which has great potential for increasing output in agriculture' holds true.

9.4 CONCLUSIONS

Overall results of the present study lead to the following conclusions. In the domestic sector which absorbs a large proportion of the total energy consumption in the country, the fuel efficiency of the 'chula' and the 'stove' is very poor. Improved designs of chulas and kerosene stoves have been evolved by some organisations. But, they are yet be popularised.

Among the household groups, salaried employee group consumed a total energy of 34,892.86 MJ per annum as against 50,808.12 MJ by the agricultural group. Energy consumption of salaried group has been considerably less because 95 per cent of the salaried households were using improved heating and cooking ovens as against 42.5 per cent in the case of agricultural households. It is observed that higher the use of improved cooking ovens, lesser the energy consumption and vice versa. The conclusion reached is that energy consumption can be reduced using improved heating and cooking ovens with greater efficiency.
The results of regression analysis for paddy and banana crops show that bio-energy and animal energy have great potential to increase the crop output of paddy and banana in the study area. Further, it is concluded that banana cultivation is more profitable and less energy intensive too.

9.5 POLICY IMPLICATIONS

Following policy implications can be derived from the study:

1. The survey results indicate that fuel efficient heating and cooking stoves have not penetrated into rural areas. The Government and non-governmental organisations should take appropriate measures to popularise the use of improved heating and cooking ovens for increasing the efficiency in energy use.

2. The Forest Department should take necessary steps for growing energy plantations by launching programmes like decentralised nursery programme, tree growers co-operatives and farm forestry co-operatives to make use of the vast waste lands.

3. As the households are prepare 'rice' as the main 'dish' in the study area, more attention has to be paid to the popularisation of solar cookers among the rural households.
4. The agricultural department has to intensify its extension services to induce farmers to use more of bio-energy which is also renewable rather than chemical fertilizers.

5. Agricultural departments can play a greater role in popularising or marketing the energy-saving improved agricultural implements to the local farmers and take necessary steps for the availability of such implements in the market.

6. The distribution of electricity to the farmers at a subsidised price rather than free of cost is recommended with a view to conserve energy from over use by the farmers.

9.6 AREAS OF FURTHER RESEARCH

The following are the areas of research which can be taken up by research scholars in future. There is more scope for preparing an energy use plan for a typical village which will address both potentials and problems in energy use and suggest practical methods for solving the problems. Attempts can be made to undertake studies on energy consumption pattern in other sectors such as transport and industry. These are the areas, researchers can take up in future for further research.