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REGIONAL WOOD ENERGY DEVELOPMENT PROGRAMME IN ASIA
GCP/RAS/154/NET

Woodfuel Production and Marketing in India

National Workshop

National Botanical Research Institute

Lucknow, India

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FOREWORD

Complex and intricate - these two words characterise the relationships between the technical, economic and social issues of wood energy systems in India and elsewhere. Valid data help us to make sense of these relationships. But are we not drowning in data and statistics on land, trees, fuels and so on? And quite often the data, or at least the interpretations that accompany the data, are conflicting. Moreover, it often seems that old concepts prevail, whatever new information we are presented with.

Among the old concepts that time and time again turn up are that something is wrong with wood energy, that woodfuel is becoming increasingly scarce, and that wood energy threatens our soils and forests. When will we abandon such generalisations and acknowledge area specific differences?

The National Workshop at NBRI, Lucknow, made serious attempts to put these issues and others into perspective and to draw sensible conclusions from the information at hand. The discussions of the workshop participants led to a number of valuable recommendations for those concerned with woodfuel production and marketing in India, including establishing and protecting woodfuel plantations, ensuring a better match between woodfuel supply and demand, adapting silvicultural techniques to increase the supply of woodfuel, better and decentralised planning, improved dissemination of woodfuel information, appropriate woodfuel training courses, and relaxing regulations which are hindering the development of the woodfuel industry. Hopefully all, or at least many, of these recommendations will be incorporated into the activities of the concerned agencies in India.

It is a pleasure to thank NBRI and in particular Prof. H.M. Behl for convening and organizing the workshop, as well as the many outstanding contributors. Special thanks are also due to Mr. Tara Bhattarai, Wood Energy Resources Expert at RWEDP, who advised the organizers. This report on Woodfuel Production and Marketing may be of use to all professionals interested in wood energy development in India.

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PREFACE

Millions of people throughout the world use wood for domestic heating and cooking. In developing countries like India, more people depend on wood for their daily energy needs than on any other single energy source. Wood can be considered the world's most important fuel. Unfortunately, it is also in desperately short supply. This grave situation is further compounded by the fact that wood is also used in several cottage and rural industries such as potteries, brick kiln, food processing, and in the manufacturing process of various plant based industries.

The gap between what is required and what is available is now very large and is growing larger every day. Presently, the system of wood fuel production and marketing is unorganized and poor. Wood from forests is considered a common property and shared at no cost. The consumers do not participate in forest management. Forests, on the other hand, are not being managed to provide wood for energy. Trees grown for energy can also help restore stability and fertility to the land, increase agricultural production, and improve the quality of rural life; thereby helping to reduce migration to the city. In fact, forests for energy should now be a major part of any rural development program. Energy plantations may well provide a novel and exciting springboard for rural development.

The role which trees can play in easing world energy problems is much broader than is generally realized. Fuelwood and charcoal have, until recently, been regarded simply as subsistence fuels, but it is now clear that they are also fuels of the future.

As fuelwood becomes scarce, women and children - who are usually responsible for heating the home and cooking the food - are the first to suffer. Rural dwellers have to walk farther and farther to collect the bare minimum amount of wood needed for survival. And town dwellers must rely on supplies that come from more and more distant locations.

The effects of fuelwood shortages extend far beyond the individual family. A lack of this basic fuel produces a chain of reactions affecting the nature of rural society, its agricultural base and the stability of its environment. As fuelwood becomes scarcer, substitutes are eagerly sought. In a rural society, agricultural residues are virtually the only alternative to fuelwood and such materials as straw, dried dung, rice husks and even plant roots are burnt instead of returned to the land. The land thus becomes impoverished, deprived of the essential nutrients in the waste and of the humus it would otherwise provide. It has been estimated that for every ton of dung that is burnt, the country is deprived of 50 kg of grain.

RWEDP has made woodfuel management a priority issue of its programme agenda. The present workshop, which is sponsored by RWEDP and organized in collaboration with the MNES and MOEF is evidence of this and evidence of the seriousness with which fuelwood management is treated in India. Part 1 of this report gives some information on the background of the workshop and its objectives, along with the conclusions and recommendations derived from the deliberations of the participants. Part 2 contains the papers presented at the workshop. Part 3 contains the appendices.

Dr. H. M. Behl, Head, Tree Biology and
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Photo Credits: Tara Bhattarai, WERS, RWEDP FAO

A local fuelwood depot in an urban center

Storage of dried animal dung cake for fuel in rainy season in Uttar Pradesh

A road-side fuelwood depot for an urban center near Lucknow

Preparation of animal dung-cake for domestic fuel in Uttar Pradesh, India

PART I: OVERVIEW OF THE TRAINING COURSE

1. INTRODUCTION AND BACKGROUND

Although about 23 percent of India is covered under “Category Forests” and “Wooded Land”, the natural forests cover only 17 percent of the land area. Plantations of different kinds account for 6.4 per cent of the remaining tree covered area. However, biomass fuels of different kinds still account for some 36-46 percent share in India’s national energy balance, consumed mostly by the household sector and some traditional industrial commercial activities located in rural areas. Statistics of energy consumption in the country over the last two decades show an increasing trend for all types of fuels. Over the decade of 1981-1991 commercial energy consumption increased by 4.5 percent annually. It is also projected that by the year 2000, the use of coal will reach twice the 1991 level of 217 million tonnes. Similarly, the use of electricity is also growing at the rate of over 8 percent annually.

Historically, there has been a visible transformation in the energy use pattern, mostly in favour of commercial fuels, as the national economy has developed. Therefore, the use of commercial fuels is expected to grow in the future, which in turn should decrease traditional fuel use. However, figures for biomass energy use in the last two decades indicate a continuing growth in biomass energy use in absolute terms, and reports on per capita consumption show a constant figure for biomass fuel. The reason for this may be, in part, due to the absence of a reliable and affordable supply of alternative commercial fuels to the domestic sector that is the major consumer of biomass fuel. Most domestic consumers do not buy woodfuel but meet their fuel needs from their own-supply sources or by collecting fuel from public, community and private lands without charge; thus woodfuel is still a non-monetized commodity for a majority of rural people. Therefore, the demand for traditional fuel is not expected to decrease, rather it may increase in absolute terms along with the growth in population, particularly in rural areas where there has been a 43% increase in rural population during 1970-90.

Traditional agroforestry schemes, home-gardens and other non-forest areas have become significant sources of woodfuel supply in recent years. Besides the privately owned non-forest areas, community lands and joint forest management schemes have started to contribute increasingly to woodfuel supply. These newly emerging supply sources need to be assessed thoroughly in terms of identifying critical constraints on production posed by current policies and implementation strategies. Any constraints must be amended where necessary. The share of own-farm and roadside bushes and trees accounted for over 78 percent of the woodfuel collected, whereas forests and other sources accounted for only around 22 percent.

The current government policy on renewable types of energy has a threefold thrust. It calls for the enhancement of biomass production for energy, the development and dissemination of different types of non-conventional sources of energy, and the enhancement of the conversion efficiency of existing biomass fuel-using devices (i.e. improved cook stoves and other technologies used in wood-fuel based commercial/industrial activities). With this in mind the Regional Wood Energy Programme (RWEDP) in Asia is assisting India to help develop her wood energy sub-sector. This national training course on “Integrating Wood-fuel Production and Marketing into Forest, Agriculture and Tree Production Systems” was one of many activities that have been or are being organised in India through RWEDP's forestry and energy focal points.

This training was organised by the National Botanical Research Institute, under the Council of Scientific & Industrial Research of the Ministry of Science and Technology of the Government of India, in collaboration with RWEDP. The course was held at the National Botanical Research Institute, Lucknow, Uttar Pradesh, India from 2-5 December 1996.

During the four days of deliberations and field observations, participants critically reviewed the woodfuel supply/demand situation in problematic areas, identified crucial issues and constraints related to supply enhancement, and recommended strategies which need to be pursued to integrate woodfuel production and marketing into forest, agriculture and tree production systems.

This national training course is a follow-up of the sub-regional workshop on "Integrating Wood Fuel Production into the Implementation of Agriculture, Forestry and Rural Extension Programs in South Asia", which was organised in October 1995 in Dhaka, Bangladesh. The course programme is presented in Appendix 1.

2. OBJECTIVES

The specific objectives of the national training course were to:

1. network key persons from the forest department, MNES and NGOs who are involved with wood energy production and marketing (flow) systems;
2. enhance the participants' understanding of the technical, economical and social issues involved and the complexity, intricacy and linkages of various elements of these systems so that the specific role of every actor or element is duly recognized and incorporated into the planning process;
3. develop the capability to co-ordinate wood fuel production and to incorporate the interests of traders and industrial consumers into production plans with the aim of enlisting their assistance;
4. develop the skills and capability of participants to design and implement similar training programs at state or regional level and to formulate proposals for these;
5. recommend sectoral development policies and plans that will ensure the effectiveness of woodfuel production and marketing systems.

3. PARTICIPANTS

Forty participants and seven resource persons, who represented both central as well as state level government organizations, attended the training course. All of the participants had a degree in forestry, agroforestry, or another wood related discipline. They were middle level professionals in relevant ministries or departments with extensive experience in planning and implementing woodfuel or renewable rural energy developmental programs/projects. They had the capability to organise regional or state level training programs as a follow up activity. Representatives of NGOs had direct involvement of more than four years in implementing woodfuel production or marketing activities in the field.

The participants can be divided into four categories:

1. Representatives of central and state level forest organizations. Most of the foresters were of IFS cadre with five to ten years experience. There was participation from institutions responsible for forest surveys and training (both formal and informal training institutions imparting training in forestry);
2. Representatives of state and center level organizations related to energy development in India such as state level units of energy development agencies. There was a fair representation from the Ministry of Non-Conventional Energy Sources. These included field and management level persons;
3. Participants from biomass research centers. These centers are situated in various universities and institutions and are supported by the Ministry of Non-Conventional Energy Sources. These centers are engaged in research and development related to woodfuel production, training and promotion of biomass production in various agro-climatic regions of the country. Most of these participants had Ph. D. degrees and were actively involved in biomass production programs;
4. Representatives of NGOs and observers from the NBRI.

Mr. Tara Bhattarai represented RWEDP and served as a resource person in the training course and Dr H M Behl, the Deputy Director of NBRI was the course coordinator. A list of participants, resource persons and observers is provided in Appendix 2.

4. COURSE FORMAT

The course was divided into five technical sessions in which resource persons presented case studies or research results. These presentations were followed by brief questions/comments sessions. The participants were then divided into a number of smaller groups (usually three) to discuss the issues presented in some depth and to formulate recommendations. The small group leaders presented their conclusions and recommendations at each day's final session. These are contained in section 6 of this report.

Apart from the technical sessions there was a field trip (see Appendix 3) to the training centre of the Non-Conventional Energy Development Agency at Chinhat, near Lucknow City, a fuelwood depot and a brick kiln.

Participants were also asked to prepare proposals for similar training courses in their own regions or states. One proposal, that of the group consisting of staff from the Tata Energy Research Institute, Delhi, is presented in Appendix 4.

5. INAUGURAL SESSION

Dr. P. V. Sane, Director of NBRI, Lucknow, inaugurated the course. He was also the Chief Guest and delivered the inaugural speech in the opening session. Dr. P. V. Sane briefly explained the need to match species to site. He emphasized that it requires a database. Dr Sane informed the participants that NBRI in collaboration with the International Taxonomy Association is establishing a legume database. This is a part of the larger database on legumes called ILDIS. Under this program NBRI is particularly concerned with the establishment of a database for leguminous plants in South Asia. Although information generated under this database system could be applicable also for woodfuel development in the sub-region, Dr. Sane suggested that a separate database should be prepared for matching species to sites. In this way the country's biomass production programs can be formulated and implemented on a sounder scientific basis.

Mr. N. P. Singh, Director of MNES, Dr. H. M. Behl, Deputy Director of NBRI, and Mr. Tara Bhattarai also made speeches in the inaugural session.

6. CONCLUSIONS AND RECOMMENDATIONS

Recommendations were sought from the participants after each of the technical sessions. These recommendations were then presented and discussed in the final session of the training course. The discussions have been summarised and along with the recommendations have been categorized under 6 headings as follows:

6.1 BIOMASS PRODUCTION

Regarding wood fuel availability, Shri A. N. Chaturvedi suggested that the country's wastelands can be utilized for wood fuel production. He calculated that 50 million hectares could meet the total demand of nearly 200 million tons (one participant disputed this figure). Another participant suggested that there is a requirement of 213.8 kg/individual/year. It was observed that the mean annual increment (Mai) for firewood is only 4 t/ha. However, soil productivity is an important and critical parameter. Silviculture knowledge of woodfuel plantations is a prerequisite. Experts should be consulted. In one of the case studies of woodfuel plantations at NBRI, it was found that 7 to 10 t/ha of leaf litter must be recycled for maintaining soil fertility in degraded land sites. Similarly, harvesting should not be done at peak Mai but should be initiated later. At peak Mai the growth is very fast and if harvested at this stage, the soil will further deteriorate.

Recommendations

1. Establishing woodfuel plantations on community land, private land and even public land can not be done by a single agency. It requires the co-operation of various state and central departments and NGOs.
2. Private entrepreneurs should be encouraged to arrange community land for woodfuel plantations, no matter how difficult this might be.

3. Site x species interaction is a critical parameter. It was recommended that a database on the lines of ILDIS or Australian models be prepared. All available information should be fed into this database so that it is available on demand. This effort may motivate other countries in the Asian region to do this too. Mechanisms to link this database with the databases of other agencies should be explored.
4. Efforts should be made to raise cloned and quality planting material.
5. The health of plants at nursery stage is a very critical factor in their development and should be given greater attention.
6. With 450 million heads of cattle, plantations cannot be protected from grazing and browsing. Efforts should be made to reduce this number.

6.2 MARKETING

Woodfuel marketing has remained neglected. It is an unorganized activity at present. A case study on woodfuel consumption and use was presented by NBRI. Mr. Tara Bhattarai of RWEDP observed that a woodfuel flow study in and around Lucknow was identified as a possible area for future collaboration between RWEDP and NBRI. This metropolitan city in Northern India was still found using a substantial amount of fuelwood for different types of industrial commercial activities. And a large number of households are also using biomass and wood as a source of energy. Some information regarding industrial use of wood biomass fuels around Lucknow was collected by NBRI recently, though the sample was very small. It would be desirable to expand the scope of the study and conduct an additional study in the same area. The new study should include different woodfuel users/end-uses, try to identify the sources of production/producers, who does what in the process of production and flow of wood fuel from the point of view of gender specific role differentiation, etc. It was also observed that NBRI possesses both manpower as well as the necessary experience to conduct this type of study.

Recommendation

1. Surveys of cottage industries, crematoria, brick kilns and other users should be carried out at local/regional levels to assess actual requirements and plug the holes in marketing.

6.3 WOOD CONVERSION

Dr. N. P. Singh and Dr. D.K. Khare presented a detailed account of the efforts of the MNES to promote wood conversion technologies. Wood utilization through gasifiers and other conversion technologies is catching up.

Recommendation

1. Silviculture techniques should be adapted to grow wood for energy conversion.

6.4 PLANNING

Planning of wood fuel management at rural, state and national level was discussed. Discrepancies and difficulties in the present set up were highlighted. The participation of women, producers and consumers in woodfuel management was thought to be important.

Recommendations

1. Surveys should be conducted to evaluate wood requirements, consumption and constraints in woodfuel commercialization.

2. Cost-effective planning models should be prepared, tested and documented for application and further improvement. There may not be a uniform policy for all states. It should be based on the ecology and the wood fuel demand of the region.
3. A decentralized integrated rural planning model should be explored in India. It will need the support of international organizations, ministries and state governments, NGOs and other relevant institutions.
4. Village level micro planning, vis-a-vis woodfuel requirements, has remained neglected. The micro-planning exercise in 2000 villages in UP (India) should be replicated in other states.
5. Government agencies should be re-oriented towards energy efficiency.
6. Linkages between RWEDP and national agencies should be strengthened.
7. Institutional linkages should be formed.
8. Terminology, techniques and methods should be standardised.

6.5 EDUCATION

The groups discussed the role of both formal and non-formal educational activities in solving woodfuel-related problems.

Recommendations

1. Information should be disseminated through training programs, the mass media and the formal education system, and biomass technologies should be made more attractive to entrepreneurs and financial institutions.

The following were suggested:

- Educational/training packages of good practices should be prepared.
- Business meetings with financial institutions and entrepreneurs should be arranged.
- Mass media should be used to raise awareness and gain publicity.
- Target-audience oriented training programs on wood fuel production should be organised.

6.6 TECHNICAL INFORMATION AND INSTITUTIONAL SUPPORT

The groups discussed matters related to institutional support that limit the promotion of the woodfuel trade.

Recommendations

1. Legislation on tree harvesting and transporting should be relaxed.
2. Information to promote and aid the cultivation of wood on private land should be up-graded and made available through information centers.
3. Market support should be arranged. Publicising technologies, case studies, success stories/ failures should be given priority.
4. Wood fuel marketing should be taken up as a commercial venture. There should be a necessary relaxation in rights for the industry.
5. Efforts to reduce the livestock population should be made at national level.
6. Power generation should be decentralized.
7. Women bear the major burden of environmental and economic distress in developing countries. They work longer hours to produce sufficient food and income to support their families, as well as collect the household requirements of fuel and water, often with little or no help. Thus women should be involved in the planning and execution of rural based wood fuel programs.

PART II: TECHNICAL PAPERS

1. Wood Energy Conversion Technologies Programmes and Policies

by

N. P. Singh, Director
Ministry of Non-Conventional Energy Sources, New Delhi

1.1 Introduction

Wood is used as fuel for cooking food, space heating and in the furnaces and boilers of various small and medium level industries throughout the developing world. In India and many other developing countries in Asia and the Pacific, wood and other biomass viz. agricultural and agro-industrial residues, cattle dung and forest residues contribute to about 35-40% of the total energy consumption. However, wood/biomass is used in an inefficient manner in traditional stoves (*chulhas*) and conventional furnaces/boilers. About 75% of India's population live in about 5,860,000 villages and depend mainly on wood/biomass for their process heat requirements. The demand for fuelwood has been increasing due to increases in population and the non-availability of coal and oil as well as the poor economic conditions of the rural people. There are no reliable data on fuelwood demand and supply in the country but estimates made by TERI and NCAER put the fuelwood demand at 160 to 270 million tonnes per annum against an estimated supply of about 30 million tonnes of fuelwood from the forests. Agricultural residues, cattle dung and the illegal cutting of forests/trees meet the balance.

During the last two decades, several advances have been made in increasing fuelwood yield on a short-rotation period and in improving the conversion efficiencies of woodstoves and combustion furnaces/boilers to reduce wood consumption and to improve the environment. Modern biomass energy technologies such as gasification, co-generation and pyrolysis have been developed and commercialized for the production of heat and power. As per the Renewable Intensive Global Energy Scenario, biomass will continue to be one of the main sources of energy in the coming 50 years in many developing countries. The Ministry of Non-Conventional Energy Sources, India whose mandate includes the development, commercialization and promotion of new and renewable sources of energy such as solar, wind, biomass etc. has been implementing various programs based on wood energy technologies. These programs are briefly described in the remainder of this paper.

1.2 Fuelwood Use in Industry

Fuelwood is used in large quantities in various rural and urban industries. Some of the industries using fuelwood are:

Agro-process Industries

- Tea/Coffee drying
- Rubber making
- Coconut drying
- Tobacco curing

Food Processing Industries

- Bakeries
- Sugar/Khandsari
- Fruit juices
- Fish smoking
- Distilleries
- Dairy products

Building Materials/Clay Based Industries

- Brick
- Rock tiles
- Lime
- Potteries
- Ceramics
- Refractories

1.3 EMERGING USE OF FUELWOOD FOR POWER GENERATION

Due to the emission of large quantities of greenhouse gases (GHG) causing global warming and other gases causing acid rain, the environmental impact of fossil fuels used in the generation of process heat and electricity is a matter of serious concern. Wood and other biomass have been considered a CO_2 neutral feedstock for the generation of heat and power, as during the growth of trees/plants the absorption of CO_2 is equal to the emission during combustion. Besides, wood does not produce SO_2 during combustion. Several developed and developing countries have started large scale developmental and demonstration projects on co-firing wood in the existing fossil fuel boilers and power plants and have set up wood/biomass based power plants employing Advanced Biomass Gasification/Gas Turbine (BIG/GT) technologies.

1.4 WOOD ENERGY CONVERSION TECHNOLOGIES

The main wood energy conversion technologies are:

- Direct combustion
- Co-Combustion
- Gasification
- Pyrolysis

- **Direct combustion**

Direct combustion of wood takes place in the presence of adequate air. 1 kg of dry wood requires about 6 kg of air for combustion. Simple examples of direct combustion are domestic and community *chulhas*, industrial ovens/furnaces and boilers. Atmospheric and pressurized fluidized combusters with improved efficiencies are commercialized for boilers for steam and power generation application.

- **Improved wood stoves**

In a typical rural household, cooking energy accounts for about 85% of the total energy consumption. This has been traditionally met through various bio-fuels viz., wood, agricultural residues and cattle dung. The gathering of fuelwood has generally been the responsibility of women and children. Traditional wood stoves have efficiencies of only 8-10 percent and emit a lot of smoke during cooking. Improved wood-stoves developed and promoted by MNES have an efficiency of 20-40 per cent. A schematic diagram of improved wood-stoves (fixed and portable) is given in Figure 1. A National Program on Improved Wood Chulhas (N.P.I.W.C.) launched in 1984-85 aims at fuel conservation, removal/reduction of smoke from kitchens, reduction in the drudgery of women's work and providing employment opportunities to rural artisans. A novel feature of this program is the multi-model approach. MNES provides assistance in the form of Rs. 50 for general category stoves and Rs. 75 per *chulha* to SC/ST and hilly areas. Over 800 models of improved woodstoves, both fixed and portables have been selected for dissemination. Under the program about 23 million households have been covered so far, resulting in an estimated saving of 16 million tonnes of firewood per annum, which is equivalent to a saving of 54 million trees per year. State-wise achievements under N.P.I.W.C. are given in Table 1.

Seventeen Technical Back-up Units (TBU) have been carrying out R&D activities related to the *chulha* technology to cater to the specific technical and local requirements. These units work in consultation with the Ministry and the various implementing agencies in the concerned states. TBUs also provide training to various target groups. The functions of the TBUs include R & D of appropriate models according to local needs; training self employed workers, potters, village artisans, entrepreneurs and various field functionaries; demonstration; adoption of villages for demonstration and field trials of various technologies developed; and testing of *tulles* for decentralized approval.

- **Dendro-thermal power generation**

Wood based power generation involves the combustion of wood in boilers to generate steam and produce power by means of a steam turbine. A schematic diagram of a dendro-thermal power plant is shown in Figure 2. A number of such plants are in operation in pulp and paper mills and other forest based industries in the USA and many other developed countries. In the Philippines, a large dendro-thermal power generation program was implemented in the last decade. India is also installing a few dendro-thermal power plants in some states, namely Andhra Pradesh, Madhya Pradesh etc.

- **Biomass gasifiers**

Biomass gasification is basically the conversion of solid biomass, i.e. wood, agricultural and agro-industrial residues, into a combustible gas mixture normally called producer gas. The producer gas can either be burnt directly for thermal applications or used to replace oil in dual-fuel engines for mechanical and electrical applications. A schematic diagram of gasifier based power generation is given in Figure 3. Gasifiers with capacities ranging from 3-500 kW have been developed and commercialized in India. The MNES has been implementing a program on biomass gasification, which encompasses research, development and demonstration for various applications. Four Gasifier Action Research Centers at Bangalore, Bombay, Delhi and Madurai have been supported for research and development, testing and evaluation and manpower development. Under the gasifier demonstration program about 1,500 gasifiers with an aggregate capacity of about 22 MW equivalent have been installed. Ten villages have been electrified through gasifiers. The emerging potential user industries are plywood, tea processing, rice-mills, solvent extraction etc. The MNES has been providing financial support for installation of gasifiers: up to 60% of the cost of the gasifier for mechanical and power generation, 30% of the cost of the gasifier for thermal use, and 75% of the cost of the gasifier and DG-engine set for village electrification. A state-wise list of gasifier installations is given in Table 2. A 500 kW gasifier for village electrification is under installation at Gaushaba village on Sunderbans Island in West Bengal.

- **Cogeneration and combustion**

Generation of power and steam from the same fuel improves the conversion efficiency of the system and the overall economic viability of a power plant. A prominent example of this technology is in the area of bagasse based co-generation, identified to have a potential of about 3500 MW of surplus power in the country's 420 sugar mills. The MNES launched a National Program on Bagasse based cogeneration in 1994-95 with the objective to create favourable conditions for early exploitation of the identified potential. The states, viz. Tamil Nada, Maharashtra and Uttar Pradesh have announced attractive buy-back rates for power from cogeneration. Seven projects with a total surplus power of about 20 MW have been completed and 13 projects with an aggregate surplus power of about 70 MW are under completion in Tamil Nadu, Maharashtra and Uttar Pradesh.

Keen interest has been expressed by international agencies/developers in supporting cogeneration projects at various sugar mills. A French and American consortium has been actively pursuing dialogues with sugar mills for taking up cogeneration projects in the independent power production sector with foreign equity participation. Efforts have been made to improve the technical capability of Indian consulting firms in designing and formulating optimum cogeneration projects by providing the services of international consultants under USAID sponsorship.

The Biomass Combustion Based Power Generation Program was initiated during 1994-95. Two projects are currently being implemented in the private sector: one of 6 MW capacity, in Andhra Pradesh, using waste wood from a wild variety of road side bushes, and another of 5 MW capacity, in Madhya Pradesh, using rice husk. The experience gained here is likely to be of immense value for those implementing future biomass based power projects in the country. A new scheme on biomass combustion based power generation at *taluka* level was launched during the current financial year. The scheme aims to use the surplus biomass available in a *taluka* for meeting all energy requirements. The projects of 10-15 MW capacity with a financial support of Rs. 25 lakhs/MW are likely to be taken up under the scheme.

- **Co-combustion**

Co-combustion or co-firing is a process in which wood chips or other biomass is combusted along with coal in the combusters of power plants. Co-combustion reduces the SO_2 in emissions from coal based power plants as wood does not contain sulphur. Co-combustion has been pursued by many industrialized countries, viz. USA, Denmark, the Netherlands etc. Combusters have been modified to use 15-20% wood/biomass.

***Table 1: National Programme on Improved Chulhas*, up to 1995-96**

State / U.T.	Potential (lakhs)	Installed Chulhas (lakhs)	% of Potential
Andra Pradesh	97.08	18.80	19
Arunachai Pradesh	1.50	0.31	21
Assam	36.00	2.55	7
Bihar	123.83	8.71	7
Gujarat	50.72	8.94	18
Goa	1.17	0.96	82
Haryana	20.61	8.11	39
Himachal Pradesh	8.53	5.66	66
Jammu and Kashmir	11.75	2.89	25
Karnataka	60.76	10.57	17
Kerala	40.73	5.49	13
Madhya Pradesh	101.58	20.22	20
Mararashtra	96.50	15.63	16
Manipur	2.64	0.52	20
Meghalaya	2.54	0.12	5
Mizoram	0.73	0.23	32
Nagaland	2.01	0.106	5
Orissa	54.55	11.06	20
Punjab	25.38	8.52	34
Rajasthan	55.54	20.57	37
Sikkim	0.73	0.41	56
Tamil Nadu	80.16	17.72	22
Tripura	4.65	0.17	4
Uttar Pradesh	187.45	27.90	15
West Bengal	98.12	8.55	9
A&N Islands	0.40	0.26	65
Chandigarh	0.66	0.17	26
Dadra and Nagar Haveli	0.25	0.10	40
Daman and Diu	0.10	0.0006	6
Delhi	9.06	2.40	26
Lakshwadeep	0.10	0.046	46
Pondichery	0.59	0.23	39
Others		19.42	
Total		227.35	19

N.B. "Others" include Improved Chulhas set up by the Khadi and Village Industries Commission, National Dairy Development Board and the All India Women's Conference.

Table 2: Consolidated Statewise List of Biomass Gasifier Systems Installed (as of March, 1996)

State/UT	UPTO 1993		1993-94		1994-95		1995-96		Total	
	No. of systems	Capacity (kW)	No. of systems	Capacity (kW)	No. of systems	Capacity (kW))	No. of systems	Capacity (kW)	No. of systems	Capacity (kW)
Andhra Pradesh	40	194	18	390	24	2400	17	1700	99	4684
Arunachat Pradesh			3	180					3	180
Assam					5	23			5	23
Bihar	2	20							2	20
Goa	3	22							3	22
Gujarat	164	1260							195	3556
Haryana	16	274	14	1030	12	1104	5	162	25	964
Himachat Pradesh	2	7	1	100	8	590			2	7
Jammu & Kashmir	4	120							4	120
Karnataka	468	2329							468	2329
Kerata	5	115	1	100	4	4			10	615
Madhya Pradesh	1005	649	100	100	14	1740	10	1500	139	3989
Maharashra	3003	1614	1	40	3	158	1	500	308	2312
Orissa	15	62							15	62
Punjab	18	430	4	90	3	140			25	660
Rajasthan	12	63	9	155					21	218
Tamil Nadu	55	393					1	40	56	433
Uttar Pradesh	34	361			1	150			35	511
West Bengal							5	500	5	500
A & N. Islands	17	167							17	167
Delhi	16	74							16	74
Others	91	318							91	318
TOTAL	1370	8472	61	2185	74	6705	39	4402	1544	21764

Figure 1:   Models of Portable and Fixed Chulhas

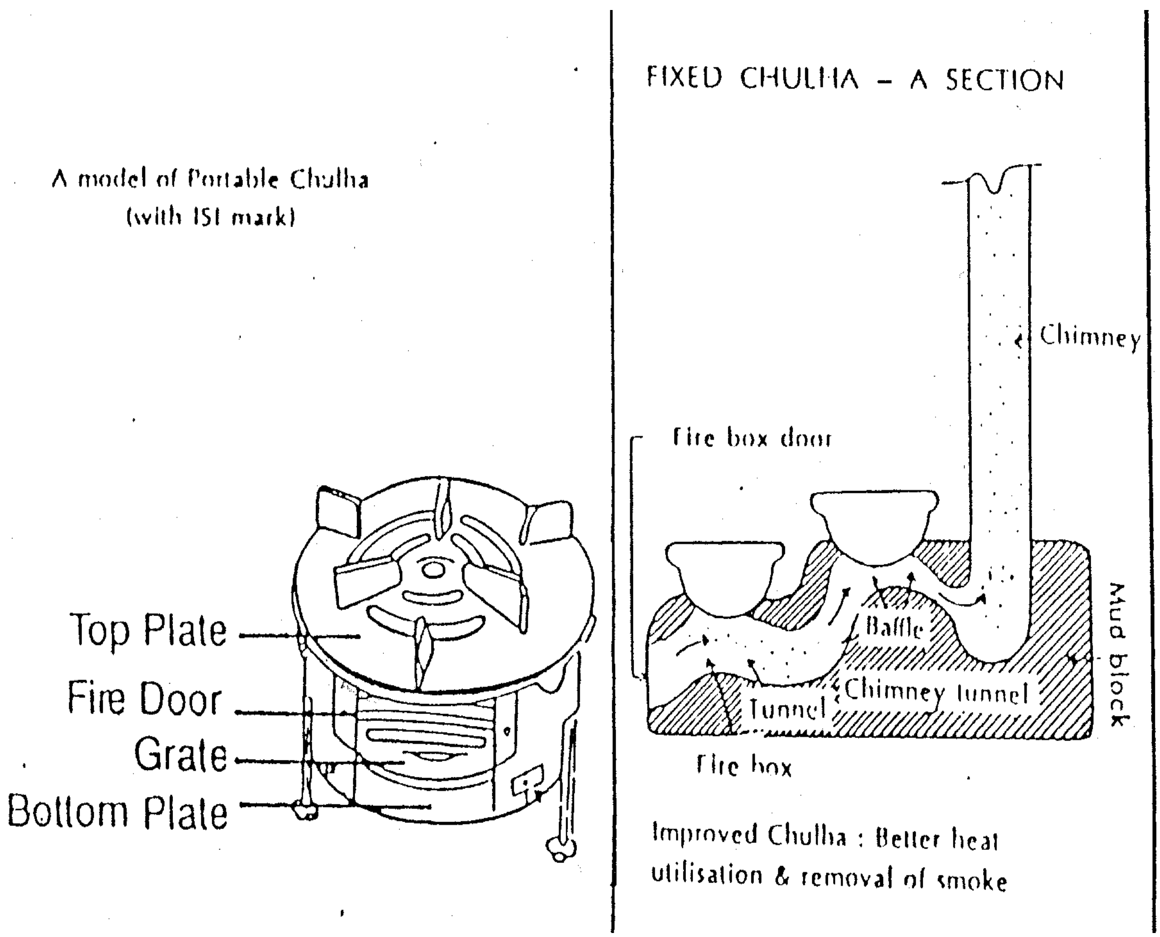


Figure 2: Schematic of 3MW Wood Burning Gas Turbine Power Plant (Brayton Cycle)

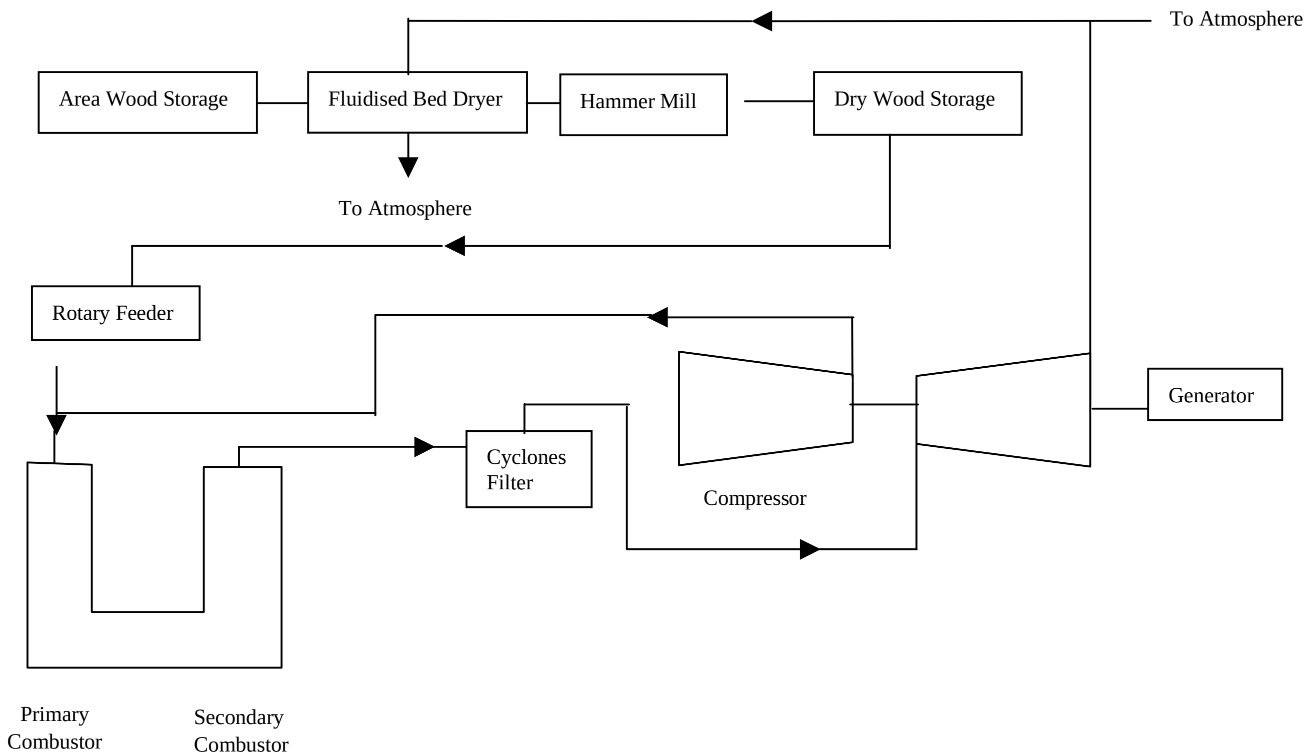
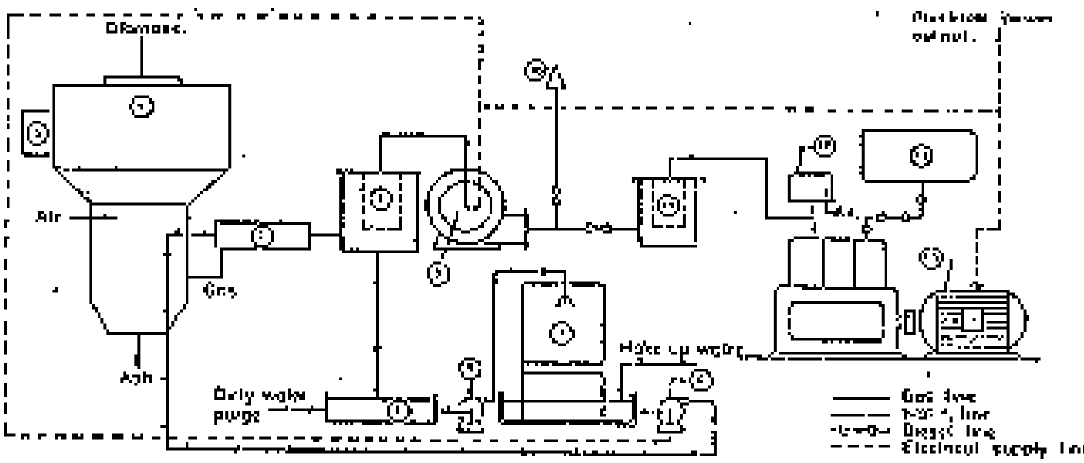


Figure 3 : Schematic Diagram for a Typical Gasifier-engine System for Electrical Power Generation (employed in India)



LEGEND

1. Gasifier
2. Gas Cooler – Cleaner
3. Vibrator
4. Hot Dirty Water Sump
5. Cooling Tower Sump
6. Water Recirculation Pump
7. Cooling Tower
8. Separator Box with Filter
9. Blower
10. Flare Burner
11. Security Filter
12. Air Filter
13. C.I. Engine
14. Diesel Supply Tank
15. Electrical Generator

2. STRATEGY FOR MEETING THE FIREWOOD DEMAND IN INDIA

by

A.N. Chaturvedi

ABSTRACT

Though large quantities of firewood are extracted from the forests of India, much of it is unrecorded, and official firewood sales generate very little revenue. Several rural industries are still dependent on firewood. About 0.5 million hectare of forests are depleted each year to meet the firewood demand. Social forestry projects have largely failed to augment the firewood supply for domestic consumption in rural areas. The climate in India is quite favourable for growing firewood in rain-fed conditions and average production of 4 tonnes/ha/year is possible. Firewood plantations of over 200 million hectares are needed to meet the present firewood needs of the country. Such lands will have to be closed to grazing and lopping leaves for fodder. It is essential that about 7 tonnes of forest biomass be permitted annually to recycle on the site for maintaining productivity. The cultivable wastelands and fallow lands can be utilized for this purpose. A good firewood species should have a high density, should be free from oil and should not throw sparks. Calorific value alone is not a good indicator of firewood property. Villagers and legislators must be convinced that the traditional free gathering of fuelwood is no longer viable.

2.1 DEMAND AND SUPPLY

According to Forestry Statistics India, 1995, published by the Indian Council of Forestry Research, the production of firewood during 1991-92; 1992-93 and 1993-94 was 1,928,571; 1,539,590 and 2,681,954 tonnes respectively, while revenue from firewood was 218.7; 253.3 and 109.5 million rupees, respectively. These statistics are considered unreliable because large quantities of firewood, locally removed from forest areas for consumption and for sale, are unrecorded. The marketing of firewood, except in metropolitan towns, is unregulated. The firewood is consumed by both the domestic and industrial sectors. Reliable statistics for consumption and production are not available. India is still largely dependent on fuelwood for its energy needs. There are over thirty rural industries and village applications using firewood-which account for 7 to 10% of the total rural fuelwood requirement. In spite of the fact that large quantities of cow dung and agricultural residues are used in rural areas as domestic energy resources, the firewood demand is estimated at 300 million m^3 (about 200 million tonnes). With average production of 0.7 m^3/ha we need about 430 million hectares of forest area for meeting this demand. This is more than the physical area of the country. About 50 million tonnes of firewood are obtained from areas outside reserved forests. About 100 million tonnes are obtained from forest areas. The balance comes from the depletion of about 0.5 million hectares of forests each year. This has been confirmed by the FAO (1993) Forest Resources Assessment 1990 (Tropical Countries Forestry Paper 112.)

2.2 SOCIAL FORESTRY FOR FIREWOOD

Most social forestry programs were designed to help villagers meet their needs for small timber, fodder and fuelwood, while at the same time trying to reduce forest destruction. The success of social forestry as a means of rural development lies in meeting the social and economic needs of the rural poor, the expected beneficiaries of social forestry. Its success essentially lies in halting the degradation and destruction of forests; at least that caused by poverty. Twenty-five years of social forestry in India have shown that programs have hardly made any impact on checking the denudation of forests. On private lands villagers prefer to plant trees which will give them direct economic returns. Trees on community wood lots have been sold to pulp factories or as poles while villagers continue to gather their fuelwood from public lands. So-called participation in social forestry is all too often coerced, not voluntary. It may make much more sense to view the forests as a base for non-farm production, such as for the development of wood based industries that could get people away from agriculture and out of the mire of poverty. Such a change could help provide the basis for sounder land use and afforestation practices. The availability of free firewood from forest areas discourages most people from growing trees for firewood. If properly priced, firewood farming on low value lands could be quite competitive with other uses of such lands. Unfortunately, social forestry projects were based on fixing targets on paper. Pandey (1996) paints a very discouraging statement of such plantations in tropical countries. Extending gross area with almost zero monitoring of plantations has encouraged many corrupt practices in plantation programs. In a number of cases, agencies responsible for implementing the plantation activities utilized part or all of the allocated money for their personal use and bribed the other officials without actually realizing the targeted plantations on the ground. Such practices became more prominent after the launching of the Community Forestry Projects where plantations were extended outside the forest reserves and governments have had to take severe measures to stop them. For example, the Brazilian government stopped the scheme of fiscal incentives in tree planting in 1988 because of corrupt practices.

2.3 POTENTIAL FIREWOOD PRODUCTION

The production of wood from man-made plantations under rain-fed conditions in India under proper management will vary from 3 tonnes to 10 tonnes per hectare per year. It will be low in arid areas and high in moist areas. Firewood cannot be transported over long distances and it would be bad economics to transport low value firewood using high value diesel oil. Firewood should therefore be produced closer to the consumption centers. With an average production of 4 tonnes/ha/year under rain-fed conditions, the total land area needed to produce 200 million tonnes of firewood is about 50 million hectares. Cultivable wastelands cover 17.1 million hectares while fallow lands occupy 9.6 million hectares. Thus, about 26.7 million hectares of degraded land are available within the cultivated lands. This land will be scattered in small or big patches. If firewood farming is developed as a business, it is quite possible to grow commercially viable firewood plantations over these areas. Presently, these lands are used as grazing lands. Growing firewood will be ecologically, socially and financially a better use of this land. The concept of free firewood is no longer viable. Firewood is collected from forest areas for sale and to provide livelihoods for many people. However laudable it may appear from a social perspective, India’s forests and the country’s environment cannot afford to continue with this system. Firewood plantation schemes can succeed only if grazing on these lands is stopped. The results of small trials of such plantations coupled with stall feeding of livestock have given encouraging results. Such examples are, however, very scarce and the money spent was far in excess of what was actually necessary. These trials can work as demonstration models of what is possible. The land ceiling laws will also require to be amended to exempt tree farming, as has been done for several plantation crops like tea, coffee, rubber etc.

2.4 TECHNICAL ASPECTS

Good firewood should have an air dry relative density of more than 0.6. The calorific values of different species do not vary a great deal. For most of the woody species the calorific values lie between 4,000 to 6,000 kcal per kg. Calorific value alone is not an indication of the firewood quality of any species. Several very light species like semal and poplar have fairly high calorific values but low density and therefore provide poor quality firewood. The wood should not produce sparks. It should not be oily otherwise it will produce soot. It should not produce any unpleasant odour.

Many species like oak, anogeissues and neem provide good firewood. Their leaves, however, are good fodder and are heavily lopped for livestock feeding. Such species should not be included in firewood plantation programs as repeated lopping will slow down their growth rates and potential productivity will not be achieved. Very successful firewood plantations have been raised in the past. Blue gum and wattle were successfully grown in the Nilgiri hills for meeting the firewood needs of Ooty. Casuarina and eucalyptus plantations have been raised in Karnataka to supply Bangalore and Chennai. Plantations of *Prosopis juliflora* were raised in several parts of UP, Andhra Pradesh, Karnataka, Haryana etc. and meet a large part of the firewood demand of these areas. In Karnataka the tile industry has shifted to areas where firewood is available. Plantation forestry is however a relatively high input economic activity. Optimization of the productivity from plantations established for production of wood becomes one of the primary objectives, and plantation management decisions like choice of species, provenance, genetic improvement, spacing, thinning, rotation age and other silvicultural treatments are directed to achieve the basic goal. Further, these decisions have to be based on the results of thorough research and sound planning. Planting a million hectares of trees is meaningless if seedlings do not survive, the quality of wood is poor and production is below the potential of the site.

2.5 MANAGEMENT OF FIREWOOD PLANTATIONS

Apart from care in raising plantations, it is essential to ensure that the plantations are managed so that the productivity of the site does not go down. Productivity of a site is maintained through the recycling of nutrients. In tropical countries, about 7 tonnes of biomass per hectare per year must be available for recycling for long term sustained yields. If biomass is removed from the site in the form of grazing, lopping or floor sweeping, the site productivity is sure to go down. Livestock grazing and firewood production cannot be sustained together on any site. The firewood plantations should preferably be of species that coppice. However, no species can be indefinitely managed under a simple coppice system. The crop should be replaced by *de nove* planting after one coppice rotation. It will be desirable to change the species at every fresh planting. This is essential in short rotation crops.

2.6 MARKETING

The marketing of firewood is a neglected subject in India except in certain areas around Chennai and Bangalore, where the marketing of casuarina is properly developed and is the main reason why private farmers plant this species on a large scale within 100 km of these towns.

H. C. Pereira (1996) states that “The basic first step, which many developing countries have yet to take, is to convince both villagers and legislators that the days of traditional gathering of nation’s fuelwood as a free good are over. Fuelwood must now be planted, tended and marketed as a crop”.

REFERENCES

Chaturvedi, A. N. (1989). Firewood Farming on Degraded Lands, UP Forest Bulletin No. 50.

Chaturvedi, A. N. (1994). Management of India’s Forest Resources, Khanna Bandhu, Dehradun.

Chaturvedi, A. N. (1986). Firewood properties of some forest species, UP Forest Bulletin No. 53.

Chaturvedi, A. N. and Behl, H. M. (1996). Biomass Production Trials on Sodic Site, Indian Forester, Vol. 122, No. 6, June 1996.

Forestry Statistics of India (1995). Indian Council of Forestry Research.

National Academy of Sciences (1980, 1983). Firewood crops Vol. 1 & 2, National Academy Press, Washington, D.C., U.S.A.

Pereira H.C. (1989). Policy and Practice in the Management of Tropical Watersheds, West View Press, London.

Pandey Devendra (1996). Tropical Forest Plantation Resources - SILVESTRIA II- Swedish University of Agricultural Sciences.

3. MATCHING TREES AND SITES

by

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3.1 INTRODUCTION

Whether the objective is to plant trees for timber, other economic products or wood fuel, it is important to know which species will be most appropriate for a given site and how it will perform. In fact we have been selecting species, both for agriculture and forestry, for decades based on our previous experience of their performance in their existing locations. The decisions, in a way, are subjective. For crops that are annuals the considerations are relatively simple as the crops grow only for a few months and one needs to concentrate and consider conditions during that time only. Another aspect is that the annuals have root systems that feed only at the top layer of the soil. However, this top layer can be manipulated by soil amendments, the addition of organic manure and even by the use of microbial additions. However, when we consider the selection of tree species the situation becomes much more complex. There are several parameters that need to be considered e.g. average rainfall, temperature, humidity etc as well as ranges and information on climatic extremes that may take place even only once in 10-15 years since the planted tree species may stay on the site for such a period. Soil conditions and soil properties also need to be considered in great depth.

When matching species and sites it is essential to consider:
1. The requirements of the species;
2. the climatic conditions of the site; and
3. soil characteristics.

If the above information is organized in a suitable digital format/files one can generate maps indicating sites which will satisfy the needs of any given species of tree.

3.2 REQUIREMENTS OF SPECIES

Species requirements can be identified by analysing the performances of the relevant species using the site-specific information available from different countries. Such information could also be generated for a provenance from various dependable trials that have been completed by foresters and researchers at agricultural universities. Such trials, in fact, contain very detailed information on growth rates, LAI, soil characteristics, various meteorological parameters, even chemical composition, nutrient uptake, etc. We may have to undertake a large-scale effort to gather such information that is available in the research literature and process it.

3.3 CLIMATIC CONDITIONS OF THE SITE

The Meteorology Department of the Government of India has a network of locations/stations where information on daily climatic parameters has been obtained over the years. These data are centrally collated, analyzed and published. It is possible to obtain such data for all the locations to develop a mean monthly climatic database using appropriate software. Such software is available and can be easily adopted for our use.

Parameters to be used**:**
Maximum temperature
Minimum temperature
Precipitation
Evaporation
Total radiation
Elevation
Dry season length
Mean maximum temperature of hottest month
Mean minimum temperature of coldest month
Rainfall regimes whether uniform, bimodal winter or summer.

3.4 SOIL CHARACTERISTICS

Parameters to be used:
Aeration - Stagnant or well drained
Base saturation - % cation exchange capacity CEC (Meq/100 g)
Depth
Nitrogen
pH
Phosphorus (available)
Potassium
Salinity
Slope
Texture (fine, coarse, etc.)

With the possibility of introducing several exotic species at available sites it is necessary to choose the right one. See Table 1 for an example of the different requirements of two Eucalyptus species.

Table 1: Requirements of Two Eucalyptus Species

Species	*Annual mean temp.*	*Min mean temp. coldest month*	*Max mean temp. hottest month*	*Annual mean ppt.*	*Dry season length*	*Absolute minimum temp.*
E. grandis	14-25	3-16	25-34	900-2500	0-6	-6-6
	18-25	5-18	23-30	1200-2200	2-6	
E. cameldulensis	18-28	6-22	28-38	400-2500	2-8	-3-6
	20-28	10-22	28-38	800-2500	2-6	

4. THE ROLE OF WOMEN IN WOODFUEL PROGRAMMES

by

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4.1 INTRODUCTION

The task of providing traditional energy supplies for domestic use is commonly the responsibility of women. General trends towards higher woodfuel prices, lower woodfuel quality and reduced access to wood-fuels increases their burden. Fuel availability and its price often have disproportionately negative implications for women, especially those of the lower income groups. They have as yet insufficiently benefited from several development schemes and research programs currently running in the country.

Women in villages spend most of their time collecting wood. In several cases, they travel several miles each day to collect wood. A good part of the day is wasted in this exercise. They are also exposed to smoke caused by burning wood in *chulhas*. This is worse when the wood is of poor quality.

4.2 USE OF WOOD ENERGY BY WOMEN

Wood energy is used by women for:

- Household maintenance;
- independent commercial activities such as firing pottery, food preparation for sale, intermediate processing etc;
- trading of woodfuel or charcoal.

RWEDP has initiated efforts to promote gender issues in wood energy planning among all energy planners. It supports these aims through the development of training materials which are designed to raise awareness of the need for gender analysis in energy planning, and through the dissemination of practical, operational tools for carrying out gender analysis and gender sensitive planning. Thus, the emphasis is not on special projects for women, but on providing general procedures for scanning and improving all wood energy projects, programs and policies. RWEDP promotes the use of these tools in wood energy planning organizations throughout the region by ensuring that suitable training is offered both at policy level and at implementation level, and will provide materials that can be used at national level for training field level workers.

We have surveyed a village in Lucknow for assessing wood-fuel requirements, consumption patterns and the problem of wood-fuel unavailability. Energy surveys in the country show that in an average village in a semi-arid region, a woman walks more than 1000 kilometers a year to collect firewood alone. The situation is much worse in arid, hill and mountain regions.

4.3 THE ROLE OF WOMEN IN WOOD ENERGY MATTERS

The following observations can be made about the role of women in wood-fuel matters:

- Women have to work for longer hours than men. Their responsibilities are producing food, cooking, taking care of the household and children, income generation through some means, and collecting fuel.
- Women's access to wood biomass is decreasing. They have to buy wood or travel long distances to collect it. Confronted with changes in fuel and biomass availability, rural households are being forced to make various adjustments that have negative effects on their living standards, work, food consumption and incomes.
- Lack of access to fuelwood leads to deforestation because women have to obtain wood from areas where it is not permitted or leads to cutting of trees which are not meant for fuelwood such as branches of fruit or timber tree species.
- When wood is not available, women use animal dung, thus depriving their fields of good fertilizers.
- In many places, crop residues such as *arhar* sticks and cotton sticks are being used increasingly for fuel. Crop wastes that can be used for mulching are being used to cook food.
- Use of poor quality wood effects the health of women and children.
- When women are away for fuelwood collection they are not able to work in the fields, resulting in loss of agricultural productivity.
- Women, particularly the poor, have rarely been involved in government or aid projects. They don't appear to have benefited from such support projects.

Serious efforts need to be made so that woman can benefit from the national and international programs and efforts for meeting woodfuel requirements in a sustainable manner.

5. STRATEGIES FOR ENERGY DEVELOPMENT

by

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5.1 INTRODUCTION

Energy is one of the key inputs for the growth of the economy. The Indian economy uses a variety of energy sources, both commercial and non-commercial.

The energy sector is both capital intensive and technology intensive and the demand for energy is increasing at a rapid pace. In order to meet the kind of demand now being anticipated in the next 15 years, a large financial investment, which the public sector may find difficult to raise, will be required. The private sector will need to help to meet the resource gap and supplement the efforts of the government in the development of this crucial sector of the economy.

The long-term development of the energy sector is fraught with a number of concerns of which environmental sustainability is the prime one. It is our endeavor to develop and use our energy resources in an environmentally sound manner. The strategy for energy development forms an integral part of the overall economic development strategy in India. Efficient use of resources and long term sustainability are two important objectives of economic planning. The concept of sustainability takes account of not only natural resource and ecological balance but also economic equity and self-reliance. Any strategy for energy planning has, therefore, to be consistent with these broad objectives.

5.2 POPULATION PERSPECTIVE

As per the 1991 Census, India's population was 844 million on March 1, 1991. About 26% of the population live in urban areas. The population of the four metropolitan cities of Delhi, Bombay, Calcutta and Madras accounts for nearly 4.6 per cent of the total population of the country. It is estimated that the population will cross the 930 million marks by the end of the current year.

5.3 RENEWABLE ENERGY POTENTIAL

A resource survey has indicated a large potential for use of the country's renewable energy sources. Table 1 gives the overall potential in the country:

Table 1: Potential for Renewable Energy in India

Sources / Technology	**Potential / Availability**
Biogas	12 million
Biomass	17, 000 MW
High Efficiency Woodstove	120 million
Solar Energy	5 x 100015 WHr/Year
Small Hydro	10,000 MW
Wind Energy	20,000 MW
Ocean Thermal	50,000 MW
Sea Wave Power	20,000 MW
Tidal Power	9,000 MW
Municipal & Industrial Waste	1,000 MW

Source : The Fuel Policy Committee (1974)

5.4 ENERGY PRODUCTION AND CONSUMPTION PATTERN

The changing pattern of energy supply in India can be realized from the fact that total energy supplies, including both commercial and non-commercial forms, increased from 85.1 Mtoe in 1953-54 to about 240 Mtoe in 1990-91. In this the share of non-commercial fuels has declined from 75 per cent in 1953-54 to 49 per cent in 1990-91. Fuelwood accounted for 65 per cent of the total non-commercial energy consumed in the country.

Amongst the indigenously produced primary commercial fuels, the relative share of oil and gas has increased from 1.2 per cent in 1950-51 to 32 per cent in 1990-91; whereas the share of coal has declined from 98 per cent in 1950-51 to 63 percent in 90-91.

Non Commercial Sources of Energy (Biomass only)

Biomass sources like fuelwood, agro-residues, urban/industrial waste and cattle dung met 38% of India's energy demand in 1993-94.

There are different fundamental forms of bio-energy use, but attention in India is always focused on bio-energy use in the traditional sector for household cooking and heating applications. Fuelwood has also been used for traditional applications in rural industries and for certain industrial applications in urban areas. Traditional industrial applications of wood include tobacco, tea, brick and pottery processing. Earlier, the biomass feedstock was available at a very low cost and, therefore, there was hardly any consideration for using it efficiently. No incentive was available for its conversion in an efficient fashion. Even a 25 per cent improvement in the fuelwood efficiency can mean a reduction of almost 40 million tonnes of fuelwood consumption.

Renewable Energy Potential

The REP program was slow to take off, but then picked up gradually with the passing years. A resource survey has indicated a large potential for use of renewable energy sources.

(a) Biomass. A vast amount of biomass material estimated at over 370 million tonnes every year is generated. On the basis of the assumed calorific value of different biomass, this amount is equivalent to around 250 million tonnes of coal. After taking into account the present patterns of use, it has been estimated that around 14,000 MW of power generation capacity can be sustained by use of such material. The goal earmarked for biomass based power by the end of 1997 is 500 MW.

A new program on bagasse based co-generation in the sugar industry has also been launched. As there are more than 400 sugar mills in the country, most of them can generate surplus power for the grid estimated at over 3,500 MW by upgrading their boiler pressures and improving their efficiencies.Urban and municipal waste material, both solid and liquid, offer a viable option for energy generation with attendant benefits of reducing the emission of greenhouse gases and minimizing environmental pollution. A potential of more than 1000 MW has been assessed through the bio-methanation route. Sixteen demonstration projects for sewage effluents, leather industry effluents, paper and pulp industry effluents, vegetable and municipal solid waste and biogas utilization based on indigenous as well as foreign technologies are planned.

(b) Biomass densification. Many of the developing countries produce huge quantities of agro residues but they are used inefficiently causing extensive environmental pollution. The major residues are rice husk, coffee husk, coir pith, jute sticks, bagasse, groundnut shells, mustard stalks and cotton stalks. A huge quantity of sawdust, a milling residue, is also available. Apart from the problems of transportation, storage, and handling, the direct burning of loose biomass in conventional grates is associated with very low thermal efficiency and widespread air pollution. The conversion efficiencies are as low as 40% with particulate emissions in the flue gases in excess of 3000 mg/Nm^3. In addition, a large percentage of unburned carbonaceous ash has to be disposed of. In the case of rice husk, a huge quantity of ash is generated every day in Ludhiana (Punjab) as a result of burning 2000 tonnes of husk. Briquetting of the husk could mitigate these pollution problems while at the same time making use of this important industrial/domestic energy resource.

Biomass densification, which is also known as briquetting of sawdust and other agro residues, has been practiced for many years in several countries. Screw extrusion briquetting technology was invented and developed in Japan in 1945. As of April 1969, there were 638 plants in Japan engaged in manufacturing sawdust briquettes, known as `Orgalite', amounting to a production of 0.81 MTY. The fact that the production of briquettes quadrupled from 1964 to 1969 in Japan speaks for the success of this technology. This technology should be differentiated from such processes as the `Prest-o-log' technology of the United States, the `Glomera' method in Switzerland and the `Compress' method in West Germany. Briquettes can be produced with a density of 1.2 g/cm^3 from loose biomass of bulk density 0.1 to 0.2 g/cm^3. These can be burnt clean and therefore are eco-friendly. Moreover, the advantages associated with the use of biomass are present in the briquettes.

With a view to improving the briquetting scene in India, the Indian Renewable Energy Development Agency (IREDA) - a finance granting agency - has financed many briquetting projects, all of which are using piston presses for briquetting purposes. But the fact remains that these are not being used efficiently because of their technical flaws and also due to a lack of understanding of biomass characteristics. Holding meetings with entrepreneurs at different levels, providing technical back-up and educating entrepreneurs have to some extent helped some plants to achieve profitability and holds out hope of reviving the briquetting sector.

6. ENERGY PLANTATIONS

by

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6.1 INTRODUCTION

It has been suggested that the solution to the fuelwood problem is to find an alternative energy source for the developing countries. Unfortunately, there is no alternative source of energy that could provide a viable substitute for fuelwood.

The best alternative to fuelwood is more fuelwood. Wood plantations can take many different forms and provide many different advantages. As well as yielding fuel, they can help provide timber for homes and village industries, restore fertility to the land, halt desertification, prevent soil erosion, reduce flooding, provide animal forage and improve the climate. No other alternative form of energy can offer such a broad prospectus.

Wood remains, so far, a cheap and renewable form of solar energy. Wood energy can provide a soft transition from a traditional economy and technology to a more advanced one. Fuelwood and charcoal have many positive features as sources of commercial energy. They are ideal, of course, for providing both process heat and shaft power for forest industries – saw milling, chipping, panel production and pulp and paper making, for example. In most cases these industries can now be run more profitably off forest energy than they can off fossil fuel. Secondly, there are many small-scale, predominantly rural industries where fuelwood or charcoal can provide a convenient source of heat. These include crop drying, brick making, and pottery firing, lime production and even the manufacture of cement. Thirdly, forest energy is also used extensively in heavy industry, notably in mineral smelting where charcoal is the preferred fuel. Finally, the use of fuelwood and charcoal for electric power production is being intensively investigated.

6.2 NEED FOR INTEGRATED SOLUTION

Solving the fuelwood problem cannot be conceived as an isolated issue, separate from related problems of rural development, agricultural production and environmental stabilization. The effective solutions will be those that include energy forestry as part of a more general development strategy, and which reap all the rewards which trees can offer, including the supply of fuel. Solving fuelwood problems in this way may need some preparation:

- Initially, more research may be needed, for example, into fuelwood demand patterns in certain areas or into the most appropriate tree species for use in replanting schemes.

- Demonstration projects may need to be arranged to ensure the full participation of local people. The MNES encouraged and provided funds for several demonstration energy plantation projects under the EPDP (Energy Plantation Demonstration Program).
- Extension workers will need to be trained so that they can instruct villagers on plantation techniques and forest management. Many rural dwellers have become hostile to forestry institutions. Altering this situation by participatory management must be a major goal in any fuelwood program.
- A particularly important area is the preparation of case studies of successful fuelwood production schemes.

6.3 WOODFUEL PROGRAMS

The following major strategies can be adopted in woodfuel programs:

a. Creating new fuelwood resources: Planting stands of fast-growing trees presents no serious technical problem. In many areas new plantations can start to yield fuelwood within a few years. It involves no foreign exchange costs, provides a multitude of other advantages and should eventually become financially self-supporting. Generally, plantations need not compete for land with other agricultural practices. If 2-5 percent of available land is planted with trees, there need be no net loss of agricultural production; in some areas tree planting actually increases food production.

b. Improving fuelwood distribution: A key factor in the price of fuelwood and charcoal is the distance over which it must be transported to the user. FAO studies indicate that fuelwood cannot be transported economically over distances of more than 100 km but that the limit for charcoal is in the region of 800-1000 km. There is an urgent need to organize and increase the efficiency of the fuelwood industry by such means as establishing marketing cooperatives, price structures and improved storage facilities. Distribution is often the key to satisfying the demand for fuelwood.

c. Improving conversion technologies: There are three possible ways of improving the efficiency with which fuelwood and charcoal are used and made. These are: (1) pre-processing the fuel - by pressing it into bundles, for example; (2) increasing the efficiency of charcoal production; and (3) the large scale dissemination of efficient woodstoves combined with efforts to improve cooking efficiency. An efficient wood stove can produce fuel savings of 30 per cent or more for a small cost.

d. Need and resource assessment: It is essential to assess the fuelwood situation in the country. On the basis of this and other information, recommendations on how best to reduce future shortages can be made.

Increase in biomass productivity can not be achieved by the isolated efforts of certain NGOs or farmers. It can be achieved by setting up clear goals, by the participation of intermediaries and end users, and by the adopting principles of sustainable development. The following are some of the components of this integrated approach:

- Production of fuelwood will have to become a major goal of national forestry policy.
- Efforts should be made to reconcile the conflicting demands of preserving forests for timber production and providing fuelwood for local people.

- Efforts should be made to provide local people with access to fuelwood resources and stimulate them to become involved in forest management and control.
- Efforts should be made to help local people manage their own fuelwood resources. Sustained yield management practices must be adopted to stimulate forest biomass production.
- The fuelwood potential of existing resources must be surveyed and publicized.
- Introducing scientific forestry practices can ensure high and sustainable yields.

6.4 Need to End Free Distribution of Fuelwood

Most rural dwellers have always regarded fuelwood as what economists call a free good – something, which costs only the labor of carrying it from the forest to the hearth. Free fuelwood can not be shared by all. Neither can all that is needed be supplied. Some take more and others take less out of a free distribution system - this can not be accepted in a civilized society.

However, current fuelwood shortages are at least beginning to make one important point clear: if fuelwood is to be continuously available within reasonable distances and at reasonable cost, it must be planted, managed, harvested, distributed and sold.

Urban dwellers, on the other hand, have rarely regarded fuelwood as a free commodity. They have had to buy both fuelwood and charcoal in the market place. As supplies have become scarcer, and as wood and charcoal have had to be carried further, so prices have risen.

Over the next few years the supply of rural fuelwood will become increasingly commercialized and the concept of firewood as a free good will disappear. Not only is this inevitable, it is desirable, despite the excessive profits that may be exacted by rapacious middlemen, and despite the difficulties which inflexible bureaucrats may introduce. A properly organized system for the distribution and sale of fuelwood will do much to protect the rural poor from exploitation by the urban middle classes.

The sale of fuelwood is often an important source of income for the rural poor and in India studies have shown that it is usually the poorest, the landless and the jobless who depend on selling firewood. Many of those who now have to travel long distances to collect fuelwood do so not only to provide fuel for the home but also to provide modest cash incomes as well. The danger is that the urban centers, with their huge appetites for fuel and their abilities to offer cash for payment, will ultimately deprive rural dwellers of the trees on which they depend for their own energy. New fuelwood plantations must be supported by a formally organized fuelwood industry. Marketing cooperatives and associations need to be organized, a price structure worked out and storage facilities established so that stocks can be accumulated to satisfy demand when supply is low.

The production and marketing of charcoal is already a commercial business in most countries, and one which is now likely to expand significantly because it is economic to transport charcoal over much greater distances than are viable for wood.

7. WOOD ENERGY

by

H. M. Behl
National Botanical Research Institute, Lucknow, India

7.1 INTRODUCTION

In the next century wood will be a major source of energy for a great variety of uses. These include as domestic fuel, for power generation, electricity generation, charcoal making, ethanol production, carbonization, gasification, the production of activated carbon, carbon adsorbent production, wood residue briquetting, wood fuel mixes, the production of essential oils, phytochemical specialties and the chemical modification of wood. This latter includes the production of phenol- and urea-formaldehyde resins using lignosulphonate residues. An integrated wood energy program also includes dyes and adhesives from woody materials, tannins, wood fibre and feed.

7.2 ARGUMENTS FOR ENERGY AND INDUSTRIAL USES OF BIOMASS

As we enter the 21st century, the utilization of wood residues and the sustainable wood production for energy and chemicals are essential practices if we are to make efficient use of the forest resource in perpetuity. There is an urgent need to shift from fossil to renewable energy resources to make fuel easily available. This shift will reduce the threat of global warming caused by greenhouse gas accumulation from the combustion of fossil fuels.

Biomass from farms and forests as well as from organic household waste is a source of energy (heat, fuels, electricity, etc.) and is a renewable raw material. Large-scale biomass production and its use could:

a. Open markets for the forest industry and agriculture: The prospects for outlets in the energy and industrial sectors represent a big hope for farmers faced with new challenges.
b. Prevent the greenhouse effect: Carbon dioxide emissions into the atmosphere would be diminished because carbon would be stored in the forests and biofuels would be substituted for fossil fuel energy.
c. Reduce the volume of waste that is saturating our society.
d. Create employment: Developing local resources would lead to decentralized employment, notably in activities related directly and indirectly to agriculture. In addition biomass, which is present throughout the country, would be distributed directly by the local governments.
e. Promote a better balance in town and village planning: Biomass for non-food uses would become an alternative to conventional forms of energy.
f. Reduce dependence on oil.

7.3 CONSTRAINTS

a. Biomass production has not been taken up in the form of exclusive biomass plantations or farms.

b. Integration of biomass production with agriculture and farm forestry has not been pursued aggressively.

c. There is no wood fuel market.

d. NGOs or co-operatives are not actively involved.

e. A business plan has not been prepared.

7.4 SUGGESTIONS

a. Integrate biomass production with farm forestry and agroforestry.

b. Involve landowners, biomass producers, converters and users (and intermediaries if any).

c. Involve various ministries to make the program effective.

d. Intensively monitor and plan in the initial years.

e. Organise business meetings and training to develop entrepreneurs.

f. Formulate business plans for states or smaller units.

g. Classify R&D as contract research, long time research, and monitoring and consultative assignments.

h. Integrate activity at Biomass Research Centers (BRCs to become nodal centers to monitor programs directly, and to be made more resourceful).

i. Provide subsidy, incentives, market linkages, co-ordinated feedback and training to entrepreneurs.

j. Create "biomass for energy” identity for generic biomass.

k. Accurately assess current & future biomass supply & demand.

l. Establish a national energy database, based on periodic/seasonal surveys.

m. Reorient government agencies (such as forestry, agriculture and other agencies) more towards an emphasis on energy.

n. Compile/update data on shrubs.

o. Establish further linkages between RWEDP & national agencies.

p. Build institutional linkages to each agency involved in wood energy and clearly define their responsibilities.

q. Standardize terminology, techniques & methods (region-wise).

8. THE HEALTH OF FUEL WOOD PLANTATIONS

by

B. P. Singh
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8.1 INTRODUCTION

Fuel wood trees and shrubs are gaining importance in agroforestry systems due to the acute scarcity of fuelwood in the domestic sector, and the commercial potential for its conversion into non-conventional forms of energy. The productivity of these trees is adversely effected by pathogens (see the following charts). This presentation deals with the short term and long term causes of biotic or abiotic stress and their management. Proper management can influence the productivity of tree plantations. An integrated system of health management in wood fuel plantations is emphasised.

8.2 HEALTH AND HEALTH MANAGEMENT

Health Promotes Productivity
• It is crucial at pre-planting stage
• It improves crop life
• It checks symptomless carriers

Agents Causing Ill Health
Biotic
• Bacteria
• Viruses
• Nematodes
• Insects

Abiotic
Water Stress
Excess Water
Poor Physical/Chemical Abiotic Stress

Measures to Check Abiotic Stress
• Water Management
• Cropping System
• Soil Physical Handling
• Management Practices with State-of the-Art Techniques

8.3 FUNGAL DISEASES

Pathogen	Disease	Trees Affected
Rhizoctonia Solani	White Web	Cupressus Macrocarpa
Fomitopsis Cajanderi	Wood Decay	Populus & Pinus
Phellinus Pini	Wood Decay	Populus & Pinus
Sphaeropsis Sapinea	Canker	Pinus
Botryosphaeria	Die Back	Eucalyptus
Dothidea		
Verticillum Dahliae	Wilt	Dalbergia Sissoo
Phytophthora	Root Rot	Alder
Cambivora		
Phyllactina	Powdery	Dalbergia Sissaoo
Dalbergiae	Mildew	
Fusarium Semitectum	Wilt	Robina
Taphrina Padi	Fruit Gall	Prunus Padus

Fungi Associated With Prosopis Spicigera
Aspergillus Botryotrichum Cladosporium Fusarium Popularia (Apiospora) Penicillium Pollularia (Auerobasidium) Rhizopus Trichsperma

8.4 COMMON BACTERIAL DISEASES

Pathogen	Diseases
Bacillus Amylovorus	Fire Blight
Agrobacterium	Crown
Tumefaciens	Gall
Pseudomonas Citri	Canker
Pseudomonas Seminum	Black Rot
Bacillus Racheiphilus	Wilt
Bacillus	Wilt
Phytophthorus	

8.5 NEMATODE DISEASES

Pathogen	Diseases
Meloidogyne	Gall
Incognita	
Heterodera	Golden
Rostochiensis	Disease
Trichinella Spiralis	Gall
Anguillula Dispsaci	Gall

8.6 MAJOR INSECTS

Type	Insect
Aphids	Myzus persicae & Aphis gossypaii
Mealy Bugs	Planococcus species
Whitefly	Bemisia tabaci
Leaf Hoppers	Circulifera tenella, Graminella nigiforus & Nephotellis cincticeps
Thrips	
Beetles	Lema species & Apion species
Mites	Tetranychus urticae & Aceria tulipae

8.7 CONCLUSIONS / RECOMMENDATIONS

- Health of the plants is crucial for commercialisation of wood
- Health management should be rural oriented
- Health of plants promotes good crops & healthy environment

9. The Involvement of Women in Wood Energy: A Case Study

by

V. L. Goel, Jyoti Misra and H. M. Behl
National Botanical Research Institute, Lucknow, India

9.1 Introduction

Fuelwood is the major source of energy for cooking in rural areas. Fuelwood is collected from the forests, village plantations, and other nearby sites mainly by women and children, with the result that other household chores are completely neglected. Women have no time to look after the children, improve sanitary conditions or participate in developmental activities. Children, the future citizens of the country, have no time to go to schools. The increasing trend of illiteracy can be traced back to this one single factor. It has been observed that wood has to be brought by women and children on head, shoulder or back, thereby causing a variety of chronic ailments. The problem is much more acute in hilly areas where deforestation has been taking place at an accelerated pace and the collection of wood causes acute fatigue due to the difficult terrain.

9.2 Fuel Consumption in Rural Households

A survey of fuelwood consumption patterns in Ramchaura village in Banthra district, Lucknow was carried out. A total of fifty families were selected randomly out of approximately 500 families residing in the village. A suitable questionnaire was prepared for interviews and survey. The details of the data related to fuel wood consumption patterns and per capita fuel requirement of village households are given in Table 1.

9.3 Collection and Storing of Wood

Data in Table 1 show that there were three major means of obtaining the fuel:

- Local collection of fuel from the roadside, nearby fields or forest plantations;
- Purchasing of wood from sellers; and
- Collection of wood from their own fields or farms.

32% of families were able to purchase wood from sellers, 24% gathered it locally, while another 24% were farm/land holders and collected fuel from their own fields. Some families (20%) collected fuel (wood and agriculture residue) from agricultural fields as well as purchased from the market as and when needed, depending on their requirements. Wood is commonly purchased from wood loaded carts in the village in the form of fuel bundles. Sometimes wood was also purchased from fuel merchants or government departments.

Table 1: Mode of Collection of Fuel

Source of fuel	No. of families surveyed	Percent
Own fuel	12	24
Purchase fuel	16	32
Gather fuel	12	24
Own+Purchase	10	20

9.4 EXPENDITURE ON FUEL

The cost of fuel varied from season to season. On average, fuel rates were Rs 80 to 125 per quintal for wood and thick branches and Rs. 60 to 75 per quintal for twigs. In some families (4 %) members were engaged in gathering and selling the wood as a source of their daily income. In families engaged in petty labour jobs, women get wood fuel or agriculture wastes from the employer (farmer). It is either free of cost or deducted from their wages.

The study revealed that the wood fuel consumption pattern depended on several factors such as the size of a family, season, and availability of wood including other alternatives such as animal dung (*upla*) and agricultural residues (*arhar* and cotton sticks and other waste). On average, the consumption of wood in a village was 0.9 to 1.22 kg per capita per day.

9.5 COST OF FUEL

The fuel sources consisted of twigs, wood shavings and saw dust. Common species used for fuelwood were acacia, prosopis, leucaena, eucalyptus, mango, neem etc.

Table 2: Cost of Fuel of Different Types

Fuel source	Cost (Rs.) per quintal
Wood and thick branches	80 to 125
Twigs	60 to 75
Arhar stalks & other agricultural waste	30 to 40

9.6 MEAL PATTERN

Most families (54 %) prepared meals twice a day. Twenty- percent households prepared snacks apart from these two meals. About 26 % of families (those classified as "relatively poor families") prepared only a single meal or they obtained their food from their employer at their place of work. These employers are usually rich farmers who have bigger kitchens.

The time spent on cooking ranged from one to three hours. On an average 3 to 5 kg fuel was consumed daily for cooking.

Table 3: Meal Pattern in Selected Families

Duration	Families	% surveyed	Time spent* (hrs)
Once	13	26	1.5 to 3
Twice	27	54	2.5 to 4
Twice + Snacks	10	20	4.5 to 6

***** Number of members in a family varied from 4 to 12.***

9.7 RESEARCH NEEDS

Very few surveys of India's villages have been carried out to ascertain the real needs, problems and issues involved in use of wood fuel. Most of the reports are very superficial and are based on common sense and secondary data.

Using fuel wood for cooking and heating creates indoor pollution that has adverse effects on human health, particularly the health of women and children. Wood burning stoves need improvements so that they consume energy more efficiently and emit less pollution. The emission of smoke, particularly from *chulhas* and ovens, directly affects the health of the stove users and needs immediate attention.

Wood-fuel species selection is very important if one wishes to investigate the amount of energy and the nature of smoke produced. A detailed study needs to be undertaken on the species used, their heat efficiencies and the ill effects they may cause to the users.

APPENDICES

Appendix 1: Course Programme

December 2, 1996

Morning (Taj Hotel)

09.00 - 10.30	Opening ceremonies and introduction of the participants

About the course:	Dr. H M Behl
Keynote address:	Dr. Tara Bhattarai
Policies & commitments:	Dr. N P Singh
Inaugural address:	Dr. P V Sane

10.30 - 11.00	Inaugural tea
11.00 - 13.00	Introductory session
13.00 - 14.00	Lunch break

Afternoon session (NBRI)

14.00 - 16.00	Session I: Wood-fuel in agriculture & farm forestry
16.00 - 17.00	Group discussion: Opportunities & constraints
19.00 - 20.00	Welcome dinner

December 3, 1996

09.00 - 13.00	Session II: Issues in the trading and marketing of wood-fuel
13.00 - 14.00	Lunch break
14.00 - 17.00	Field visit to depots, forest corporation & traders
17.00 - 18.00	Comments on the field visit

December 4, 1996

09.00 - 13.00	Session III: Wood fuel utilization
13.00 - 14.00	Lunch break
14.00 - 16.00	Session IV: Case Studies
16.00 - 18.00	Session V: Preparing proposals for state level training

December 5, 1996

09.00-11.00	Session VI: Presentation of reports & group discussion
11.00-13.00	Classifying & identifying training material
13.00-14.00	Lunch Break
14.00-16.00	Group discussion & presentation of recommendations
16.00-17.00	Closing ceremony
18.00-20.0	Farewell dinner

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APPENDIX 3: FIELD TRIP

Information Proforma # 1

<u>To be completed during the field trip</u>
Who are the customers?
Number of customers attended per unit time
Nature of the customers (individuals/traders/others)
Customers' demands
Constraints
Policies
Extension/training for customers
Suggestions

Information Proforma # 2

<u>To be completed during the field trip</u>
Total Wood Production
Is production effort integrated with marketing?
Comments
Constraints
Suggestions

Woodfuel Marketing
Observations on trade
Volume of trade
Species traded

Constraints

<u>Do you find gender a factor involved:</u>

(a) in marketing? Yes/No % involvement
Remarks
(b) in processing? Yes/No % involvement
Remarks
(c) in production? Yes/No % involvement
Remarks

Field trips

<u>Sites to be visited:</u>

1. Private wood fuel depot
2. Chinhat Training Institute of NEDA, UP
3. A Brick Kiln

APPENDIX 4 : PROPOSAL FOR AN INDIAN REGIONAL TRAINING COURSE ON FUELWOOD PRODUCTION AND UTILIZATION

BACKGROUND

Fuelwood is the most common and popular source of energy in India for cooking, space heating, etc., especially in the rural areas. However, population pressure, both human and cattle, coupled with the present state of India's forests have created a wide gap between the demand for and the supply of fuelwood. The present consumption is about 250 million tonnes against the sustainable yield of about 87 million tonnes. Consequently a sizeable population in the country is facing a fuelwood scarcity. It is predicted that by the turn of the century more than 300 million people in the developing countries of the world may have enough food grain but not sufficient fuelwood to cook it.

Fossil fuel reserves are also decreasing rapidly. In these circumstances, renewable fuel sources like forest biomass have a critical role to play in the future sustainable supply of energy. Fuelwood plantations and the efficient utilization of fuelwood are important means of providing an alternative to conventional energy sources. Fortunately, the required technological interventions are already available.

In India, there are several million hectares of wastelands with enormous potential for the production of bio-energy crops on a commercial scale and for reversing the process by which such wastelands have developed. Many agencies and organizations would, however, need to be involved to ensure that land is available for energy plantations and to implement plantation programmes. To effectively co-ordinate the work of the various agencies or organizations and promote their mutually beneficial co-operation, suitable training of the key persons at regional level is essential. Once trained such personnel will, in turn, train the district level agencies/people to motivate and guide the farmers, industries, etc. in the production and efficient utilization of fuelwood. This will help in meeting the people's fuelwood requirements and may also provide a secure economic base for them under a decentralized wood production system.

The target group of this training proposal is key persons involved in the woodfuel business at regional level. The goal is to enhance the production of fuelwood in community/farm lands and ensure its efficient utilization. This will be accomplished by organizing regional training courses.

OBJECTIVES

- Focus on regional issues related to fuelwood production.
- Train personnel to cultivate and manage fuelwood plantations.
- Train personnel to distribute and utilize fuelwood efficiently
- Improve capabilities of participants to organize district level training courses.

PARTICIPANTS

Participation will be by nomination only. Nomination of the key persons will be made by the Ministry of Environment and Forests and the Ministry of Non-Conventional Energy Sources and their nodal agencies, State Forest Departments, Agriculture Departments, Non-governmental Organizations, Industries, Regional Biomass Research Centers, and other agencies involved in fuelwood production, marketing and utilization. The course will be conducted for the representatives from the three northern states of Delhi, Haryana and Punjab. A total of 40 participants will be trained in the proposed program.

CO-ORDINATING AGENCY

The course will be organized by the Tata Energy Research Institute (TERI), and it is proposed to be held in New Delhi with financial assistance from the Ministry of Non-Conventional Energy Sources, Government of India.

PROGRAM DETAILS

The training course will last four days. Resource persons on various aspects of fuelwood production will devote the first two days to lectures followed by group discussions. During the other two days participants will be exposed to practical and field demonstrations of energy plantation models, wastelands development and various renewable energy interventions.

TOPICS OF DISCUSSION

Discussion will mainly be on how to co-ordinate and integrate the activities of various agencies, and also on the modalities of enhancing fuelwood production and its efficient utilization. Discussion will also involve major issues related to the participants envisaging raising fuelwood plantations and infrastructure developments. As such, the following major issues will be discussed in detail: the fuelwood situation in the region and the major issues related to its production and utilization; the trend and current land availability for fuelwood production; content of the training materials and modus operandi of training the district level persons; co-ordination of activities of the various agencies related to fuelwood production and utilization; modus operandi of technology transfer and peoples' participation for fuelwood production; and any other topics highlighted by the participants.

TRAINING METHODS

- Lectures by resource persons
- Group discussions
- Distribution of training materials
- Practical and field demonstration

OUTPUTS

- A classification and prioritization of the major issues related to fuelwood production and utilization
- The production of training materials
- Enhanced capability of participants to organize similar training courses
- Plans for the district level training will be completed.

DATE AND VENUE

The program is non-residential and tentatively scheduled for the first week of April, 1997 at the Habitat Place, Lodi Road, New Delhi - 110 003 and at Teri's Field Station at Gual Pahari, Gurgaon (Haryana).

RESOURCE PERSONS

Highly skilled and experienced persons will be drawn from the government, research institutes and industrial sectors to conduct the training which may include Mr. SK Panned (mooed), Dr. N.P. Singh (MNES), Dr. Pradeep Chaturvedi, Mr. S.K.Dhar (HFD), Mr. Pyare Lal (Industry), Dr. Pradeep Monga (UNDP), Dr. V.V.N. Kishore, Mr. P.V.Ramana and Dr. S.P.Banerjee (TERI).

CONTACT PERSON

The contact person and local organizer for the course will be:
Dr. J. S. Rawat,
Tata Energy Research Institute,
Habitat Place, Lodhi Road,
New Delhi - 110 003.
Phone: 462 2246 or 461 1550;
Fax: 462 1770 or 463 2609
Email: mailbox@teri.ernet.in

BUDGET

The expenditure per participant will be Rs. 5000/- inclusive of the training materials, etc. There will be about 40 participants and, as such, a total of Rs. 200,000 will be required for organizing the course in New Delhi.

JUSTIFICATION

In spite of many programs of fuelwood production through social forestry, farm forestry, etc., no significant impact on this aspect is evident in India so far. This may be due, in large measure, to lack of institution building and involvement of people in the raising and management of fuelwood plantations. As such, the major issues related to technology, infrastructure, land availability, etc. need to be sorted out for the successful implementation of the program over and above conducting more vigorous demonstration and awareness building activities among the people. Training of the key persons for organizing similar training courses for fuelwood production and utilization will help guide the farmers, industries, etc. to grow more and more fuelwood and utilize it efficiently. This will not only bring about a revolution in the fuelwood situation but also will help to provide an economic base for the people in addition to providing a solution to their energy needs.

Tata Energy Research Institute has been working in these important areas for many years and has developed an appropriate technological package, and has the infrastructure and logistical supports to organize the course.