Summary
and
Conclusions
India is a country of villages. The development of India will be incomplete without the development of villages. According to Aslam (1981), India being predominantly the country of villages could not conceive of any coordinated planned approach without developing the villages. These villages have remained in a state of backwardness, where people had been living at barely the subsistence level. Villagers were ignorant of the advantages of science and technology nor were they possessing the resources of their utilization.

There are marked differences in energy consumption pattern between rural and urban areas. The most important fact about energy consumption in rural areas is that the consumption of energy is dominated by the domestic sector. A major part of the energy consumed in this sector comes from non-organized sources. A significant amount of the non-organized fuel source may be turned noncommercial in the sense that they are obtained "free" and collected by the final consumer. Agrawal (1982) reports that 99 percent of the rural households depend partially or entirely on noncommercial energy sources for cooking operations. According to an old estimate of the Fuel Policy Committee, ministry of Petroleum, Chemicals, Mines and Metals, Govt. of India, quoted in the Report of National commission on Agriculture, nearly 65 percent of the energy requirement in rural areas, where the main need for energy is for cooking, is met by the use of firewood, supplemented by agricultural waste (about 20 %) and cow dung (about 15 %) (Hooja 1985).
The population of India has almost doubled in the last thirty years and correspondingly the requirements of kitchen fires have also multiplied. On the other hand, the fire wood and other fuel resources have been fast depleted.

Deforestation and large scale removal of the vegetative matter have begun to pass a serious challenge to ecological balance in the country. As these forests reserve and tree covers are removed, there is a gradual decay in the regeneration of forests, leading to fast shrinkage of the natural fuel or energy resources in the form of natural wood. This has created an urgent need for some strategies which will motivate people to conserve existing fuel sources, regenerate fuel sources or switch over to some renewable energy sources.

Biomass is the energy source of the poor. It is also the major source of indoor air pollution. Millions of poor households in developing countries like India which rely on traditional biomass fuels for cooking and domestic heating, suffer a disproportional high burden of ill health form exposure to indoor smoke. Compounding the situation is the lack of public awareness, insufficient knowledge of effective interventions and inadequate attention given to policies and technological solutions to improve access of poor households to cleaner forms of energy. Over the past few months, two major international conferences were held in India to address issues closely related to the problem of indoor air pollution. Widely attended by the world’s leading toxicologists, epidemiologists, scientists and health managers, the conference highlighted the significant contribution of air pollution to respiratory illness which is responsible for a large share of the global burden of diseases, and the need for identifying and promoting cost-effective interventions to reduce this burden.
The alarming scale argues for additional efforts to understand the conditions that lead to such severe pollution levels in villages and urban slums in India. Yasmin (2000) WHO scientist pointed out the research gap in the area of fuel consumption-conservation of indoor air pollution and found that in order to comply action by decision maker it is necessary to develop awareness raising strategies and recommended awareness programme to advise mothers to keep their children in another room while cooking.

Very few studies in India have looked at the impact of intervention programme on awareness and adoption of improved devices and so that effective intervention can result in significant reduction in fuel consumptions and reduction in respiratory diseases. Lower incidences of lung cancer will be observed if the respondents switched over to improved stove. A vigorous programme of intervention researches can serve to provide a firm scientific foundation for environmental policies.

Objectives of the study:

In order to gain a focus and to give direction to the study, the investigator formulated the following objectives.

(1) To make an assessment of management practices of rural women regarding fuel consumption and conservation.

(2) To study the effect of age, education, occupation i.e. personal variables of the rural homemakers on the fuel consumption.
(3) To study the contribution of landholding and season on fuel consumption.

(4) To identify the problems related to traditional chulha faced by rural homemakers.

(5) To study the human management practices in terms of time spent in collecting the fuel by rural families and its association with family and situational variables.

(6) To assess the awareness of the respondents regarding energy related aspects.

(7) To study the fuel consumption practices and to find its association with advancement of village and level of income of the respondents.

(8) To conduct an intervention programme for enhancing awareness on “Energy Related Aspects” on selected sample.

(9) To introduce improved devices for optimizing use of fuel for cooking, monitor its use and to find out the extent of its use.

(10) To evolve effective, socially viable fuel management parameters.

HYPOTHESES:

H1: There exists a significant difference in awareness regarding energy related aspects among the homemakers due to their selected personal, familial, situational variables viz. (I) Personal variables: (1) Age, (2) Education, (3) Occupation. (II) Family variables: (4) Type of family, (5) Size of family, (6) Income of family, (7) Land holding status. (III) Situational variables: (8) Type of Village.
H2 : There is a difference in fuel management practices of the homemakers due to selected personal, familial, situational and intervening variables.

H 2.1: There is a difference in fuel consumption practices of the homemakers due to selected personal, familial, situational and intervening variables.

H 2.2 : There is a difference in fuel conservation practices of the homemakers due to selected personal, familial, situational and intervening variables.

H 3 : There is a relationship between human energy management practices of the homemakers and their selected personal, familial, situational and intervening variables.

Hypotheses for intervention programme :

H 4 : There will be a difference in the awareness regarding energy related aspects among the homemakers before and after the intervention programme.

H 5 : There will be a difference in the fuel conservation practices of the homemakers before and after the intervention programme.

Hypotheses for testing of socially viable parameters :

H 6: There is a significant difference in fuel between various treatments given to the homemakers
H 7: There is a significant difference in fuel consumption between control group and experimental group of the respondent after treatment.

Methodology:

To achieve the formulated objectives and to test the hypotheses, suitable methodology for the study was decided. Interview schedule, record sheet, intervention programme matter and the scales for assessing awareness regarding energy related aspects, fuel consumption practices, conservations practices and coping strategies to overcome the problems of traditional chulha were formulated. After the data collection, coded data were analyzed, suitable statistical tests were performed. After interpreting the data, conclusions were drawn and they were presented with suitable tables, figures and illustrations. Socially viable parameters were developed and were field tested. A follow up programme was carried out to know the acceptance/rejection of the improved device.

Conclusion

Section 1: Background Information

The advance villages had primary school, health sub centre, post and telegraph office, drinking water supply and connected with state and/or national highway through a road. Bus service was available. The village had no industry, no river and no social forestry planned in waste land around village. Both the villages had man-made pond which was leased out for fishery. The villages were electrified for all purposes.
The backward villages had kutchi approach road from main state highway. Villages have no communication facilities, no PHC, PDS and industries were there. One primary school is there. The villages have no pond or any employment opportunity except to work as agricultural laborers. No social forestry is planned for food, fodder and fuel.

Background information of the respondents:

- Majority of the families (62.94%) were nuclear, but the size of the family was large.
- Mean number of family members was 3.4.
- Mean per capita income of the respondent was Rs. 4628.08/-. 
- Nearly 2/3rd of the respondents were landless, young, illiterate and employed as farm labourers. 
- Nearly 80 percent respondents had one traditional 'C' type chulha as major cook stove. 
- One third of the respondents possessed wick stove, 60 percent had LPG, 19 percent had improved chulha which were not used, and nearly 2 percent of them had biogas which was not live and was not used.
- Cent percent of the respondents used traditional chulha for water heating, 95 to 97 percent of them used traditional chulha for Rotla, Tea, Khichadi and vegetable preparation. Remaining used either wick stove, pressure stove or LPG for these activities. Only 60 percent used fuel for agricultural use and they used traditional
chloric for that purpose.

> Majority (95.46%) used fire wood, little more than one third of them used dung cake, about 30 percent used LPG as major fuel sources.

**Section II : Awareness regarding energy related aspects :**

> From the personal variables, education of the respondents showed highly significant difference in awareness scores.

> From the family variables, occupation of the respondents showed significant difference in awareness regarding energy related aspects.

> Village type had highly significant effect \( t = 4.598 \) on awareness regarding energy related aspects. \( P > 0.05 \)

The awareness regarding energy related aspects was found to be poor in all the respondents.

**Section III : Fuel management practices.**

(A) **Fuel consumption practices :**

> Majority of the respondents, irrespective of type of village, ate food at different timings, one third of the respondents ate dinner together.

> Majority of the respondents used leftovers and foods like Rotla, Khichadi were used the next day too.

> Eating pattern was not a prominent factor to affect the fuel consumption.
 Majority of the respondents were low users of energy but spent high percentages of their income on fuel.

Landless respondents spent more percentage on purchase of fuel as compared to land holders.

Village type, family type, family size, land holding status of the respondents did not show any significant difference on use of fuel due to season.

Respondents used maximum amount of fuel in winter, then comes monsoon and summer is the season when least fuel was used.

Respondents from advance village spent less as compared to the respondents from backward village.

{B} Energy conservation practices:

Illiteracy of the homemakers discouraged them to use pressure cooker, unknowingly 97 percent of them used vessels appropriate to the size of chulha and 98 percent covered food while cooking with the fear of some insect falling in the food, but not as good practice of energy conservation. None used small sized wood, soaked dals, and used adequate amount of water.

Non-conventional energy sources and improved chulha were not used by any one of them.

Regardless of all the selected variables, all the respondents fell in the category of Poor fuel managerial practices.
Irrespective of any selected variables, there was no remarkable difference in measures taken to solve the problems.

Section IV: Human management practices

Fuel sticks were collected thrice a week by majority of the respondents, cattle dung was gathered daily and fire wood too was purchased daily by majority of the people as they lived from hand to mouth. Backward village respondents used more quantity of dung cake as compared to families from advance village.

On an average 1.77 persons per household were engaged in procuring fuel.

More then 58 percent households spent up to 5 hours per day, 40.29 percent 5 to 10 hours per day and one percent household spent more than 10 hours a day for fuel procurement.

One third of the sample had involvement of one person per household, 65.20 percent involved two people and 5.13 percent involved three people per household in fuel procurement.

To collect fuel sticks, on an average 892.50 K Cal. per day was spent in backward villages whereas in advance village 1045.80 Kcal. per day spent. To collect dung 342.30 K Cal. and 185.50 K Cal. were spent by respondents from backward and advance village respectively.

Less percentage of respondents from backward village faced problems in procuring fuel as compared to the respondents from advance villages. Nearly half of the respondents from advance village faced the problem of difficulty in getting wood in nearby area.
Bundles of fuelsticks were either stacked on roof or used as bathroom partition, dungcakes were hanged on walls inside the house, kerosene and LPG were stored in a corner of the kitchen, where as firewood was kept in backyard; only the higher income group respondents and landholders had provision of separate space and stored in separate room.

Section V: Testing of Hypotheses.

From the selected personal variables of the respondents (age, education and occupation) only age showed significant difference ($P > 0.05$) in mean calorific value of fuels used.

Family variables viz. land holding status, size of family and type of family played highly significant role in affecting the calorie consumption where as income showed significant difference. ($P > 0.05$)

When mean scores of practices where checked against effect of personal variables (age, education, occupation) all the factors did not show significant difference in practice.

The results of 't' test were checked against family variables to see significant difference, it was found that type of family (joint and nuclear) and income had significant effects on practices of fuel consumption among the respondents.

There exist no significant difference between type of village and fuel consumption practices of the respondents.

Forward regression analysis too established the fact that village type, family
size and land holding had highly significant effects. Advance villages used less fuel in comparison to backward as the land holding increases the consumption decreases.

**Section VI: Intervention programme**

Intervention programme was a big success as post intervention programme tests showed that the awareness regarding energy related aspects, fuel consumption and fuel conservation practices improved to a great extent. This helped in success; full adoption of new devices.

**Conclusion related to field experiments:**

- From the experiments planned at field level, it could be concluded that there is highly significant difference in per capita calorific value of fuels consumed by the control group and the experimental group.

- Amongst the treatments planned for fuel conservation, highly significant difference was observed in treatment I and III (treatment III which was preferred by the respondents), regardless of types of village which was a selected independent variable as per regression analysis results.

- The results of ANOVA showed that when variability between groups and within groups was tested, the significant variation was observed only in village type. Thus, village type is a factor which is significantly affecting the fuel consumption.

- After the intervention programme all the three treatments planned for fuel conservation showed highly significant difference in calorie consumption of fuel used by the respondents. The highest saving was done when Damru chulha was combined.
After intervention programme the awareness scores of all the respondents (regardless of any variables) showed highly significant difference. The awareness regarding energy related aspects was enhanced due to intervention programme.

After intervention programme the practices of all the respondents (regardless of any variables) improved and showed highly significant difference in ‘t’ value. (P > 0.05).

Respondents who were from younger group of age, were literate, were working as labourers, were living in joint families, were earning more income, were landholders and were from advance village showed greater difference in practices before intervention and after intervention.

Section VII : Development and testing of socially viable fuel management parameter and follow up programme.

Damru chulha (portable mud chulha), Amika chulha (portable metallic chulha) and fireless cooker were advocated and given for testing acceptance by the respondents. The fuel conservation treatment mentioned above were successfully accepted and saved fuel, time, money and the surrounding environment as expected.

Implications of the study:

The present study aimed at assessing energy (fuel and human) management practices of rural home makers and develop socially viable energy management parameters. The findings of the study clearly throws light on some implications of the study.
(1) Implications for educational institutes: The awareness of energy related aspects showed that the rural home makers had very poor awareness before the intervention programme but the same homemakers showed remarkable difference in awareness level after intervention programme. Thus, before planning any educational programme for rural women, they should be made aware through motivation so that the change could be brought out successfully. The curriculum planner should emphasis non-formal education for rural homemakers to elevate their standard of living. Courses on environment and fuel technology should be introduced to bring out eco-consciousness in the students. To make teaching effective, use of audiovisual aids and demonstration should be encouraged. Research and development activities in this area with extension work should be encouraged. They should collaborate with government plans and take up programme to boost progress.

(2) Implications for non-government organization: All NGOs should join hands together with educationists, should collaborate with government programmes and help in implementation of the developmental programmes. The extension work is sustainable and with proper follow up to create lasting effect of teaching so that the technology introduced to elevate life style will become permanent. NGOs should study local requirement and plan separate, region wise programme and teaching for success. While planning promotion and outreach programmes consider the family size, type and advancement of the area before introducing technology as these factors were found to be affecting fuel management practices. NGOs should plan programme for generating ecoconsciousness among rural homemakers and initiate and implement social forestry programme by collaborative efforts with Government or any other agencies.
(3) **Implications for society**: Society is made up of individuals who share common property resources and interest. The background information of the respondents in the present investigation throw light on natural resources in and around village. It was observed that much of barren waste land was lying around the village, unused. The society or village community can take up social forestry programme so that land could be used, fuel wood be made available to larger group of villagers and will help in saving time to collect wood—which will provide opportunity for them to get gainful employment. It was also observed by the investigator that Biogas plants were installed but were nonfunctional. These could be recharged and enough motivation, awareness and teaching programmes be planned to inculcate the habit of using renewable energies. Plan and celebrate social festivals like “SUNDAY”, “Energy Conservation Week”, “Smoke Free Day” to bring about ecoconsciousness and float some awards for social work felicitation in this line. Sponsor programmes like “chipko movement”, form groups of interested people in renewable energy and give slogans of 3 ‘R’s. namely (Reduce, Reuse and Recycle) in public areas.

(4) **Implications for government and planners**: (a) Implement programmes to get positive results. (b) Do not be over ambitious in setting target and not be in hurry to complete target (c) Have sustainable, self sufficient programmes, all though Government is interested in and has installed fixed models. Informal talks with respondents revealed that the dislike for such model was found.

As mass media is a powerful means of reaching the community at large, one has to develop a strategy that is based on the optimal use of existing media to raise general level of awareness on energy and its relevance to development.
The society at large and family specifically would be benefited through the results of the study and would learn good fuel management practices, develop ecoconsciousness, relieve from drudgery filled task of fuel gathering, lead healthful life free from disease and save the environment from pollution.

The Nation will be benefitted due to smoke free environment, enjoy healthful environment, the forest denuding would be stopped, green house effect would be stopped and fuel crisis which hinders the development will be solved.

RECOMMENDATIONS FOR FURTHER STUDIES:

The heavy dependence on conventional cooking fuel indicates the need to develop alternatives to meet the situation and reduce the energy crisis.

* The present study may be carried out on urban biomass consuming households.

* Follow up surveys on success and failure of improved stove may be carried out region wise in order to make desired changes in design.

* Educational programme on biomass conservation may be in parted at micro level in every corner of the country and effectiveness may be tested.

* A comparative study of urban and rural household fuel consumptions may be carried out to study the factors affecting consumption-conservation practices.

* Good mass media programmes should be developed and its effectiveness may be tested.

* More and more indigenous fuel conservation devices should be developed, and field trial may be carried out to test its suitability.