RWEDP Report No.44

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

WOOD ENERGY PLANNING

STUDY TOUR IN INDIA

23 October - 5 November 1995

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Bangkok, July 1999

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

WOOD ENERGY PLANNING

STUDY TOUR IN INDIA

23 October - 5 November 1995

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Bangkok, July 1999

Published by
the FAO Regional Wood Energy Development Programme in Asia,
Bangkok, Thailand.

For copies write to: Regional Wood Energy Development Programme in Asia
c/o FAO Regional Office for Asia and the Pacific Tel: 66-2-280 2760
Maliwan Mansion, Phra Atit Road, Fax: 66-2-280 0760
Bangkok, Thailand. E-mail: RWEDP@fao.org
Or visit our website: http://www.rwedp.org

FOREWORD

National energy planning is generally concerned with conventional fuels like coal, gas and oil products, and electricity. The need to incorporate wood and other biomass fuels into energy planning is often not fully recognised by decision-makers, even when such fuels constitute a substantial part of the national energy balance. In most countries in Asia, woodfuels are an important energy source, particularly for the rural poor, and woodfuel use has important implications for public sector interests such as the environment, public health, rural development, employment and foreign exchange.

The neglect of woodfuels in energy planning may be explained by the generally held beliefs that woodfuels are widely available, that they are locally collected for free, that no woodfuel data are available for use in the planning process, and that one should move away from using woodfuels. Such beliefs, which are often implicit, are neither based on facts nor on a proper understanding of the roles and potentials of wood and other biomass energy.

However, there are real constraints to wood energy planning in many countries such as problems of inter-sectoral and institutional co-ordination, as well as limited expertise in planning methods and models that are applicable to the wood energy sector. Amongst the institutional constraints is that relevant information is often spread over many different sectors such as energy, forestry and agriculture, and is collected by numerous survey institutes and statistical offices.

The study tour on Wood Energy Planning in India considered these issues along with the approaches developed and practised in India to overcome the constraints. The visits and discussions provided a meaningful and interesting experience for the participants from RWEDP member countries. The study tour was organised by the Ministry of Environment and Forests in co-operation with the Ministry of Non-conventional Energy Sources, with support from RWEDP.

RWEDP is grateful to the organisers and individuals who facilitated the study tour. Special thanks are due to Mr. Conrado Heruela, Wood Energy Planning Specialist at RWEDP, and Dr. Pradeep Chaturvedi who advised the study tour organisers.

Dr. Willem S. Hulscher
Chief Technical Adviser
FAO / RWEDP

TABLE OF CONTENTS

1. INTRODUCTION

Wood energy will continue to contribute significantly to the energy supply of many countries. Wood energy use today can be technically efficient, economically viable, and environmentally safe, and effective strategies are available for managing and utilising wood energy resources on a sustainable basis. Moreover, wood energy can be transformed into a "modern energy source - a clean and convenient fuel" of the future.

Yet, the feasibility and desirability of wood energy strategies as a component of national energy programs is not fully appreciated. This lack of appreciation stems primarily from incomplete or inadequate understanding of wood energy systems that comprise the production, collection, processing, transportation, distribution, marketing, and utilisation of woodfuels. Indeed, this lack of knowledge is the root of institutional and organisational weaknesses that constrain the formulation of right policies and implementation of appropriate strategies to fully tap the potential of wood energy.

Inadequate understanding of wood energy systems is due basically to an inadequate wood energy information base. This situation hinders the integration of wood energy into macro energy planning and puts wood energy concerns on the sideline. If wood energy is ever incorporated into energy planning and policy formulation activities, no proper assessment of wood energy strategies can be made because data are not available. Moreover, existing methodologies and analytical tools for energy planning have a bias against traditional sources of energy, and institutional factors such as weak agency linkages (which constraints information exchanges), inadequate or lack of expertise, and political intervention undermine efforts to include wood energy in the planning process. The result is that any strategies for wood energy development are weak and ineffective.

RWEDP, since its inception, has sought to address this situation. Its aim is to assist member countries (now numbering 16) to develop their capabilities to effectively integrate wood energy into national energy planning processes, including forestry, agriculture, and rural development planning activities. Specifically, RWEDP helps member countries develop their capabilities to collect and process wood energy data, build up a wood energy database, and adopt appropriate modelling techniques and computing tools that aid strategy and policy formulation. All this is achieved through seminars, workshops, country case studies, fellowships, and internships. Study tours have played an important role in these group activities and the study tour in India was no exception.

India is one of the few countries in the world that has addressed wood energy planning and the development and implementation of wood energy policies and strategies as part of its national energy program. However, like the other countries, India's wood energy programs are incorporated into rural energy development, with certain activities also linked to forestry development. Thus, a look at wood energy development programs in India will essentially be a look at its rural energy and forestry development programs.

Nevertheless, the information base and institutional structures for rural energy development in India continue to evolve and greater emphasis is now being placed on the creation of new (energy) markets where wood and other decentralised renewable energy systems could substitute centralised (conventional) energy sources. Because of this trend, the need for a decentralised, area-based planning process has been recognised. The institutional base for project formulation and implementation is being widened to accommodate the private

sector, non-governmental organisation (NGOs), and the rural communities themselves. Measures are being taken to improve the knowledge of end-users and to provide them with front-end financing. Human resource capabilities are also being developed and enhanced to be able to undertake a scaled-up technology diffusion program.

In the agriculture and forestry sectors, several governmental and non-governmental organisations are involved in data gathering and management. For example, a national agency gathers and regularly publishes crop production and crop residue statistics, and forest departments have been established in various states and union territories to compile and maintain databases on forest resources.

India, therefore, is in a position to share not only raw information but also substantial knowledge and experience with respect to data assessment and analysis for wood energy planning and the other aspects of implementing wood energy programs. The country provides a wealth of experience from both successful activities, which can be emulated, and failed attempts, from which lessons can be learned. The wood energy situation in India, a vast and populous country, varies across the land and can be representative of the various conditions found in the different countries in Asia.

The general objectives of the study tour were: (1) to present India's experience in data assessment and analysis for energy planning, and (2) to demonstrate the initiatives undertaken by the country in integrating wood energy into national and decentralised energy planning.

Specifically, the study tour aimed to facilitate the exchange of information, knowledge, and experience between the participants and the host country and among the participants themselves and offer an opportunity to the participants to gain first hand experience of the following aspects of planning activities in India:

1. Institutional and organisational set-ups for planning and management of energy, forestry, and other relevant programs, particularly those dealing with wood energy systems;
2. methods and techniques for collection, analysis, and organisation of data, particularly wood energy data, for planning purposes;
3. planning techniques, that is, modelling and other analytical methods used; and
4. problems, constraints, and other limitations encountered.

The main target participants of the study tour were key officials of energy planning units of member countries who are in a position to initiate changes in their country's energy planning process so as to accommodate wood energy concerns. Targeted also were officials from forestry and agriculture planning units and from economic planning bodies who are in a position to initiate changes in the planning process to create linkages with wood energy planning. Thus, RWEDP invited two participants from each member country based on these criteria.

The study tour consisted of two weeks of hectic visits to various government agencies, project facilities, and research centres in Delhi, Dehradun, Hyderabad, Bangalore, Lucknow, and Agra. In between and during these visits, participants attended brief seminars on various topics related to wood energy planning. The purpose was to blend theory and the practice that was observed or learned during the field visits. The study tour was capped with an action plan for India to follow up on the lessons learned from the study tour. Moreover, the participants went back to their home countries with recommendations to develop their own capabilities in wood energy planning.

As always, this activity would not have been possible without the co-operation and help of many individuals and organisations. RWEDP is deeply grateful to the Government of India for hosting the study tour. Special thanks are due to the Inspector General of Forest of the Ministry of Environment and Forests for co-sponsoring the activity by providing the necessary logistical support. RWEDP also appreciates the co-operation of a number of organisations in India, which lent their expertise and facilities during the field visits and seminars. Finally, RWEDP thanks the participants for their very active contributions and the organisations they represent for allowing them leave of absence to attend the study tour. Needless to say, the only real test of the success of the study tour is the extent to which the participants are able to apply the knowledge and experience gained from this study tour in their work.

2. COUNTRY BACKGROUND

India is a very large country with a land area of more than 3.28 million square kilometres. It is one of the five countries in South Asia (the other four being Nepal, Pakistan, Bangladesh, and Sri Lanka). With a population of more than 920 million in 1996, India remains the second most populous country in the world (after China, whose population was about 1.2 billion in 1996). Population growth in India is around 2% per annum.

The people of India are distributed in 26 states and union territories, the largest of which (in terms of population) is Uttar Pradesh (with a population of 153 million) which is located in the north of the country. Delhi, the nation's capital, is located farther north and has a population of 11.3 million in 1996.

India is a poor country. More than 74% of the inhabitants of the country live in rural areas. Like most countries in the region, the Indian economy continues to rely heavily on agriculture even though its share declined from 35% in 1985 to 29% in 1994. During this same period, India's economic growth rate of 5.1% real gross domestic product (GDP) was lower than that of Thailand (9.6%), China (8.5%), Indonesia (7.7%), Malaysia (7.5%), Bhutan (6.5%), Maldives (8.7%), and even Pakistan and Cambodia (both at 5.3%). Fortunately for India, it was able to exceed 6% after 1994, thanks to the high growth in the manufacturing sector.

This economic growth brought about a slightly faster rate of increase in energy consumption. Commercial energy consumption grew at 6% per year between 1985 and 1995. Despite this relatively high growth rate, the per capita commercial energy consumption of 9 gigajoule (GJ) was way below the world average of 60 GJ.

Industry was responsible for nearly 50% of commercial energy consumption in 1994/95. Transport was second with 22%, followed by residential consumers with 10%. It should be noted, however, that these numbers do not include consumption of traditional or non-commercial energy sources.

Information on traditional energy is scanty. For instance, the national energy balance of India published by the Tata Energy Research Institute does not include traditional energy sources. It is estimated, however, that traditional energy sources (fuelwood, crop residues, and animal dung) account for more than 50% of the final energy consumption. In 1993/94, the consumption of non-commercial fuels is estimated to have reached 118.8 million tonnes of oil equivalent (Mtoe). Fuelwood accounted for about 65% of this figure, equivalent to 160 million tonnes annually. The majority of these non-commercial fuels is consumed by rural households, primarily for cooking and heating. If included in the official energy statistics, the share of households in the total final energy consumption would increase significantly.

India is rich in coal and produces oil and natural gas. In 1994/95, domestic coal production reached 126.4 Mtoe, accounting for 69% of total indigenous energy production. Oil and natural gas contributed 18% (32.2 Mtoe) and 9% (16.6 Mtoe), respectively. In addition, natural gas production saw a remarkable increase when it almost tripled (from 6.2 Mtoe) between 1984/85 and 1994/95.

These figures do not take into account the production of traditional fuels. Statistics from India's Planning Commission indicate that indigenous production of traditional fuels was in

the vicinity of 50% in 1993, though this had been declining since 1953 when the corresponding figure was more than 70%.

The energy sector in India involves many agencies. For the purpose of this report, the relevant agencies are the Ministry of the Non-conventional Energy Sources (MNES), the Ministry of Environment and Forests (MEF), and the Planning Commission. MNES was created in 1992, when the Department of Non-conventional Energy Sources was elevated to a ministry. The main task of MNES is to promote the development and utilisation of new and renewable energy sources (e.g. biomass, solar, wind, small hydro, ocean, and geothermal energy). The Indian Renewable Energy Development Agency (IREDA) acts as the implementing arm of MNES and offers technical and financial assistance to renewable energy project proponents.

MEF is the nodal agency in the administrative structure of the Government of India for the planning, promotion, and co-ordination of environmental and forestry programs. It undertakes environmental impact assessments, implements environment and forestry programs, formulates environmental policies, and enforces environmental legislation. Under the MEF, the National Afforestation and Eco-development Board (NAEB) is entrusted with the task of promoting afforestation, tree-planting, ecological restoration, and eco-developmental activities nation-wide. NAEB oversees the regeneration of degraded forests and lands adjoining forest areas, national parks, sanctuaries, and other protected areas, as well as the ecologically fragile areas such as the Western Himalayas, Aravallis, and the Western Ghats. Its focus is on developing financially viable models for the reclamation of degraded lands.

The Planning Commission is the Government of India's foremost planning agency. Its prime responsibility is to frame the country's economic growth and development policies. The energy sector is represented in the Planning Commission by the Energy Policy Unit (EPU). EPU's mandate is to ensure adequate energy supply at minimum cost, while achieving energy self-sufficiency and protecting the environment from the adverse impacts of energy use. Needless to say, EPU is the prime implementer of the government's energy policies.

The Planning Commission holds a key position in the national energy planning process. The Planning Commission is responsible for preparing both the Five-Year and Annual Plans for the various sectors of the economy. The overall plan perspective is provided by the Perspective Planning Division while inputs to the sectoral plans come from concerned divisions. The Energy Planning Unit, of course, provides the major inputs to the Energy Sector Plan.

When formulating the Five-Year Plan, the Planning Commission sets up a number of working groups, basically representing the various sectors of the economy. The different energy sub-sectors are represented by corresponding working groups. The working group for each energy sub-sector comprises the representatives of the sector's major producing industries, the consumer groups, as well as official representatives from the Planning Commission and concerned ministries.

The energy working groups prepare sectoral energy demand estimates that are used by the Perspective Planning Division as inputs to its own sectoral energy demand estimates that should be consistent with the growth targets of the economy. This exercise is based on an

elaborate input-output model as well as energy demand and supply optimisation models developed by the Planning Commission and other agencies (for example, TERI).

The government of India has recognised the role of the energy sector in sustaining economic growth and meeting the basic needs of the people. Integrated energy planning was recognised as an essential element of development planning as early as the 1960s. A number of (Energy) Committees/Working Groups have been set up to examine various issues and make short-, medium-, and long-term recommendations for the development of the concerned sector. These recommendations are obviously useful when preparing the Five-year Plans. For example, the Energy Survey of India Committee was formed in 1963 to study "the present and perspective demand and supply of energy" at national, regional, and sectoral levels. The report of this committee was submitted in 1965, well ahead the deadline for the Fourth Plan. In the subsequent Five-Year Plans, similar committees were also constituted: the Fuel Policy Committee (Fifth Plan), Working Group on Energy Policy (Sixth Plan), and Advisory Board on Energy (Seventh Plan). The Planning Commission recently created the Energy Policy Committee to draft recommendations for the Ninth Five-Year Plan.

References

- Maggo, J. N. "Analysis of Wood Energy Issues in National Level Five-Year Development Planning Exercises." Paper presented at the Study Tour in Wood Energy Planning, India, October-November 1995, FAO-RWEDP.
- Tata Energy Research Institute (TERI). TERI Energy Data and Directory Yearbook 1995/1996. TERI, 1995.

3. STUDY TOUR ORGANISATION

The Study Tour on Wood Energy Planning in India was conducted between October 23 and November 5, 1995. The Ministry of Environment and Forests (MEF), in particular, the Office of the Inspector General of Forests (IGF), upon the request of RWEDP, was the latter's main counterpart in India in organising the activity. The Ministry of Non-conventional Energy Sources (MNES) lent valuable co-operation and support.

Eighteen (18) participants from ten RWEDP member-countries joined the study tour (see Annex 1). As expected, most of the participants (14 of them) represented the energy or forestry departments/ministries of their respective countries. One participant worked with the national planning agency of Bangladesh. One of the participants from the Philippines was connected with the department of environment. The two remaining participants (one from China and the other from Maldives) came from the agriculture/fisheries departments. Each of the participating countries sent two representatives, except for Maldives and Myanmar, which sent one each, and the Philippines, which sent three.

The Study Tour was formally inaugurated on October 24 at the Hotel Kanishka in New Delhi. (See Annex 2 for full details of the itinerary of the Study Tour.) Mr. M.F. Ahmed, Inspector General of Forests, officially welcomed the participants, resource persons, and guests. He thanked the RWEDP for placing confidence in the Government of India to host this study tour. He assured the participants that the activity had been "tailor made" to suit their (the participants) requirements and those of RWEDP.

Mr. Peter Rosenneger, FAO Representative in India and Bhutan, also delivered a welcome address, on behalf of FAO, to the participants. He stressed in his address that wood energy plantations and agricultural cropping are not competing land uses. These two, in fact, are complementary. He reminded the participants that policy and decision-making must take this relationship into account.

Prof. W. S. Hulscher, the Chief Technical Adviser of RWEDP, gave an overview of the Study Tour and its rationale. He began by thanking the government of India, in particular the Ministry of Environment and Forests and the Ministry of Non-conventional Energy Sources, for hosting the Study Tour. Prof. Hulscher reiterated the fact that wood and biomass fuels are the primary energy sources in many countries in Asia, exceeding coal, oil, and hydropower. Despite this, wood and biomass energy are overlooked in policy-making. He enumerated three reasons for such neglect. First, people assume that wood and woodfuels will always be available. Second, people believe that wood and biomass fuels are slowly phasing out as energy sources (that is, their use is on the decline). Third, people make the excuse that data on traditional energy sources are lacking or inadequate to justify their contribution. He immediately countered that lack of data should not become an excuse for abstaining from energy planning.

Mr. B.R. Prabhakara, Secretary of the Ministry of Non-conventional Energy Sources, delivered the keynote address. He gave recognition to RWEDP for organising activities like this Study Tour, which provide a forum for member countries for exchanging knowledge and experiences in order to gain mutual benefits. The remainder of his address focused on India's own experience. He said that a large part of the energy consumed in the rural and urban areas of India is produced in the rural areas in the form of fuelwood, agricultural residues, and cow dung. This energy supply is being augmented by energy conservation,

through promoting energy efficient technologies including biogas and improved cookstoves, the production of fast-growing and short rotation tree species, and the use of biomass in gasifier systems. He offered details of performance of each of these programmes. He also talked about Integrated Rural Energy Planning as implemented in 650 “blocks” in India and how this approach promotes an optimal mix of energy sources, including conventional and renewable energy. He pointed out that the MNES is carving a niche in co-generation using bagasse from sugar mills, power generation from agricultural residues, integrated biomass gasification and gas turbine system using bagasse. He enumerated the fiscal incentives given by the MNES to promote these programmes.

Mr. Rajesh Pilot, Minister of MEF, gave an inaugural address in which he stressed the important role of woodfuels in meeting the cooking needs of the poor in rural and urban areas and in sustaining rural industries. He offered to provide all support to RWEDP and form technical co-operation with other RWEDP member-countries in terms of data acquisition, analysis, and planning.

The opening ceremonies closed with a vote of thanks from Mr. S. K. Pandey, Additional Inspector General of Forests, who also thanked RWEDP for choosing India to host this Study Tour. He promised that India would develop an Action Plan at the national level to follow up on the objectives of this Study Tour.

The afternoon of the first day and the next ten days were spent learning about India’s experiences in wood energy development activities. The learning process consisted of a combination of listening, discussions, and observations. Presentations on various aspects of wood energy development and planning were made, followed usually by a panel discussion on related issues. These seminars and discussions cannot be separated, however, from the site visits, in five major cities of India, which served to reinforce the knowledge gained by participants through listening to and discussing with India’s wood energy experts. The sites visited comprised: the Biomass Characterisation Laboratory of the Indian Institute of Technology (Delhi); the Forest Survey of India (Dehradun); Dehradun’s Mussoorie area and Shivalik Ranges (where the participants observed India’s deforestation problem); the Indian Council for Forest Research and Education (Dehradun); the National Remote Sensing Agency (Hyderabad); the Biomass Gasifier Laboratory and the ASTRA (Appropriate Science and Technology for Rural Advancement) at the Indian Institute of Science (Bangalore); and forest areas in Agra (where the participants learned about India’s social forestry programmes). A summary of the presentations, panel discussions, and site visits are given in the next two chapters. Annex 3 also gives the full text of the presentations.

On the last day of the Study Tour finally the participants shared their impressions and the lessons that they learned during the Study Tour. This was capped by a set of recommendations that were a synthesis of the lessons learned.

The host country, through the Office of the Inspector General of Forests, added to this by proposing a National Action Plan that would follow up the objectives of the Study Tour. The Action Plan was in terms of year-round national consultations that would be held in collaboration with RWEDP. The theme of these consultations (and the target venues) would be as follows:

1. Fuelwood in Energy Policy (New Delhi)
2. Fuelwood Resource Assessment (Dehradun)
3. Fuelwood Planning (Baroda)
4. Fuelwood Production (Madras)
5. Fuelwood Conversion and Conservation (Calcutta)

The Valedictory Session was then held in the afternoon of November 2. Mr. Pradeep Chaturverdi, RWEDP's consultant who is based in India, comprehensively summed up the activities of the Study Tour. Mr. M. F. Ahmed and Mr. Peter Rosenegger made closing remarks on behalf of the Government of India and FAO, respectively. Both speakers expressed appreciation for each other's role in this Study Tour. Prof. P. J. Kurien, State Minister for Non-conventional Energy Sources delivered the Valedictory Address. He talked about India's biogas and improved cookstoves programmes, which he described as one of the largest in the world, involving several rural-based NGOs. He emphasised that the role of national governments in policy formulation and fiscal support is of paramount importance in promoting efficient biomass production and utilisation technologies in the developing world. He stated his hope that India's experience will serve as a model for the countries represented in the Study Tour. Finally, Mr. Conrado Heruela, Wood Energy Planning Specialist of RWEDP, gave the Vote of Thanks. He lauded MEF for its important role and gave recognition to the support and co-operation of various individuals and agencies, government and private, in India in making this Study Tour possible.

4. SUMMARY OF PRESENTATIONS AND PANEL DISCUSSIONS

The Study Tour made extensive use of brief seminars and panel discussions to familiarise the participants with India's experience in wood energy development and planning. Ten presentations were made and about the same number of panel discussions (excluding the last one on Lessons Learned from the Study Tour) were held.

All the presenters were either officials from government agencies in India or officers of private sector agencies devoted to energy research and development.

A brief summary of the presentations and a short account of the panel discussions are given below in chronological order.

Wood Energy Situation in India: Planning Strategies and Policies, by S. K. Pandey, Additional Inspector General of Forests, MEF

The situation in India's forestry sector was described, pointing out the growth of fuelwood plantations in forest areas. It was indicated that the National Forestry Action Plan focuses on fuelwood production on a scientific basis to meet the demand. Resource allocation and the responsibility of state governments are the two crucial elements in the effective implementation of the Plan. But the lack of standardised, uniform, and authentic micro-level resource and consumption data can constrain planning for fuelwood energy.

Planning and Implementation of Bio Energy Projects by MNES, by N. P. Singh, Director, Ministry of Non-conventional Energy Sources

The efforts of the renewable energy sector, in particular the biomass sector, to meet the increasing energy needs of the economy and the social needs of a growing population were enumerated. Activities relating to the promotion of commercially advanced technologies in power generation such as co-generation, gasification, briquetting, wind and micro-hydel, using institutional financing, were described. Meeting growing rural energy needs through integrated rural energy planning, national biogas development programmes, and national improved *chulhas* programmes have become a major government responsibility. Improvement in the performance of solar cooker, biogas plants, and high efficiency stoves are major concerns of the MNES. The Ministry's thrusts are on strategy formulation and implementation, technology improvement, provision of extension services, financial incentives, and training.

Panel Discussion: Incorporating Wood Energy Analysis into Macro-Sectoral Planning Exercises

Issues raised during the previous two presentations were taken up. Details of the MNES approach to resource assessments and developing national plans were discussed, identifying similarities with other countries. Some of the participants briefly described the situation in their countries and raised the possibility of adapting the approach followed by India.

Wood Energy Conversion and Utilisation Technologies, by Prof. P.D. Grover, Chemical Engineering Department, Indian Institute of Technology

An overview of various conversion technologies developed in India and abroad with regard to the use of woody biomass and agro-residues was presented. A description of state-of-the-art technologies, including the problems and constraints connected with their development and use offered the participants technological options according to the conditions existing in their home countries. In this regard, the possibility of co-operation among the RWEDP member-countries and the development of suitable training facilities were explained.

Wood Energy Data Collection, Assessment, and Analysis, by I. Natarajan, Director, National Council of Applied Economic Research (NCAER)

An account of the All India Household Energy Survey conducted by NCAER in 1978 was given. This study provided household energy consumption estimates at the State level according to different types of fuels and by type of end-use. The basic data were collected through a sample survey covering 12,500 households, of which 8,000 were selected from the rural areas, representing 610 villages. The study covered commercial and non-commercial fuels and distinguished, for example, between logs and twigs.

The study developed an indirect method to estimate the amount of fuel consumption. Fuel consumption was related to consumption of auxiliary variables, for which data can be easily collected. The total energy consumption was desegregated into consumption of commercial and non-commercial fuels. The study also analysed amount of fuels purchased and collected. The norms were derived from the sample itself.

The study produced many interesting findings. For example, there were a significant number of households who used purchased fuels exclusively for cooking. The energy needs in the hilly and desert areas were totally different from those in the plains regions. The source of collected fuelwood varied from forest to roadside. Eighty (80) percent of the surveyed households felt that there was really no change in the availability of the fuelwood, while 10% felt that there was a decline in availability. The remaining 10% were not sure if there was change in availability of fuelwood. The study also showed that, although the general opinion was that fuelwood is not usually traded in rural areas, there exists an informal market for most of the fuelwood consumed in rural households.

The 1978 survey was the first attempt to provide comprehensive estimates of household energy consumption in the whole of India. The results of this survey are still used as a basis for estimating current household energy consumption. For example, based on this study, NCAER estimates that the demand for fuelwood will increase from 140 million tons (MT) in 1994-95 to 160 MT in 1999-2000.

Fuelwood Production on Non-Forest Lands, by Ranjit Issar, Joint Secretary, Department of Wasteland Development, Ministry of Rural Development.

The ill-effects of deforestation and land degradation and the efforts to establish fuelwood plantations on non-forest wastelands to counter these ill-effects were described. Wasteland development, which is an approach to meeting fuelwood, fodder, and minor forest produce needs, is based on the concept of watershed development. However, constraints were observed: poor market intelligence; high profits of middlemen; non-standardisation of

products; lack of research back-up; poor genetic planting stock; indiscriminate felling; and transportation laws. Nevertheless, the target is to develop 7.7 million hectares in three to four years. The involvement of the local people is being emphasised. Studies have shown that wasteland development projects can coup an internal rate of return (IRR) of over 19%. With government subsidy, the IRR can shoot up to 25%. Wasteland development programmes can improve decentralised fuelwood production and availability while also contributing to the protection of the environment.

Analysis of Wood Energy Issues in National Level Five-Year Development Planning, by J. N. Maggo, Deputy Adviser, Planning Commission

The government of India recognises that energy is a key input to the development of the country's economy. Integrated energy planning, therefore, is a major component of the development planning exercise and has been practised since the 1960s. The presentation outlined the energy planning process in India within the context of the national five-year development plans. It focused on the due attention given to fuelwood in the energy planning process and discussed fuelwood planning issues.

Major inputs to the energy plan come from high level committees or working groups which are set up to examine in detail various issues confronting the different energy sub-sectors and to make the subsequent recommendations. In 1981 The Planning Commission established a Fuelwood Study Committee to study all aspects of fuelwood - from production to consumption. The Committee stressed the need for a dynamic, integrated, and long-term action plan for promoting the growth of fuelwood plantations in the country in view of the importance of fuelwood, which is consumed by Indian households at the rate of 200 million tonnes per annum. The Committee recommended: (i) a survey to assess the availability and production of non-commercial fuels; (ii) the identification of forest and non-forest areas for intensive rural fuelwood production; (iii) the introduction of improved management programmes for increasing fuelwood availability; and (iv) programs to increase the efficiency of wood energy devices and to develop alternative biomass energy sources and technologies.

The Advisory Board on Energy reported in 1985 that, though at least 60 million hectares of land might be available for raising fuelwood and fodder plantations, it may be difficult to meet the fuelwood requirements of certain areas in the country.

Nevertheless, India will continue to rely on fuelwood during the next 20 years and this has important implications. Extraction of fuelwood from forests will worsen ecological degradation and deforestation. If fuelwood becomes unavailable, crop residues and animal dung consumption would increase with possible adverse impacts on soil fertility and animal productivity. Fuelwood consumption also has negative environmental and health impacts concentrated in the homes. Inefficient burning of wood has contributed to indoor pollution. This can be abated by introducing more efficient cookstoves or by asking fuelwood users to shift to modern fuels. However, this is easier said than done. Most poor households spend 10-14% of their income on energy and asking them to shift to the more expensive modern fuels will exert a heavy burden on them. The only real solution to the problem is to raise their purchasing power.

Assessment of Fuelwood Resources from Forest Areas, by S. N. Rai, Director, Forest Survey of India

A profile of the Forest Survey of India (FSI) was first given. FSI was created in 1981 and has its headquarters in Dehradun and four zonal offices in Shimla (North), Bangalore (South), Calcutta (East), and Nagpur (Central). The objectives of FSI are to: (i) prepare a State of Forest Report and vegetation maps of the country every two years; (ii) prepare thematic maps on vegetation once every ten years; (iii) create a database for national and state level planning; (iv) undertake a forest inventory; and (v) train forestry personnel in resource survey and data processing.

FSI's future plans are to: (i) complete the database and use GIS for national and state planning; (ii) monitor reforestation activities; (iii) assess growing stock; and (iv) continue to train forestry personnel, particularly from State Forestry Departments.

It was also indicated that for countries in Asia, it is best still to adopt conventional technologies and techniques rather than jump to using the state-of-the-art ones.

Fuelwood as Energy--A Major Policy for the National Forestry Action Plan for India by A. K. Mukerji, Vice Chairman, National Afforestation Eco-Development Board

In the forties, adequate supplies of fuelwood were available in and around the villages. With the growing population, especially in the rural areas, and the development of wood-based rural industries, the demand for fuelwood has risen sharply. The National Commission of Agriculture (1976) estimated that biomass fuels contributed 90% of the total energy consumed by households. Moreover, a major portion (85%) of total household energy consumption was accounted for by villages. Nation-wide, fuelwood and charcoal accounted for 46% of total energy consumed in India.

The growing population, together with a host of other related factors, has exerted pressure on forest resources that in turn has threatened the sustainability of the fuelwood supply. For example, the Forest Survey of India (FSI) estimated that from 1950 to 1980, nearly 4.3 million hectares of forest areas were converted to non-forest uses, including agriculture. The large-scale conversion of private and community lands planted with trees to farmlands added extra pressure. Agricultural lands increased from 134 million hectares in 1951 to 154.7 million hectares in 1991. The increase in agricultural lands has reduced the source of fuelwood supply in rural areas.

Certain remedial measures are being considered to ensure the continuous supply of fuelwood:

a) The increase of budget allocation in the forestry sector from the present one percent to raise at least 20 million hectares of fuelwood plantations;
b) the enhancement of investment in more modern cooking equipment, crematoriums, and biogas plants;
c) the raising of fuelwood trees on community and private lands as an essential part of development and employment generation programmes;
d) the development of clear-cut rural energy policy at the central level; and
e) the motivation of state governments to initiate moves to integrate the raising of energy plantations into rural development programme.

It was also suggested that every country should develop a separate Wood Energy Plan apart from the National Forestry Master Plan.

Analysis of Fuelwood Supply from Non-Forest Areas, by Narayan Singh, (Ret) Additional Inspector General of Forests

Based on national level studies conducted by different agencies in 1990-91, an overview of biofuels consumption in rural areas during the same period was presented. It was shown that annual fuelwood consumption per capita is different in rural and urban areas and also varies from state to state.

India's efforts to "take forestry to the people," beginning in the Sixth Five-Year Plan (1980), that led to a massive planting effort both in and outside forest areas were discussed. While the first six Five-Year Plans could promote only 8.7 million hectares, the Seventh Five-Year Plan could promote 8.8 million hectares. The National Forestry Action Plan indicated that 40% of industrial wood comes from lands owned by individual farmers, and the same is true of fuelwood. A comparative study of Kerala and Haryan was reported to show the impact of different agro-climatic conditions. It was explained that with the new coppicing varieties, the fuelwood production scenario is improving. People's participation was advocated for increasing micro-level fuelwood production as well as the establishment of an effective credit system for fuelwood plantation.

Use of Remote Sensing Techniques for Assessment of Fuelwood Resources, by C. B. S. Dutt, Head, Forestry and Ecology Division, National Remote Sensing Agency

An overview of NRSA activities was presented. Developments in the technology of satellite imaging and interpretation has enabled the fast processing of data and helps in identifying changes in forest cover. The global model for determining forest change may be summed up as biomass vs. number of trees in deciduous forests and the GIS model for forest zonation. A number of satellite images created between 1973 and 1983 at Tibri Hills of Shivaliks (near Mussoorie) were presented to show changing deforestation in the area.

Forest Resource Assessment and Planning at the State Level, by Kamal Naidu, Principal Chief Conservator of Forests, Government of Andra Pradesh

The historical background of forest management in Andra Pradesh that began in 1800 was presented. A consolidated working plan was first prepared in 1962 and these working plans have been called the management plans since 1983. The management of forests are prescribed in these working plan documents which stock map the entire forest areas and divide them into forest blocks and compartments. Based on the stock map information and depending on the condition of the forests the area is further divided into working circles (homogeneous strata). These plans are made for a period of 10 to 15 years and are revised afterwards.

But these working plans never estimated the total potential of the forest area. The areas considered were only forest divisions and only the local needs were taken into account without considering the growing forest based industries. The government, therefore, set up the Pre-Investment Survey of Forest Resources (PIS) at Dehradun in 1965 in collaboration with FAO. Since then PIS has conducted resource assessment surveys in several areas. In 1976, the Forest Department, in collaboration with the National Remote Sensing Agency, conducted resource assessment surveys.

In the last three to four decades, the demand on the forest products have increased substantially with population growth resulting in the denudation of forests. Changes in land use have also reduced forest areas.

The main problems in planning were reported: resource maps are approximate and subjective; data on soil condition are not available; analysis of local demand is lacking; projects have long gestation periods and cost-benefit analyses are not conducted.

The satellite-based techniques for imageries and their cross-checking with aerial photographs were also described. For estimating growing stock, a systematic sampling was adopted by using information from the Survey of India. In catchment areas, systematic cluster sampling was followed.

Renewable Energy Programme Implementation at the State Level: Experience of Andra Pradesh, by T.H. Sastry, Managing Director, Non-conventional Energy Development Corporation of Andra Pradesh (NEDCAP)

A profile of NEDCAP was given. NEDCAP surveys, develops, and implements renewable energy programmes of state and central governments; imparts training; and promotes research and development in the sector. Major programmes undertaken by NEDCAP include National Project on Biogas Development, National Programme on Improved *Chulhas*, National Project on Wind Energy, and National Project on Solar Energy, to name a few.

Other officers of NEDCAP talked about the accomplishments of the renewable energy programme in Andra Pradesh.

Biomass Gasifier Programme at Indian Institute of Sciences (IISc), by H. S. Mukunda, Chairman, Combustion, Gasification, and Propulsion Laboratory, IISc

The various routes for biomass utilisation in a gasifier system and in improved cookstoves were described. For example, biomass conversion through the gaseous route has more value-added as compared to biomass conversion through direct incineration. In 1993, the development and testing of 100 kW wood gasifier according to Swiss pollution standards was an important landmark. The tests included measurement of tar and particulate matter in the gas and COD, BOD in the affluent. The composition of the gas showed a very high efficiency of gasification.

A brief account of the field programme of IISc at Hoshahalli Village, about 120 km from Bangalore, was given. A biomass plantation has been raised there to meet the needs of the village.

International Convention on Climate Change and Wood Fuels, by N. H. Ravindranath, Indian Institute of Science, Bangalore

The usefulness of biomass energy for developing countries from the energy and environmental points of view was discussed. This was recognised in the report “Energy Options for Climate Change” under the Energy Action Plan of the Inter-Governmental Panel on Climate Change. Woody biomass fuels are looked at as an incentive to promote environmental preservation for the developed as well as developing world. In this regard, wasteland reclamation will have the double impact of fulfilling energy needs and providing

the necessary clean environment. It was noted that financial institutions like the World Bank are also expressing a preference for renewables and biomass.

Renewable Energy Programme Implementation at the State Level--Experience of Karnataka, by M. S. Ramaprasad, Executive Secretary, Karnataka State Council for Science and Technology

A profile of the State Council was given. It was set up in 1975 and has played a catalytic role in promoting the use of science and technology for development. It was responsible for implementing renewable and rural energy programmes at the State level. The Council has promoted a number of R&D programmes and has emphasised dissemination activities.

An account of the Karnataka experience was then given. The programme involved installing gasifier systems at Karnataka. So far 522 gasifiers have been installed and these are being regularly monitored. The programme also involved installing biogas systems.

Participation of Beneficiaries in the Planning and Implementation of Energy Programmes, by I. Natarajan, Chief Economist, National Council of Applied Economic Research.

The NCAER study in 1978 showed that 60% of the households preferred fuelwood as the cooking medium, because it was highly accessible and practically free. Since then, however, fuelwood collection has become difficult.

The indiscriminate felling of trees has resulted in widespread denudation of forests with its attendant ill effects to the environment.

NCAER has evaluated programmes like the Integrated Rural Energy Programme and several reasons have been identified for their successes and failures. Most are basically intervention programmes, which can succeed only if the villagers are involved from the start. Many have long gestation periods and thus target beneficiaries cannot easily appreciate the benefits.

Intensive training programmes will ensure the involvement of the villagers. Implementing agencies have fulfilled their targets on the number of training programmes. However, there is room for improvement in terms of quality and content.

Panel Discussion: Role of Beneficiaries in Planning and Implementing Wood Energy Programmes

The participants offered their perceptions of beneficiary participation in planning and implementing wood energy programmes. They also tried to identify the possibilities of adopting the methodology presented for assessing beneficiary participation in their respective countries.

5. SITES VISITED

5.1 BIOMASS CHARACTERISATION LABORATORY, INDIAN INSTITUTE OF TECHNOLOGY

The Indian Institute of Technology (IIT) in Delhi was established in 1959 in collaboration with the British government to provide facilities of international standard for higher education, research, and training in various fields of science and technology. The Institute offers undergraduate, post-graduate, and doctoral programmes in the various field of engineering. Interdisciplinary programmes are also available, for instance Energy Studies and Rural Development and Appropriate Technologies.

IIT (Delhi) hosts one of the Ministry of Non-Conventional Energy Sources' (MNES) Action Research Centres (ARC) - The Biomass Characterisation Laboratory - which is devoted to strengthening existing biomass R&D activities in the country.

Prof. P. D. Grover guided the participants around the Laboratory and demonstrated various models of gasifiers and pyrolysers developed by IIT. He also explained the operation of the different laboratory equipment used to identify the characteristics of woody biomass and residues. Samples and their characteristics were shown.

Prof. Grover assured the participants that the facilities of the laboratory are open to RWEDP member countries and thus IIT research and development activities could benefit not only India but the Asian region as a whole. For example, knowledge of the characteristics of different types of biomass could help in choosing the right species of wood for growing in fuelwood plantations.

5.2 FOREST SURVEY OF INDIA, DEHRADUN

The Forest Survey of India (FSI) was created in June 1981 to monitor periodically (every ten years) the changing situation in land and forest resources by conducting regular forest inventories. The participants were shown the facilities of the Inventory Unit for processing forestry data. The Unit also functions as a National Forest Data Bank and relevant data on forest inventory are stored here. The participants also toured the Digital Image Processing and National Forest Data Management Center, which was created by the government of India in 1987. The purpose of digital image analysis, computer aided cartography, and the processes of developing a suitable geographic information system were explained. Techniques to identify the important forest types by intensity classes and to prepare vegetation maps were shown.

5.3 DEHRADUN: MUSSOORIES AREA AND SHIVALIK RANGES

A walk through visit was organised at Dehradun, Mussoorie area. Although in general fuelwood is not the main cause of deforestation, it can contribute to forest degradation in some areas. This seems to be the case in the area visited, where fuelwood is produced and traded on a commercial basis. The participants could observe the variation in fuelwood consumption patterns, from low consumption in the town due to higher purchasing capacity and availability of alternative fuels, to higher consumption at higher altitudes. Also the efforts of the Eco-Development Task Force involving popular participation to overcome problems related to fuelwood were discussed during the visit.

5.4 FOREST RESEARCH INSTITUTE, INDIAN COUNCIL OF FOREST RESEARCH AND EDUCATION, DEHRADUN

The Indian Council of Forest Research and Education (ICFRE) is the premier Council for conducting forest research. ICFRE is devoted to research and development and promotional activities related to forestry and the environment. The Forest Research Institute (FRI) at Dehradun is one of the 11 institutes and centres under ICFRE.

The participants were guided through the FRI History Museum to gain a picture of the various stages of growth of the Institute. Visits were also made to the Botany Division which houses one of the richest live collections of both indigenous and exotic wood species in the country, and the Social Forestry Division, which was established in 1988 to provide technical support to agro-forestry ventures.

Earlier research at the FRI focused on silvicultural, agro-silvicultural, and extension aspects of tree species; standardisation of nursery practices; plantation methods; yield forecasting techniques; and development of schedules for pruning, thinning, and lopping of agro-forestry species. For example, studies on tree crop interactions in the agro-forestry systems (farmlands) to understand the yield of wheat and other agro crops under different fuelwood species have also been undertaken.

5.5 NATIONAL REMOTE SENSING AGENCY, HYDERABAD

The National Remote Sensing Agency (NRSA) is an autonomous organisation under the Department of Space. It is responsible for providing operational resources survey services to users/clients by utilising modern remote sensing techniques. The organisation continues to make significant progress in all spheres of its activities: acquisition, processing, generation, and dissemination of satellite data products; analysis and interpretation of remotely sensed data for resource management/environmental applications; and training of users in various remote sensing and related fields, including research and development.

5.6 INDIAN INSTITUTE OF SCIENCES, BANGALORE

The Indian Institute of Sciences (IISc), like IIT, hosts one of the four action research centres (ARC) of the Ministry of Non-conventional Energy Sources. The ARC in IISc is devoted to Biomass Gasification and Combustion. The participants were taken to the Combustion-Gasification and Propulsion Laboratory to view the different models of gasifiers and improved cookstoves. A video presentation on biomass utilisation technologies developed over the years at IISc was shown.

5.7 SOCIAL FORESTRY PROGRAMME SITE, AGRA

The last site visit was literary a “roadshow presentation.” The participants travelled through the beautiful city of Agra to witness various social forestry programmes, soil conditions, and fuelwood plantations. The State Forest Department was most willing to show the participants impressive plantations of Eucalyptus, Poplar, Shisham and Acacia nilotica. Aside from meeting the fuel and non-fuel needs of farmers and their households, these plantations, raised mostly on saline lands, enhance soil and water conservation. A greenbelt of trees of various species planted around Agra, to protect the city from industrial pollution, fascinated the participants.

6. CONCLUSIONS AND RECOMMENDATIONS

The Study Tour in India was one activity among many in which RWEDP has sought to convey to its member countries the important role played by wood energy in people's lives and to assist them to develop their capabilities to integrate wood energy in their national development processes. Achieving these goals involves a learning process. The Study Tour was intended to be such a learning process, or more properly, the beginning of a learning process.

Thus, prior to the closing ceremonies, a final panel discussion was held to summarise the lessons learned from the two-week Study Tour. There was really no format for this panel discussion as in the others; so the participants could talk freely about their impressions. Many participants pointed to similarities with their country and India and were impressed by the model role played by India in wood energy development and planning. The participants called on RWEDP to assist their countries to attain the same level of expertise and technological advancement as that existing in India.

This was the general theme of the reactions of the participants from Sri Lanka, Myanmar, Maldives, China, and Bangladesh. The participants from Sri Lanka were impressed by the administrative set up in India in which the State governments play an important role. They were quick in saying that this set up could be a model for the provincial governments in Sri Lanka. In addition, they contemplated the idea that contact with Indian institutes and agencies may be useful for developing or establishing similar facilities in their country.

The lone participant from Myanmar pointed to the extensive use of cow dung as something that his country and India shared to a significant degree. This and some others could be the basis for collaboration with India with the support of RWEDP.

The participant from the Maldives did not mention a shared trait with India but did suggest the need for Indian experts to come down to the Maldives to help them assess their wood energy resources and the potential use of improved cookstoves and gasifiers.

The Chinese participant was impressed by what he saw in India and was convinced that the Integrated Rural Energy Programme played an important role in meeting the energy needs of people in the rural areas.

The participants from Bangladesh thought that the models developed in India could be used in their country. However, shortages of manpower, technology, and financing could hinder this transfer. While technical and financial assistance may be provided by international agencies, they complained that these oftentimes do not conform to the needs of recipient countries. They, therefore, recommended a regional programme spearheaded by RWEDP to address these constraints.

The participants from Nepal and Indonesia simply shared information about their countries, but also were of the opinion that the examples provided by India were worth imitating. In fact, the participant from Nepal said that a few more visits to energy centres and institutes in India should be arranged by RWEPD. They also thought that the visit to the forests of Dehradun was very informative. The Indonesian participants agreed that the Study Tour could be the start of collaborative programmes with India.

The participants from Thailand expressed their appreciation of the energy facilities in India and hoped that these facilities could be accessible by other countries for training purposes.

The participants from the Philippines, however, complained about the short time given to learning about all these facilities. In addition, they suggested that field visits should have been better co-ordinated with the presentations.

Lastly, the participants from India praised RWEDP's efforts to conduct the Study Tour. They suggested that RWEDP disseminate the information and experience gained during the Study Tour and support national wood energy development initiatives to improve the state of wood energy planning in member countries.

Recommendations

The participants unanimously agreed on the following recommendations:

1. Exposure to institutions and experts help in having collaborative programmes in training on resource assessment and planning.

2. Field visits help in understanding the effects of deforestation due to unplanned fuelwood felling, difficulties in planning due to lack of credible data base, and the effects of fuelwood substitution on fuelwood consumption.

3. RWEDP should support follow-up activities in different countries by promoting linkages among the institutions represented in the Study Tour and other institutions having a stake in wood energy.

4. National commitment is necessary for the development and implementation of a sustainable wood energy programme.

5. RWEDP should develop a comprehensive networking programme on a regional basis as this will help to identify local needs more effectively.

6. Participants with relevant background should be selected to attend various RWEDP workshops and training programmes. Their follow-up assignments after receiving the training should also be monitored.

Evaluation

Not only was the Study Tour a learning experience for the participants, it also gave RWEDP and the national collaborating agencies opportunities to improve the conduct of future activities similar to the Study Tour. Participants were asked to fill in forms to evaluate the conduct of the Study Tour. Their comments are summarised thus:

1. Detailed advance information regarding the Study Tour would have been helpful.

2. Cut-off date for final selection of participants should have been more than one month.

3. At least one day should be given free for gathering information before the start of the Study Tour.
4. Linkage between data acquisition agencies and government departments should have been elaborated.

5. Actual working of data collection and interpretation should have been scheduled.

6. Time for presentation by member countries should have been scheduled.

7. Time for interaction amongst the participants should have been scheduled.

8. Discussions with participant beneficiaries at the village level should have been arranged for better understanding of fuelwood consumption pattern and issues involved in micro-level planning.

Despite these noted shortcomings, all the participants agreed that the Study Tour in India constituted an important learning experience. The Study Tour, therefore, should be looked on as a basis for future activities that are geared towards enhancing wood energy planning in RWEDP member countries.

APPENDIX 1. LIST OF PARTICIPANTS

Bangladesh

- MR, A. K. M. ABDUS SATTAR
  Joint Chief
  Planning Commission
  Ministry of Planning
  Tel: (02) 814731 (Off.)
  (02) 836186 (Res.)

- MR. A. H. M. MONZURUL KARIM
  Conservator of Forests
  Ministry of Environment and Forests
  Banabhaban, GuIshan Road
  Mohakali, Dhaka - 1212
  Tel: (02) 603537 (Off.)
  (02) 412128 (Res.)
  Fax:(02) 870704

China

- MR. WANG GEHUA
  Director of Institute of Rural Energy
  Chinese Academy of Agricultural
  Engineering Research and Planning
  11 Nongzhanguan Nanli
  Beijing 100026
  Tel: (10) 4193003
  Fax:(10) 5002448

- MS. ZHOU ZAIZHI
  Assistant Professor
  Research Institute of Tropical Forestry
  Chinese Academy of Forestry
  Longdong, Guangzhou 510520
  Tel: (20) 7725614 (Off.)
  (20) 7728896 (Res.)
  Fax:(20) 7725622

India

- MR. N. P. SINGH
  Director
  Biomass Division
  Ministry of Non-Conventional Energy Sources
  Block No. 14, C.G.O. Complex
  Lodi Road, New Delhi 110003
  Tel: (11) 4361920 (Off.)
  (11) 8761558 (Res.)
  Fax:(11) 4360396, 4361298

- MR. P. C. KAUSHAL
  Asst. Conservator of Forests
  Himachal Pradesh Government
  Dist. Kangra
  Himachal Pradesh
  Tel: (01 892) 24887 (Off.)
  (01 892) 22258 (Res.)

Indonesia

- MR. AINUL WAFA
  Rural Energy Planner
  Jl. Hr. Rasuna Said Blok X-2
  Kau. 07-08
  Jakarta (12950)
  Tel: (021) 5252108 (Off.)
  (021) 3143605 (Res.)
  Fax: (021) 5256044

- MR. RUFIIE
  Directorate of Forest Products Utilisation & Marketing
  Directorate General of Forest Utilisation
  Gedung Manggala Wanabakti
  Block I/Lt 6, Jl. Gatot Subroto, Jakarta 10270
  Tel: (021) 5730262 (Off
  (021) 5505843 (Res.)
  Fax:(021) 5733336

Maldives

- MR. HUSSAIN RASHEED
  Asst. Agriculture Officer
  Ministry of Fisheries & Agriculture
  Ghazee Building
  Ameer Ahmed Magu, Male 20 - 05
  Tel: 322625 (Off.)
  326664 (Res.)
  Fax:326558

Myanmar

- U KHIN MAUNG NYUNT
  Staff Officer
  :(Planning and Statistics Division)
  Director General's Office
  Forest Department, West Gyogon
  Insein, Yangon
  Tel: (01) 63408 (Off.)
  Fax

Nepal

- MR. VISHWA BHUSHAN AMATYA
  Energy Engineer
  Water and Energy Commission
  Secretariat (WECS)
  P.O. Box 1340, Singh Durbar
  Kathmandu
  Tel: (1) 228969 (Off.)
  (1) 472831 (Res.)
  Fax:(1) 227185

- MR. GAURI SHANKAR TIMALA
  Assistant Planning Officer
  Department of Forests
  Babar Mahal, Kathmandu
  [Res.: 3/26, Taumadhi, Bhaktapur]
  Tel: (1) 220303 (Off.)
  (1) 613127 (Res.)
  Fax:(1) 227374

Philippines

- MR. HERMINIO A. ARIOLA
  Science Research Specialist
  Department of Energy
  PNPC Complex, Merritt Road
  hariola.mid.doe.gov.ph
  Fort Bonifacio 1201
  Makati City
  Tel: (32) 8152098 (Off.)
  (32) 7141538 (Res.)
  Fax:(32) 8436438
  Email:

- DR. WELLINGTON Z. ROSACIA
  Senior Science Research Specialist
  Ecosystems Research and Development Bureau
  DENR, College Laguna 4031, Laguna
  Tel: (094) 2269,3221,3481 (Off.)
  (092) 467 -7578 (Res.)
  Fax:(63) (94) 2850

- MR.BAYANINERA
  Asst. Director
  Forest Management Bureau
  Visayas Avenue
  Diliman, Quezon City
  P.O. Box 2363
  Tel: (632) 9274784
  Fax:(632) 9200374

Sri Lanka

- MR. D. A. U. DARANAGAMA
  Asst. Director (Energy)
  Ministry of Irrigation, Power & Energy
  500, T. B. Jayah Mawatha, Colombo 10
  Tel: (94-1) 687357
  Fax:(94-1) 687386

Thailand

- MRS. SIRILUK TATAYANON
  Technical Forest Officer
  Forest Products Research Division
  Forest Research Office
  Royal Forest Department
  61, Phaholyothin Road, Jatujak
  Bangkok 10900
  Tel: 5795411
  Fax: 5795412

- MR. CHAIWAT POLLAP
  Project Assessment Consultant
  National Energy Policy Office
  394/14, Samsen Road
  Dusit, Bangkok 10300
  Tel: 2824818 (Off.)
  4913767 (Mobile)
  Fax: 2824607

RWEDP / FAO Representative

- DR. W. S. HULSCHER
  Chief Technical Adviser
  Regional Wood Energy Development Programme in Asia (RWEDP)
  c/o FAO Regional Office for Asia and the Pacific
  Maliwan Mansion, Phra Atit Road
  Bangkok, 10200 Thailand
  Tel: (662) 2802760
  Fax: (662) 2800760
  Email: rwedp@fao.org

- MR. CONRADO S. HERUELA
  Wood Energy Planning Expert
  Regional Wood Energy Development Programme in Asia (RWEDP)
  c/o FAO Regional Office for Asia and the Pacific
  Maliwan Mansion, Phra Atit Road
  Bangkok, 10200 Thailand
  Tel: (662) 2802760
  Fax:(662) 2800760
  Email: rwedp@fao.org

- MR. K. L. GULATI
  Administrative Officer FAO
  55, Maxmueller Marg, New Delhi
  Tel:(011) 4628877, 4627707(Off.)
  Fax (011) 4620115

- MR. PRADEEP CHATURVEDI
  FAO Consultant
  55, Maxmueller Marg, New Delhi
  Tel:(011)46288779,4627707(Off.)
  Fax: (011) 4620115

GOI / MOEF

- MR. AMBARISH C. CHAUSEY
  DIG (Forests)
  Room No.523
  Paryavaran Bhavan
  CGO Complex, Lodhi Road
  New Delhi - 110 003
  Tel: (011) 4362875 (Off.)
  Fax: (011) 4360678

- MR. ASHOK RAMTEKE
  AIG (Forests)
  Room No.523
  Paryavaran Bhavan
  CGO Complex, Lodhi Road
  New Delhi - 110 003
  Fax:(011) 4360678

APPENDIX 2. ITINERARY AND SCHEDULE OF ACTIVITIES

23 Oct 95 - Mon - Delhi

9:30 am - 6:00 pm — **Arrival of Participants**

24 Oct 95 - Tue - Delhi

8:30 am - 9:30 am — **Registration**

9:30 am - 10:30 am — **Inaugural Session:** (venue: Meeting Room, Hotel Kanishka)

- *Welcome Address* - by Mr. N. R. Krisnan
  Secretary, Ministry of Environment and Forest (MOEF)
- *Address* - by Mr. P. Rosenegger
  FAO Representative in India and Bhutan
- *Overview and Rationale of the Study Tour* - by Dr. W. S. Hulscher, Chief Technical Adviser, RWEDP
- *Keynote Address* - by Mr. B. R. Prabhakara
  Secretary, Ministry of Non-Conventional Energy Soruces (MNES)
- *Inaugural Address* - by Hon. Shri KamaInath
  Minister for Environment and Forests, Government of India
- *Vote of Thanks* - by Shri M. F. Ahmed
  Inspector General (Forests), MOEF

10:30 am - 11:30 am — *Inaugural Tea*

11:30 am - 1:00 pm — **Presentations:**

- *Wood Energy Situation in India - Planning, Strategies and Policies* by Mr. S. K. Pandey - Additional Inspector General (Forests), MOEF
- *Relevance of Wood Energy Planning in the Wasteland Development Programme* by Shri Ranjit Issar - Joint Secretary, Department of Wasteland, Ministry of Rural Development

1:00 am - 2:30 pm — *Lunch Break*

2:30 pm - 3:30 pm — *Planning and Implementation of Wood Energy-Related Programmes in India* by Mr. N. P. Singh - Director, MNES

3:30 pm - 4:00 pm — *Tea Break*

4:00 pm - 5:30 pm — **Panel Discussion:** "Incorporating Wood Energy Analysis in

	Macro-Level Sectoral Planning Exercises"
<u>25 Oct 95 - Wed - Delhi</u>	
9:00 am	**Departure for India Institute of Technology (IIT), Delhi Campus by Bus**
9:30 am - 10:30 am	**Presentation**- (venue: Conference Room, IIT) - *Wood Energy Conversion and Utilisation Technologies* by Prof. P. D. Grover, Chemical Engineering Dept., IIT, Delhi.
10:30 am - 1 1:00 am	*Tea Break*
11:00 am - 12:30 am	**Site Visit:** Biomass Characterisation Laboratory, Chemical Engineering Dept., IIT, Delhi.
12:30 am	**Departure for Hotel by Bus**
1.00 pm - 2:30 pm	*Lunch Break*
2:30 pm - 3:30 pm	**Presentations:** (venue: Hotel Meeting Room) - *Wood Energy Data Collection, Assessment and Analysis* by Mr. I. Natarajan Director, National Council for Applied Economic Research
3:45 pm - 4:00 pm	*Tea Break*
4:00 pm - 5:00 pm	- *Analysis of Wood Energy Issues in National-Level Five-Year Development Planning Exercises* by Mr. J. N. Maggo Deputy Adviser, Energy Policy Cell, Planning Commission
5:00 pm - 5:30 pm	**Panel Discussion:** "Incorporating Wood Energy Analysis into National-Level Development Planning Exercises"
<u>26 Oct 95 - Thu - Dehradun</u>	
7:00 am	**Departure from Delhi by Bus.**
1:00 pm	**Arrival in Dehradun**
1:00 pm - 2:30 pm	*Lunch Break*
2:30 pm - 5: 30 pm	**Site Visit:** Facilities of the Forest Survey of India (FSI) **Presentation:** (venue : Meeting Room, FSI) - *Assessment of Wood Fuel Resources from Forest Areas* by Dr. S. N. Rai Director, FSI, Dehradun
<u>27 Oct 95 - Fri - Dehradun</u>	
9:00 am - 1:00 pm	**Site Visit:** Forest areas nearby Dehradun.

1:00 pm - 2:30 pm *Lunch Break*

2:30 pm - 5:30 pm **Site Visit:** Facilities of Indian Council for Forest Research and Education (ICFRE)

28 Oct 95 - Sat - Dehradun/Delhi

8:30 am - 10:30 am **Presentations:** (venue: Hotel Meeting Room)

- *Incorporating Wood Energy Analysis in the National Forestry Action Plan* by Mr. A. K. Mukherjee - Vice-Chairman, National Afforestation Eco-Development Board (NAEB)
- *Analysis of Wood Fuel Supply from Non-Forest Areas* by Mr. Narayan Singh - Retd. Additional Inspector General (Forests)

10:30 pm - 1 1:00 am *Tea Break*

11:00 pm - 1:00 pm **Panel Discussion:** "Formulating a Comprehensive Approach for Assessing Wood Energy Resources and Supply"

1:00 pm - 2:30 pm *Lunch Break*

2:30 pm **Departure from Dehradun**

9:00 pm **Arrival in Delhi**

29 Oct 95 - Sun - Delhi/Hyderabad

2:30 pm **Departure from hotel to airport**

4:40 pm **Departure from Delhi by Air IC 839**

6:30 pm **Arrival in Hyderabad**

30 Oct 95 - Monday - Hyderabad

8:30 am **Departure from hotel by bus**

9:00 am - 12:00 pm **Site Visit:** Facilities of the National Remote Sensing Agency (NRSA)

Presentations: (venue: Meeting Room, NRSA)

- *Use of Remote Sensing Techniques for Assessment of Wood Fuel Resources"* by Dr. B.L. Dikshithulu - Director, NRSA

12:00 am **Departure from NRSA by bus**

12:30 pm **Arrival at the Non-Conventional Energy Development**

	Corporation of Andra Pradesh (NEDCAP)
12:30 am - 1:30 pm -	*Lunch Break*
1:30 pm - 3:30 pm	**Presentation:** ▪ *Forest Resource Assessment and Planning at State Level"* by Mr. Kamal Naida - Principal Conservator of Forests (PCCF) of Andra Pradesh **Discussion:** "Planning and Implementation of Wood Energy Utilisation and Wood Conservation Technologies (Biomass Gasifiers, Improved Cookstoves, and Domestic Biogas Digesters)" - with officials of NEDCAP
3:30 pm - 4:00 pm	Tea Break
4:45 pm	**Departure from Hyderabad by air IC 516**
5:45 pm	**Arrival at Bangalore**
<u>31 Oct 95 - Tue - Bangalore</u> 9:00 am	**Departure for the Indian Institute of Science (IISc) Bangalore by bus**
9:30 am - 10:30 am	**Presentation:** ▪ *Micro-Level Planning on Biomass Production and Utilisation - A Case Study* by Prof. H. S. Mukunda - IISc, Bangalore
10:30 am - 1 1:00 am	*Tea Break*
11:00 am - 1:00 pm	**Site Visit:** Biomass Gasifier Laboratory and ASTRA (Appropriate Science and Technology for Rural Advancement), IISc Bangalore
1:00 pm - 2:30 pm	Lunch Break
7:50 pm	**Departure from Bangalore by air IC 404**
10:20 pm	**Arrival at Delhi**
<u>01 Nov 95 - Wed- Delhi/Agra</u> 6:00 am	**Departure from Delhi to Agra**
Whole Day	**Field Visits**

6:00 pm	**Departure from Agra to Delhi**
<u>02 Nov 95 - Thu - Delhi</u> 9:30 am - 10:30 am	**Presentation:** ▪ *Participation of Beneficiaries in Planning and Implementation of Energy Programmes* by Mr. I. Natarajan Director, NCAER
10:30 am - 11:00 am	*Tea Break*
11:00 am - 1:00 pm	**Panel Discussion:** "Role of Beneficiaries in Planning and Implementing Wood Energy Programmes"
1:00 pm - 2:30 pm	*Lunch Break*
2:30 pm - 4:00 pm	**Panel Discussion:** "Lessons Learned from the Study Tour"
4:00 pm - 4:30 pm	*Tea Break*
4:30 pm - 5:30 pm	**Valedictory Session** ▪ *Summing-Up* by Dr. W. S. Hulscher CTA, RWEDP - FAO ▪ *Valedictory Address* by Hon. Shri S. Krishnakumar Minister for Non-Conventional Energy Sources, Goverment of India ▪ *Vote of Thanks* by Shri S. K. Pandey Additional Inspector General (Forests), MOEF
Evening:	**Farewell Dinner**
<u>03 Oct 95 - Fri - Delhi</u>	**Departure of Participants**

APPENDIX 3. SELECTED PAPERS

WOOD ENERGY DATA COLLECTION AND ASSESSMENT IN INDIA

I. Natarajan
Chief Economist
National Council of Applied Economic Research, New Delhi (India)

The National Council of Applied Economic Research (NCAER) conducted a comprehensive all-India Household Energy Survey in 1978. Although the emphasis of this survey was on kerosene, the study covered all the fuels in view of the fact that the fuels are all substitutable. The study provided consumption estimates of different fuels at the state level and also by their end-uses such as heating, lighting, etc. Both rural and urban areas were covered in the survey.

The sample

The basic data for the study was collected through a sample survey covering above 12,500 households of which around 8,000 households were selected from rural areas. The rural households were selected through a two stage stratified sample design with villages as the first stage units and households as the second stage units. The samples were selected independently in each district of the country. The total number of villages selected was 610. In each village all households were stratified in 5 income groups and samples were drawn independently from each income group.

Method of Estimation

A variety of fuels are used in India, for diverse uses, which are normally measured in different units. It is therefore necessary to express them in a common unit to measure the relative importance of each fuel.

In the present study, the fuels are expressed in terms of Coal Replacement (cr) which takes into account the use efficiency of different fuels. In other words, the fuels are expressed in terms of useful kilocalories and not in terms of gross energy or physical dimensions.

Households use both commercial and non-commercial fuels, consisting of:

(1)	Kerosene	(6)	Firewood-twigs
(2)	LPG	(7)	Sawdust
(3)	Soft coke	(8)	Wood shavings
(4)	Electricity	(9)	Dung cakes
(5)	Firewood-logs	(10)	Crop wastes

Perhaps this is the only study where a distinction is made between logs and twigs. This differentiation is found necessary as twigs burn faster and hence the effective heat utilisation would be less compared to logs.

Commercial fuel is mostly purchased while non-commercial fuel is mostly gathered or garnered at zero cost, particularly in rural and forest areas. The fuel thus collected ranges from dead twigs, branches and brushwood to solid logs. The collection is done from own farms, roadside, public land as well as forests. Both children and adults participate in fuel gathering.

Crop residues are obtained mostly from own farms. Landless labourers and agricultural workers, who work on farms, receive crop residues occasionally from landowners.

The source for dried animal dung is again mostly from own animals, although collection of dung by women and children who tend cattle is also commonly found in some countries of South Asia. Charcoal is partly commercial and partly home produced.

The picture is somewhat different in urban areas. Here the dominance of non-commercial fuel is relatively less. A sizeable portion of non-commercial fuel is also purchased in town/cities. In cities firewood is bought either at the firewood depots or from "head loaders" who bring collected wood from rural areas for sale in towns. In the latter case, wood is sold invariably by bundles and not by weight. The urban poor collect and use biofuels, twigs, wood from packing cases and broken furniture, and agricultural residues such as coconut husks, shells, etc.

Charcoal and dung cakes are also mostly purchased. The urban poor collect dung, make cakes and sell them to urban users.

Thus, there is only an informal market for most of the biofuels consumed by households where the seller knows the households that buy the bio-fuel. In this informal market no records are available either on the quantity of use or on the prices of these forms of fuel. The households themselves do not keep any record of their own purchases or consumption. The acquisition of these forms of fuels for use in the kitchen itself is not uniform over time, which makes even imputation sheer guesswork. The quantity collected in a day varies due to a number of factors such as the availability of material, the availability of persons to do the collecting and the strength of the cattle that are used to transport the fuel. The stock acquired ranges between a day's consumption to a week's consumption, beyond which storage may prove to be a constraint.

In view of these difficulties, this study evolved an indirect method to estimate the quantities of consumption of fuels that are collected. This method, basically normative, relates the quantities of consumption to auxiliary variables for which the data can be collected more easily. The variables used are different for various end-uses. For example, in the case of lighting, mainly 2 fuels are used, electricity and kerosene. Use of electricity for heating/cooking is rare, but kerosene is commonly used for both lighting and heating. Since both fuels are purchased, the total consumption of these fuels is not difficult to obtain. But to estimate the quantities by end-uses such as heating and lighting, the quantities purchased need to be apportioned. Thus, additional household data were collected on the type and number of lamps and stoves used, their usage in terms of number of hours per day and number of days in the year, the size of the container, the average number of days for one filling etc. Using these data, the quantity of kerosene was apportioned between the end-uses. NCAER also conducted experiments by burning several kerosene lamps and stoves of various shapes and sizes to estimate the specific fuel consumption of a particular lamp/stove. The findings were used to cross-check the data provided by the households.

A major use of fuel in rural areas is cooking, and energy use is directly related to the quantity of food cooked. In low-income households the food consists essentially of food--grains. As we move up to higher income levels, supplementary foods, like vegetables, milk and meat, are added. Therefore, for the same consumption of food-grain, households in the upper income strata would require more fuel to meet their cooking requirements. This phenomenon was first observed in an energy study done by NCAER for Bombay City and this was later confirmed in the study "Survey of Rural Energy Consumption in Northern India". The correlation between fuel consumption and quantity of food grains consumed is used to quantify the non-monetised fuels consumed by the households. Essentially it involves deriving a norm of consumption of energy used for cooking per unit of food grain consumed. In view of the high correlation observed between household income and energy use per unit of food grains consumed, these norms were worked out separately for different income categories.

The norms were derived from the sample itself. There were households who used specific purchased fuels exclusively for cooking. For such households, the norms were derived in terms of Coal Replacement per kilogram of food grain. The data on stoves and related efficiencies were taken into account while deriving these norms. To control the variations in these norms, further refinements were made. For example, recognising that the energy needs are higher in hilly and desert areas compared to the plains; energy needed to cook rice is less than that for making *chapatis* (local bread) from wheat flour, etc. In view of these, the country was divided into seven zones based on food habits and agro-climatic conditions. These were

1. Plains of Uttar Pradesh, Punjab, Haryana, Rajasthan and Madhya Pradesh
2. Hilly areas of Uttar Pradesh, Jammu and Kashmir and Himachal Pradesh
3. Maharastra and Gujarat
4. Plains of Assam, Bihar, West Bengal and Orissa
5. Hilly areas of Assam and West Bengal
6. Plains of Tamilnadu, Andhra Pradesh, Karnataka and Kerala
7. Hilly areas of Madhya Pradesh and the Southern region.

Finally, to allow for economies of scale, within a zone and within an income group, households were further grouped into 4 categories on the basis of the quantity of food grain cooked in a day. These were:

- 0-2 kg
- 2-3 kg
- 3-4 kg
- more than 4 kg.

The consumption norms thus estimated are presented below.

AVERAGE CONSUMPTION OF FUEL FOR COOKING 1 KG. OF FOOD GRAIN (KG.)

Income group						
Daily food grain consumption (Kg.)	**Up to Rs. 6,000**		**Rs. 6,001 – 12,000**		**More than Rs. 12,000**	
	Rural	**Urban**	**Rural**	**Urban**	**Rural**	**Urban**
Zone 1						
0-2	1.20	1.54	1.55	2.18	1.97	2.69
2 – 3	0.96	1.28	1.30	1.81	1.65	2.23
3 – 4	0.83	1.01	1.13	1.43	1.43	1.76
4>	0.65	0.79	0.88	0.09	1.11	1.34
Zone 2						
0-2	1.80	2.31	2.17	3.05	2.72	3.71
2 – 3	1.44	1.92	1.82	2.53	2.28	3.08
3 – 4	1.25	1.52	1.58	2.00	1.97	2.43
4>	0.98	1.19	1.23	1.53	1.53	1.85
Zone 3						
0-2	1.16	1.53	1.48	2.08	1.84	2.51
2 – 3	0.94	1.25	1.23	1.71	1.51	2.06
3 – 4	0.81	0.98	1.05	1.35	1.31	1.62
4>	0.64	0.76	0.83	1.06	1.02	1.24
Zone 4						
0-2	1.12	1.52	1.41	1.99	1.71	2.33
2 – 3	1.15	1.22	1.16	1.61	1.38	1.89
3 – 4	0.80	0.95	0.98	1.27	1.19	1.49
4>	0.63	0.74	0.78	1.03	0.94	1.14
Zone 5						
0-2	1.40	1.90	1.69	2.39	2.03	2.77
2 – 3	1.15	1.53	1.39	1.93	1.64	2.25
3 – 4	1.00	1.19	1.18	1.52	1.42	1.77
Over 4	0.79	0.93	0.94	1.24	1.12	1.36
Zone 6						
<2	1.07	1.46	1.34	1.93	1.64	2.26
2 – 3	0.85	1.17	1.07	1.53	1.30	1.70
3 – 4	1.00	1.19	1.18	1.52	1.42	1.77
4>	0.60	0.66	0.69	0.95	0.84	1.09
Zone 7						
0-2	1.50	1.93	1.86	2.62	2.34	3.20
2 – 3	1.20	1.60	1.56	2.17	1.96	2.65
3 – 4	1.04	1.26	1.36	1.72	1.70	2.09
4>	0.81	0.99	1.06	1.31	1.32	1.59

The assumption behind this methodology was that for any given household, the quantity of energy consumed for cooking would not vary much over time in the short run if the quantity of food cooked remained relatively stable. This is a standard statistical estimation procedure, popularly known as “ratio estimates”.

The normative approach may not yield a precise estimate of the level of energy consumption for a particular household. However, for a group of households, classified by income, size and locality, the errors are expected to even out and the estimates at this level are expected to conform closely to reality.

To validate this consumption, NCAER, in a survey conducted in two villages of Bihar and Uttar Pradesh, asked the interviewers to weigh the quantity of fuel and food grain for a sample of households for a period of one week. The total number of sample households thus covered was 36. Based on the data collected, energy consumption per kg of food grain was worked out for each of the 36 households. These norms were then compared with those obtained from the earlier study done by NCAER in 1978-79. Care was taken to ensure that the level of food grain consumption, level of income, and locality were comparable between the two series. This comparison was attempted mainly to see how the two norms deviate at the individual household level and at the group level. The results are presented below.

COMPARISON OF COOKING NORM OF ENERGY FOR 36 SAMPLE HOUSEHOLDS IN U.P. AND BIHAR

Income Group (Rs.)								
Below 6,000			***6,000-12,000***			***Over 12,000***		
A	B	Deviation %	A	B	Deviation %	A	B	Deviation %
0.80	0.74	8.1	0.98	1.22	-19.7	1.19	1.14	4.4
1.15	1.22	-5.7	0.98	0.95	3.2	1.38	1.59	-13.2
1.12	1.22	8.2	0.78	0.74	5.4	1.43	1.22	17.2
0.63	0.74	-14.9	0.98	1.17	-16.2	1.43	1.46	-2.1
0.63	0.74	-7.3	0.78	0.77	1.3	1.45	1.46	-0.7
1.15	0.95	21.0	0.98	1.12	-14.3	1.97	1.86	5.9
0.63	0.74	-14.9	0.78	0.74	5.4			
0.63	0.74	-14.9	0.78	0.85	-8.2			
1.15	1.07	7.5	1.41	1.54	-8.4			
0.63	0.69	-8.7	-0.78	0.74	5.4			
0.63	0.80	-21.2	0.78	0.87	-10.3			
1.15	1.22	-5.7	1.41	1.58	-10.8			
1.15	1.09	5.5	0.78	0.97	-19.6			
0.63	-0.74	-14.9						
1.15	1.28	-10.2						
1.12	1.18	-75.1						
1.15	1.11	3.6						
Avg 0.91	0.95	-4.2	0.94	1.02	-7.8	1.48	1.45	2.1

It is seen that, while the difference between the two estimates varies from 0.7% to 21.2% for individual households, at the aggregate level, namely, for any income group, the difference is small, from 2.8% to 7.8%.

Energy surveys are meant to provide a bench mark picture of level and pattern of energy consumption, by the type of fuel, sector or end-use. It will form a basis for the designing of suitable energy policies. In any sample survey, only averages of the groups of households are considered reliable, and individual variations are assumed to cancel out. The indirect approach, in this sense, is as good as any other direct method of data collection and estimation.

Major Results of the Study

The total energy consumed in the household sector was estimated at 132.1 million tonnes of coal replacement (mtcr). Of this, 95.2 mtcr was for rural areas. The overall per capita

consumption was 206.1 kgcr. The rural average was less at 189.7 kgcr compared to the urban 265.5 kgcr

HOUSEHOLD ENERGY CONSUMPTION IN 1978-79

Energy consumption	Rural	Urban	Total
Total consumption (mtcr)	95.2	36.9	132.1
Average household (kgcr)	1180.0	1531.7	1209.1
Average per capita (kgcr)	189.7	265.5	206.1

Around 90 per cent of the energy consumed in rural households was met through non-commercial sources. Firewood alone accounted for a little over 50%. Nearly 80 million tonnes of firewood was consumed by rural households. Only a fourth of this was in the form of logs.

PATTERN OF FUEL CONSUMPTION

Fuel	Unit	Quantity	Share in total energy
Coal/coke	000 tonnes	1,143	1.8%
Kerosene	000 kl	2,559	7.1%
Electricity	Mill. kWh	2,460	1.8%
LPG	000 tonnes	7	0.1%
Total Commercial			10.8%
Logs	000 tonnes	20,109	17.8%
Twigs	000 tonnes	58,742	33.4%
Sawdust	000 tonnes	235	0.2%
Wood shavings	000 tonnes	236	0.2%
Crop waste	000 tonnes	29,528	16.3%
Dung cakes	000 tonnes	66,755	21.1%
Charcoal	000 tonnes	72	0.1%
Bio-gas	000 cum	24	0.1%
Total, Non-commercial			89.2%
Total, All fuels			100.0%

Dung cake was another important fuel contributing a little over 20% of the rural households energy consumption, followed by crop waste, 16.3%, While firewood was consumed in significant quantities in both rural and urban areas, crop wastes and dung cakes are mostly consumed in villages. Another striking difference between urban and rural areas is in the composition of firewood. While twigs dominated in villages, logs accounted for the major share (over 70%) of the firewood use in cities.

Purchase versus Collection

Practically all the commercial fuel consumed was purchased. The only exceptions were coal and soft coke – in these cases a small portion was collected. On the other hand around 90% of the non-commercial fuel was collected in villages. Firewood is collected from roadside bushes and trees, from forests etc. Land owning households collect crop wastes from their farms. Agricultural labourers sometimes receive fuel in the form of crop residues

from their employers. Standing trees are also cut and burnt as fuel by farmers. Cattle owning households make dung cakes from the animal dung for fuel. The collected fuel referred to in this study includes all these forms of collection.

Income did not have any effect on the rate of collection in rural areas. It looked as though rural households resorted to collecting fuels whenever there was access or opportunity. Purchase entered into the energy scene as the last resort.

SHARE OF NON-COMMERCIAL FUELS, COLLECTED IN RURAL INCOME

Income group	Percent collected
Up to 3,000	90.1
3,001-6,000	88.1
6,001-12,000	88.3
12,001-18,000	89.8
Over 18,000	91.7

Source of collection

Firewood is collected from several sources, such as:

- Farms;
- road side bushes and trees;
- forests; and
- other sources, including wages in kind.

The collection of logs was mainly from two sources, farms and forest, while in the case of twigs, apart from these two sources, a significant quantity was collected from road side trees.

FUELWOOD: A MAJOR POLICY ISSUE FOR THE NATIONAL FORESTRY ACTION PLAN (NFAP)

SHRI A.K. MUKERJI
Former Inspector General of Forests and Vice-Chairman, National Afforestation & Eco-Development Board, Ministry of Environment & Forests, Government of India

1. Introduction

It is estimated that fire was discovered by man some 50,000 years ago and since then fuelwood has been used for cooking food. Neolithic man began practising agriculture, fishing and animal husbandry around 10,000 years ago, and wood from forests was (and continues to be) used for agriculture implements, for house building, for building carts, for cottage industries. The first evidence of the proper management of forests in India for multiple uses is found in Kautilya's **"Arth Sastra"** (321 B.C.) at the time of the Mauriya Kingdom, when forests were classified based on their management and use as below:

a) Reserve forests preserved for hunting pleasure of the king and royalty.
b) Forests donated to Brahmins and important persons for the use of their families.
c) Forests for the public use.

The Gupta period which followed also maintained similar categories for forest management. These were used up to 673 AD. However, after that the country remained divided into small kingdoms that used forest products extensively and without much concern for forest management. During the Moghul period, large forest areas were cleared for agriculture though some tree plantations were raised along canals, roads, etc.

During the British era, the forests were initially overexploited to meet the demand for teak and other timber for the Royal Navy, the construction of railways, etc. Scientific forest management was initiated with the appointment of Mr. Dietrich Brandis as the first Inspector General of Forests, Government of India in 1864. However, with the rise of population from 238.40 million in 1901 to 361,10 in 1951 and 846,36 in 1991, the pressure on forests, especially for fuel, increased tremendously leading to over-exploitation and degradation of forest areas and resources.

2. Fuel Wood Demand and Supply Scenarios

2.1 Demand Scenario

In the pre-independence era (prior to 1947), there were still substantial forests in the countryside on government, private and community lands and the demand was manageable as the population was only 318.40 million in 1941. The usual practice of collecting fuelwood from forest areas for domestic cooking and cremation continued unhindered. Adequate supplies were available in and around the villages. However, with the rising population, especially in the rural areas, and the development of rural industries requiring fuelwood (brick kilns, jaggery making, tobacco roasting, etc.), the demand for fuel wood increased sharply.

The National Commission of Agriculture (1976) estimated that fuelwood, agricultural wastes and animal dung constituted the major biomass energy source in India accounting for approximately 90% of the energy consumed by households. The major portion of this, i.e.

about 85% (62% wood fuel, 23% agricultural waste and cow dung) was consumed in villages. At national aggregate level, fuelwood and charcoal (from wood) accounted for 46% of the total energy consumed in India (National Council for Applied Economic Research-1985). Forest Survey of India (FSI) in its report of 1981 estimated an annual demand of fuelwood of about 225 million m^3.

The Planning Commission Study Group (1991) on fuel for VIIIth Plan estimated the demand of fuelwood during 1991, 1996 and 2001 as 306.40, 342.80 and 383.58 million tonnes respectively.

The Rural Energy Database prepared by the Tata Energy Research Institute (TERI) in 1991 indicates the following breakdown of the bio-fuel requirement.

Type of Fuel Source	**Consumption Demands (in MT/year)**
Fuelwood	252.1
Dung cake	106.9
Agriculture residue	99.2
Total biomass	458.2

As such there has been considerable variation in the assessment of the country's biofuel requirement, especially for fuelwood. A major portion of the fuelwood is collected free of cost (under various rights and concessions granted to the rural and tribal people) from the government-owned forests that form more than 90% of the forest area in the country. A policy paper prepared by the Ministry of Environment and Forests in 1992 indicates that this unrecorded removal of fuelwood from forest areas amount to around 220 million tonnes per year, in addition to supplies from trees growing in community and private lands.

2.2 Supply Scenario

At the time of independence, India had around 40 million ha of Reserve and Demarcated Protected Forests. An area of nearly 37 million ha, was added to this over a 20-years period from 1950 to 1970 due to the abolition of the *Jamindari* system and the "princely states" and the subsequent surrenders made under the Land Ceiling Act etc. At the initial stage, due to population pressure and the associated needs both for forest products and land, as well as the uncertainty of ownership and tenure on land and trees, large-scale deforestation took place in this 37 million ha of forest areas. Moreover, it is estimated by FSI that from 1950 to 1980, nearly 4.3 million ha of government forest land were also converted to non-forest use such as agriculture, horticulture, submergence by dams, urban and industrial development, etc.

Moreover, the pressure on fuelwood from forest areas increased further due to the large-scale diversion of private and community land and the reclassification of government revenue land from miscellaneous tree crops to agriculture. The land under agriculture increased from around 134 million ha in 1951 to 154.70 million ha in 1991 (nearly 50% of the country's geographical area of 328.8 million ha).

Thus, 20 million ha of forests, tree crops, agricultural wastes, etc were diverted bringing additional pressure on the existing forest land. Moreover, nearly 0.7 million ha of forested land is being used for agriculture (without authorisation) and 3.5 to 4.0 million ha of forest area is subjected to shifting cultivation. All these activities have substantially reduced the source of fuelwood supply to rural areas.

In its 1993 assessment using satellite data interpretation FSI indicated that though officially it is claimed that the government forest area in India is 76.77 million ha (23.34% of country' s geographical area of 328.8 million ha), the actual forest cover in India was only 64.01 million ha (19.47%). Of this only 38.55 million ha. (11,73%) was dense forest cover (crown density 40% and up), 25.03 million ha. (7.61%) of open forests (crown density 10%-40%) and 0.42 million ha (0.13%) mangrove forests. Though India's forest policy lays down that the country should have 33% area under forest/tree cover, FSI has estimated that out of 413 districts only 105 districts have 33% or more of forest cover.

The FSI has also estimated that the country's forest growing stock is approximately 4,740,858 million m^3, or only 74.42 m^3 per ha of the vegetation cover. Furthermore, the FSI has estimated that the annual increment contributed by this forest growing stock is around 87.62-million m^3. As such, it is clear that withdrawal of fuelwood is far in excess of the production capacity of the present stocking of Indian forests.

3. Possible Remedial Measures

The National Forest Policy of 1988 states that forests should be managed to meet the basic needs of the rural population on a sustainable basis. In view of the serious situation of the growing demand of fuelwood beyond the carrying capacity of our forests, there is an urgent need for adopting remedial measures, such as those indicated below.

A) Presently, the investment in Forestry in India is only 1% of the national development plan amounting to nearly Rs,8000 million (242.4 million US$) per annum. The estimated withdrawal of biomass (220 million tonnes fuel, 280 million tonnes fodder, 12 m^3 timber and few hundred thousand tonnes of gums, resins, medicinal plants, *tendu* leaves, etc,) priced at US$ 15 per tonne comes to an estimated value of nearly 10 billion US$ per annum.

B) The current investment can at best lead to the raising of a million ha of plantation in government areas and another 0.3 to 0.5 million ha on private and community lands. Taking the average production of 5 metric tonne of fuelwood per year per ha from a well-maintained forest, more than 45 million ha of forests are needed only for fuelwood supply. This will be very difficult to ensure considering that 14 million ha of the country's best forests are classified as sanctuaries and national parks.

C) Even considering a rather high productivity of around 8 to 10 tonnes per ha per annum from well-managed Plantation/agroforestry areas, the need of the hour is to raise at least 20 million ha. of fuelwood plantations in degraded forest areas, community land, etc. during the next 10 years period to prevent over-exploitation of the natural forests.

D) Another supportive activity would be to enhance investment in the provision of more modern cooking equipment, crematoriums and animal dung gasification plants in the villages, as well as in the provision of non-conventional energy sources such as wind, solar**,** etc, to relieve the pressure of biofuels. As fuelwood trees are a basic need of rural India their establishment on community and private lands should be made an essential component of rural development and employment generation programs.

Moreover, 70% of the investment on fuelwood plantation would be in the form of wages thereby creating large-scale employment opportunities.

E) The states having more than 33% area under forest should identify forest deficit districts that are to be brought up to the optimum level of 33% tree cover through agroforestry and planting on community lands. The states that cannot reach the optimum level of 33% forest or tree cover of their geographical area should work out an appropriate optimum level that they can achieve through afforestation and tree planting inside and outside forests in the next 20 years.

F) Need based afforestation, tree planting, eco-restoration and eco-development programmes should be conducted on the forest and non-forest areas of government, community and private ownership. The attainment of optimum forest or tree cover in the next 20 years period is being worked out in the State Forest Action Plans now under preparation,

G) At present the states do not have a Rural Energy Policy and pressure is on the forests for the supply of fuelwood for domestic use, head loading for sale in the towns and cities and consumption by rural industries, namely, lime kilns, brick kilns, tobacco curing, etc. At the central level also a clear rural energy policy is lacking. It is, therefore necessary to frame clear policies at the Central and State level.

H) The Planning Commission should set up an expert group including experts from the Ministries of the Environment and Forests, Non-conventional Energy Sources, Rural Development and Agriculture departments and NGOs to develop a Rural Energy Policy. This group should clearly identify the emerging pattern of biomass consumption in the rural energy sector and apportion the responsibility of each sector for meeting the demand on a sustainable basis. It should then lay down policies and programmes and provide funds accordingly in proportion to the targets fixed for each sector for meeting biomass based energy needs.

I) The State Governments should also initiate moves to integrate programs to raise energy plantations into rural development programs. This sector needs appropriate investment as it will meet essential domestic needs and also create large-scale rural employment opportunities, conserve soil & water, preserve biodiversity in the natural forests and provide environmental stability to the country.

PARTICIPATION OF BENEFICIARIES IN PLANNING AND IMPLEMENTATION OF ENERGY PROGRAMMES

I. Natarajan
Chief Economist
National Council of Applied Economic Research, New Delhi

Firewood is a major source of energy for households in India. Though not a clean fuel it is preferred by a significant section of the population, particularly in rural areas. In an energy study done by NCAER in 1978-79, it was found that over 60% of the households preferred this fuel for cooking. For a vast majority of the poor, firewood is perhaps the only free fuel available for the kitchen. Households gather wood in numerous forms from a variety of sources. And, although it is a renewable source of energy, it has been exploited in the past much faster than the rate of regeneration.

Inevitably, therefore, two things have happened. Over the years, collection has become difficult. Women and children, who normally gather fuel, have to walk several miles in search of any biomass that could serve as a substitute for firewood. The rural landless and urban labourers have been hit the hardest. Not accustomed to paying for the fuel, they have been left with the option of either spending more of their scarce time on collection of fuel or paying for a superior fuel they could ill afford.

The indiscriminate felling of trees has resulted in widespread denudation of the tree cover with its attendant ill effects on the environment. It has affected the amount and distribution of rainfall. This large-scale deforestation has had other harmful effects also. The absence of tree cover reduces the amount of sub-surface water percolation and average run-offs. Another harmful effect is the resultant decrease in soil stability and accelerated soil erosion.

Realising the serious nature of the situation, the Government of India has begun responding to these problems. The Government invests large sums of money in afforestation programmes for rejuvenating the lost greenery. There are other programmes such as biogas and improved cooking stoves that can help in the conservation of energy. There is also the Integrated Rural Energy Programme (IREP), where energy planning and implementation are done at the micro level. One of the objectives of this programme is to induce villagers to adopt energy saving devices and to popularise the use of non-conventional energy sources such as solar, wind, etc.
During the last 10 years the National Council has evaluated some of these programmes and has found that the programmes have had varying degrees of success. Some performed poorly, a few had moderate success, while a few were generally successful. Some programmes succeeded in some aspects but failed in others.

The afforestation programme has several components such as social forestry, plantations on community lands, farm forestry, etc. It was found that in a number of cases the survival rates were low, turnout was poor, and the plantations were not maintained properly, which resulted in them being damaged by cattle grazing. In some cases, villagers destroyed the plantations by chopping down the trees for fuel. In the case of improved stoves, many (more than 20%) had a short life span as they were not maintained properly by the villagers. In the

case of biogas plants, there were 2 types - family plants and community plants. While family plants were successful, the same cannot be said about community plants.

The results of IREP also varied between states. In a few states this programme was a success while in the others the performance was average. There were several reasons identified for the success or failure of these programmes. They all varied depending on the nature of the programme. But in all these cases there was one crucial factor, the extent to which the villagers are involved in the programme.

Most of these programmes are basically intervention programmes. The aim is to induce energy conservation behaviour and/or shift to more fuel-efficient appliances that do not destroy the environment. Such a change can come about only when the villagers believe in the programmes. Normally, the villagers will not change their traditional ways unless they perceive some benefits. Since these are people-oriented programmes, the participation of the villagers is a prerequisite for success

Some of these programmes give only long-term benefits. Many of the afforestation programmes fall into this category. The villager neither foresees nor appreciates such benefits. There are a few villages in the country where the energy crisis is already felt. In these villages people have to travel long distances to gather wood and other material. But in most villages, the situation is not that acute. This was borne out in a number of energy surveys done by NCAER in the recent past. Villagers still do not perceive energy as a problem area. They do not foresee that at the present rate of consumption of renewable sources of energy, such as wood, they are instigating an energy crisis. To most villagers the conservation of energy is not an immediate concern. This is one of the major reasons why villagers do not get involved in the energy programmes.

Even when the benefits are immediate, as in the case of adopting more efficient devices/sources of energy, the villagers invariably give a lukewarm response. A lot of convincing is needed before they accept a new device. It has been seen time and again, that coercion or inducement through subsidies does not work. Only when the villagers believe that the change is for the better, are they willing to switch over.

It is clear that to ensure the participation of villagers, they need to be prepared through intensive training. All these programmes already referred to have had a training component for beneficiaries. The basic objective of the training is to make them aware of these new devices and to enlist their co-operation. But even although impressive schedules are drawn up for training the villagers, these are not always taken seriously or given due importance.

In the following paragraphs, the results of the evaluation studies of 2 programmes, namely Improved *Chulha* (stoves) and IREP are presented to show how the involvement of villagers or the lack of it affects the performances of these programmes.

Improved *Chulhas*

In rural India, a *chulha* is traditionally used for cooking. The traditional chulhas used in rural households have a low thermal efficiency of around 8 per cent. On the other hand, it is claimed that the improved *chulhas* (ICs) have an efficiency of around 24 to 26 percent. Thus, improved *chulhas* need only a third of the quantity of fuel required to cook the same food using a conventional/traditional stove. Improved *chulha* models, though developed

mainly to improve the boiling and evaporation efficiency, provide a chimney to let out smoke from the kitchen. Furthermore, efficient burning of the fuel reduces smoke emission significantly. Consequently, the use of ICs, besides cutting down on fuel consumption, would provide several benefits to households. They provide a cleaner environment inside and outside the house, relief from the drudgery of fuel collection, and they lower the incidence of eye and lung diseases. Cleaning of cooking vessels is also made easier as there is considerable reduction in carbon deposits on them. The housewives will have no difficulty in switching over from traditional *chulhas* to ICs as in terms of use there is no difference between the two. The ICs are also inexpensive, made of local materials so that even poor households can afford them. The improved chulha is ideally suited for rural India. It is easily adapted to suit local conditions, and being very cheap, it can be acquired by the masses, unlike biogas and other similar devices. If adopted on a large scale it can really make a dent in the firewood demand. Yet this programme, even after a decade since its initiation, has not achieved the level of success one would expect, considering the number of positive aspects of this programme.

NCAER undertook an evaluation study of the *chulha* programme based on a survey of 15,000 *chulha* owners who had acquired their *chulhas* between 1988-89 and 1991-92. According to this study, 40% of the *chulhas* installed during this period were no longer functional. Two major reasons identified for this were defective construction and installation, and improper maintenance. Regular maintenance of *chulhas* not only increases the life of the *chulhas* but also ensures energy fuel efficiency leading to fuel savings whatever the fuel. It is recommended that the chimney should be cleaned once a fortnight to remove the carbon deposits. The study also showed that the survival rates of *chulhas* where the chimney was cleaned every fortnight was 68% as against 28% where this operation was not done. In fact, even cleaning the chimney once in 3 months nearly doubles the life of the *chulha*. The reason for not undertaking this operation in many cases is ignorance. The users are supposed to be trained in *chulha* repair and maintenance by the implementing agencies. But according to the survey results only a third of the households claimed to have received any training.

The importance of user involvement through training is recognised by policy-makers and there is an emphasis on intensive training for the beneficiary households by the implementing agencies and specific targets for the same are given in the programme manual. The implementing agencies for their part invariably fulfil these targets, but the quality and content of these training programmes in a number of cases leave a lot to be desired.

It is of course, unfair to blame only the implementing agencies. The beneficiary households should also take an equal share of the blame, if not more, for this state of affairs. There is a general lack of interest among beneficiaries in the *Chulha* Programme. Training sessions are never taken seriously. Every new beneficiary is supposed to attend the training programme but many choose not to. Since the major use of fuel in rural areas is for cooking, one would think that women would be more likely to perceive the advantage of ICs than men, but very few women take advantage of these sessions. Usually, it is the men who attend the training and they seldom pass on the knowledge acquired to the women. Even when they do, it is not complete in every respect.
This lack of interest is also evident in the maintenance of the *chulha*. Many of the non-functional *chulhas* could have become operational with a few minor repairs or with proper maintenance. The cleaning of the pipe is not done at stipulated intervals in a majority of

cases. In fact, the pipes themselves are missing for one reason or another in many cases. The men normally clean the pipes as it involves climbing the roof and lowering a cloth covered brick attached to a string down the chimney, then moving it up and down to remove the carbon. The men are reluctant to undertake this task often.

One of the reasons for this indifference on the part of the beneficiaries is that they have little or no stake, financially, in the *chulhas* installed in their houses. The cost of the *chulha* to the beneficiary is hardly Rs. 10 while the market price of the chimney pipe provided along with it is more than Rs. 50. Some households have opted for the *chulhas* only because of the attraction of the subsidy in the form of pipes, iron grates, etc. In a number of cases the chimney pipes have been grossly misused for sanitary latrines, irrigation channels, etc. or even sold in the open market, after being removed from the *chulha*.

Although nearly 2 million *chulhas* are introduced into the system every year, the fact that many (over 20%) have a short life span means that they contribute very little to the woodfuel conservation effort.

For a programme of this kind to succeed villager involvement is essential. The involvement of women, who are the real users of the *chulhas*, is a must. Women's organisations should be encouraged to participate in larger numbers in the training activities, The present apathy towards maintenance and repair of *chulhas* would disappear once the villagers are convinced of the usefulness of the ICs.

Today chulhas are not demanded, but are invariably thrust on villagers. If the villagers perceive the benefits of this pro*g*ramme, a demand for this product would be generated. Then and only then, would this programme achieve the success it richly deserves.

Integrated Rural Energy Programme (IREP)

Recently, NCAER undertook an evaluation of the IREP programme in 6 states of North India. The major findings with regard to the state of Haryana are given below.

The IREP is a big success story in Haryana. This state has implemented IREP in the way it was conceived and developed. It has a highly motivated and dedicated staff and it has involved the villagers at all the stages of planning and implementation. The staff attached to the programme constantly interacts with the villagers through group discussions and demonstrations and convinces the villagers of the benefits of IREP and the usefulness of the devices.

The programme is target-oriented. Availability of funds is of course the primary consideration in fixing targets. The state conducts various cooking competitions for women in order to encourage their participation in the programme. The feedback from these competitions and from the beneficiary awareness camps is taken into consideration when

fixing the targets. Every year, the programme is implemented in a few villages. Normally villages are selected in rotation. The major considerations for the selection of the villages are:

- extent of involvement and acceptance of a particular technology in the village in the past;
- response of village Panchayats and Mahila Mandals towards the development scheme; and
- feedback from beneficiaries in awareness camps.

In the selected villages, beneficiaries are selected from the awareness camps. Sometimes the beneficiaries are selected on the recommendation of the village headman and in such cases applications are invited from potential beneficiaries for specific devices in the prescribed forms. Thereafter, depending on the targets, the necessary assistance is provided to the beneficiary. Thus, the involvement of beneficiaries occurs at all stages of the programme. As a result, this state has emerged as the model for others to emulate.

These 2 examples show how important the participation of beneficiaries is for the success of any people-oriented welfare programme.

The objective of the Integrated Rural Energy Programme is to provide an institutional framework for investment planning and optimal allocation of resources for meeting rural energy needs in the most cost effective manner through the least-cost mix of various energy sources, including conventional, non-conventional, commercial and non-commercial energy.

IREP is eco-friendly, income and employment growth oriented, rural and resource based and people-oriented. The programme is well conceived and aims to provide better and cleaner energy sources to the villagers.

India is a vast country, with diverse agro-economic conditions. The states vary widely with regard to endowment of natural resources. There are variations in the eating/cooking habits of people. Their energy needs are different. In formulating energy programmes one has to take into account all these factors. The strategies should be different for different areas. What is applicable to Uttar Pradesh may not suit Kerala. Planning at the macro level is absolutely necessary. This is where the strength of IREP lies.

Moreover, the programme ensures large-scale people's participation in the planning and implementation of the programme through direct involvement of Panchayats, voluntary and nonofficial bodies and institutions and the establishment of self-managed organisations and other appropriate people-oriented arrangements wherever feasible at the micro-level for the implementation of IREP projects. Involvement of people is vital for any intervention programme, It makes people believe in the programme and hence ensures sustainability.

Another positive aspect of the programme is that it is not carried out in isolation. It is integrated with all the other on-going rural development programmes of the state and is dovetailed with the state plan. Thus, it is consistent.

Another component of the programme is ‘Human Resources Development’ through training. This training is envisaged at several levels with the setting up of training institutes at the national, regional and sub-regional levels where villagers are trained to use energy saving devices and technologies. Through this training, the villagers are made to realise the importance of energy conservation and of energy sources that are eco-friendly and do not destroy the environment. The programme also provides support services for the maintenance and repair of devices. This gives the villagers confidence that the devices they acquire can be repaired without difficulty.

WOOD ENERGY ISSUES IN NATIONAL-LEVEL FIVE-YEAR DEVELOPMENT PLANNING

J.N. Maggo
Deputy Adviser, Planning Commission

India is a large country with a geographical area of nearly 328 million square kilometres. The population of the country was 844 million on March 1, 1991 Census. The population is likely to cross the 930 million mark by the end of the current year. About 74% of the total population resides in rural areas. The Indian economy continues to be primarily based on agriculture even though the share of agriculture sector in the total GDP has been steadily declining over the years.

India became independent in 1947. The planning process was initiated in 1951 with the launching of the First Five-Year Plan. Since then eight Five-Year Plans have been formulated and executed. There were a number of Annual Plans also during this period. The work on formulation of the Ninth Plan is to be initiated shortly.

Energy is one of the key inputs in the development of the country's economy. Energy is consumed in a variety of forms. Fuelwood, animal waste and agricultural residue constitute the traditional sources of energy that continue to meet the bulk of the energy requirement, particularly in the rural households. But commercial fuels like electricity, coal, lignite, petroleum products and natural gas are gradually replacing these traditional or “non-commercial” fuels. The share of non-commercial fuels in the total primary energy supply has declined from more than 70% in 1953 to less than 50% in 1993. The consumption of non-commercial fuels in 1993-94 is estimated to be 118 8 Mtoe (million tonnes of oil equivalent). Fuelwood comprises the major share and accounts for a little more than 65% of this consumption. In actual units the fuelwood consumption is estimated to be around 160 million tonnes annually.

The energy planning process in India is shown in Figure 1. The Planing Commission is responsible for preparing both the Five-Year and Annual Plans for the various sectors of the economy. The Perspective Planning Division provides the overall plan perspective while the concerned divisions provide inputs for the sectoral plans. At the time of formulating a Five-Year Plan the Planning Commission sets up a number of Working Groups. There is a working group for each of the energy sub-sectors. The working groups comprise representatives of the concerned major producing industries, the consuming sectors as well as of the Planning Commission and the administrative ministries. The sectoral estimates of energy demand provided by the working groups are then used by the Perspective Planning Division of the Planning Commission to work out the sectoral demand estimates consistent with the growth profile of the economy. This exercise uses an elaborate input-output model. Other models of energy demand and supply optimisation, which have been developed within the Planning Commission as well as by other agencies like the Tata Energy Research Institute (TERI) are also used.

In view of its importance for sustaining economic growth and meeting basic needs, the Government has given energy sector development serious consideration. Integrated energy

planning was recognised as an essential element of development planning as early as the 60s. A number of high-level Committees/Working Groups were set up in the past to examine in detail the various issues and make recommendations concerning the development of this sector in the short-, medium- and long-term. The recommendations made by this committees/Working Groups came in handy while formulating various Five-Year Plans. The Energy Survey of India Committee was constituted in 1963 to study "the present and perspective demands and supplies of energy, both total and in respect of constituents of energy on a national, regional and sectoral basis." The Committee's report was submitted in 1965, well before the Fourth Plan was finalised. In later years, the Fuel Policy Committee's report was prepared for the Fifth Plan, the Report of the Working Group on Energy Policy was prepared for the Sixth Plan and recommendations of the Advisory Board on Energy where submitted at the time of the Seventh Plan. The Planning Commission has recently constituted the Energy Policy Committee. The recommendations made by this committee will be kept in view while finalising the Ninth Five-Year Plan.

As has been mentioned above, estimating energy demand for different fuels by the consuming sectors forms the initial step in the process of energy planning. In the case of non-commercial fuels, including fuelwood, the demand mostly arises from the household sector for meeting the cooking needs of the households. The database for energy consumption in the household senator especially for the non-commercial fuels is not comprehensive, This is because non-commercial fuels are mostly gathered outside the market place and the transactions are rarely recorded. Primary data are available from field surveys conducted by the National Sample Survey Organisation (NSSO), the National Council of Applied Economic Research (NCAER) and other research institutes and individuals. However, these surveys are far too scattered to give a comprehensive picture of the regional variations in the pattern of energy consumption of these fuels.

The household sector is the major consumer of energy. Non-commercial sources of energy play a major role in meeting the energy requirements of the household sector, particularly in the rural areas. The methodology of estimating the household energy demand was first adopted by the Energy Survey of India Committee (ESIC) in 1965. On the basis of the results of the sample surveys carried out by the agencies mentioned above, the ESIC adopted an energy consumption requirement norm of 0.39 tonnes of coal replacement (tcr) per person per year for urban households and 0.38 tcr per person per year for rural areas. After so determining the total energy requirement in the household sector, the projected contribution of commercial sources of energy was subtracted from it to arrive at the share of non-commercial fuels. The same was then apportioned among fuelwood, agricultural waste and cow-dung at a ratio of 65:20:15. This is only to indicate that the available estimates of non-commercial energy consumption in the household sector yield only rough estimates rather than precise estimates. This methodology continued to be adopted till the mid-80s. The Advisory Board on Energy adopted the concept of useful energy requirement per person in the household sector. In the report 'A Perspective on Energy Demand and Supply in India in 2004-05'' published in 1985, the ABE adopted a norm of 650 kilocalories of useful energy requirement per person per day for cooking and space heating in the year 2004-05. The fuel mix for the year under consideration was then worked out on the basis of population, the rural-urban distribution of population etc. The fuel mix adopted for the exercise was as per the Domestic Fuel Survey of the NCAER for the year 1978-79. In 1986 the Energy Demand Screening Group (EDSG), set up by the Planning Commission, lowered the consumption requirement of useful energy to 520 kilocalories per person per

day in rural areas. Other studies carried out later like the Sectoral Energy Demand in India estimated the useful energy requirement in 2009-10 as 641 kilocalories per person per day.

The requirement of fuelwood as estimated from these exercises was of the order of 200 million tonnes per annum. This is an indicator of the importance of fuelwood as an energy source. Fuelwood is obtained not only from forests but also from trees that exist outside the forests. However, the area under forests is no indicator of the quantity of fuelwood available in the forests which could better be described by an index called 'Growing Stock' and the annual increment in growth of the forests called the 'Mean Annual Increment' (MAI). These indices depend on the nature of the forest, the varieties of trees, etc. Adequate information was not available about the yields each of the tree species would provide. Growing stock estimates made by different agencies gave different results. The Pre-investment Survey, carried out in 1965 in collaboration with the FAO, investigated the forest resources in three small selected areas of the country. The results of the survey indicated that the quantity of growing stock would be widely differing in the different areas. Furthermore, the estimates of growing stocks made were with reference to timber yields only and excluded the yields from bark, twigs and branches The Gross Annual Increment of forest represent the additional wood produced each year in the forests. If the extent of removal of wood from the forests is at the same level as the annual increment and if such extraction is scientifically managed, the stock of wood in the forest would remain unchanged. In such cases where the removal is more than the increment, problems will arise. Keeping all this in view, the Working Group on Energy Policy in its report in 1979 opined that the state of knowledge about the fuelwood resources was very inadequate. The Group recommended that a committee of technical experts, including experts on rural energy and fuel technology, examine the methodology for assessment of fuelwood resources.

A Fuelwood Study Committee was created by the Planning Commission in 1981 to study all aspects of fuelwood for energy planning purposes. Past experience in India and other countries was to be taken into account and a suitable proposal for inclusion in the plan was to be worked out. The Fuelwood Study Committee examined the subject in detail and gave a set of recommendations. In view of the major role fuelwood plays in meeting the energy needs of the rural and urban populace, augmenting fuelwood supplies is of prime importance and calls for various additional measures to be initiated and implemented. Keeping in view of the data on the energy consumption pattern in the rural areas and the availability of commercial and non-commercial fuels, the Committee stressed the need for a dynamic, integrated and long-term action plan for promoting the growth of fuelwood plantations in the country.

The recommendations made by the Fuelwood Study Committee included carrying out a survey to assess the availability and production of non-commercial fuels and identifying forest areas for intensive rural fuelwood and/or biomass production in each state. It recommended the introduction of improved management programmes for increasing the fuelwood availability from lands of different categories identified above. The Committee further stressed the need for carrying out an R&D programme in the area as well as complementary programmes for increasing the efficiency of the devices using wood and wood products and developing other energy sources like biogas plants. The Committee further recommended identifying fuelwood as one of the basic needs that should be covered under the minimum needs programmes.

The Sixth Five -Year Plan (1980-85) recognised firewood as the most important non-commercial fuel that was becoming increasingly scarce and also becoming commercialised. Energy forestry was also recognised as an important component of the energy strategy as it was felt that the rural communities would continue to depend on firewood for several decades to come. A large programme of fuel and farm forestry was adopted in the Plan. Also, an Integrated Rural Energy Program (IREP) was initiated in the Sixth Plan on a pilot scale with the objective of providing a mix of energy options for meeting the energy needs of the rural areas on an area-wise basis in the most cost-effective manner. To implement this programme, the Planning Commission set up a separate Rural Energy Division. A Rural Energy Planning Exercise was commissioned by Planning Commission to develop the design and approach of planning and implementing area based block-level integrated rural energy projects.

The Advisory Board on Energy brought out a report 'Towards A Perspective on Energy Demand and Supply in India in 2004-05 in 1985. The main conclusions of the report were that at least 60 million hectares of land (comprising open/degraded forest land, barren and uncultivable land, cultivable wasteland, land other than current fallow, farm and perimeter land), might be available for raising fuelwood/fodder plantations. Given the acute pressure on land, and the other uses it could be put to, not more than half of the land area identified could actually be used for plantation purposes. The study revealed that the productivity of the Indian forest lands is quite low and need to be increased. On the-basis of the yields expected, present day *chulha* efficiencies and the availability of land, it may be difficult to meet the-fuelwood requirements of certain areas of the country.

As has been mentioned above, India currently consumes nearly 119 million tonnes of oil equivalent (Mtoe) of non-commercial energy. According to the report on Sectoral Energy Demand in India (1991), despite the large substitution by commercial energy, the level of non-commercial fuels will still be at a level of 103 Mtoe in 2004 and 84 Mtoe in the year 2009. As is to be expected, the bulk of this will have to come from fuelwood. Even if afforestation were to be taken up on a large scale during the next 15 to 20 years, it would still leave a sizeable deficit of forest cover in terms of what is optimally required and what is actually available. In order words, the emerging energy supply scenario will imply continued heavy dependence on fuelwood for energy during the 20 years to come and, consequently, continued “mining” of the tree cover with accompanying ecological degradation. In the case of both crop residue and dung, since the competing demands for these forms of biomass will also increase simultaneously, it is difficult to visualise any incremental availability of either dung or crop residue without its further adverse impact on soil fertility and livestock productivity. It is important to note here that if commercial energy supplies fail to materialise to the extent envisaged in future, there will be a heavier burden imposed on the traditional fuels leading to an aggravation of the problems referred to above. The present balance is a fragile one. Added to this, commercial energy supplies (oil) are subject to the vagaries of the external markets.

Another aspect that needs to be considered is that the inefficient burning of biomass emits smoke causing health hazard to beneficiaries who are largely in the lower income groups of the rural and urban areas. In the normal course, the major objective of energy planning should be either to replace these traditional fuels completely or introduce cleaner and more

efficient technologies for the conversion of biomass into useful energy for cooking. The latter option will call for major investments as well as technological upgrading. In the case of dung, biogas is a well-established technology If the traditional fuels are to be replaced completely, it will require either kerosene or coal-based fuels. Taking into account the relative calorific values as well as the end-use efficiencies, the requirement of equivalent quantities of coal and kerosene for replacing these fuels have been estimated. In other words, to protect the rural and the urban poor from exposure to excessive emission of smoke, it is necessary to step up fossil fuel supplies, either petroleum products or coal or both.

Even from the point of view of the long-term effect of carbon dioxide emission on the environment, it should be noted that one tonne of coal used in the household sector will save 2.25 coal-equivalent tonnes of fuelwood. Similarly, one tonne of kerosene used in this sector will save 5.6 kerosene equivalent tonnes of fuelwood. This is a typical example of how fossil fuel consumption at the margin can be environmentally benign in developing countries like India.

While such a transition from traditional to commercial fuels will, therefore, be welcome from the point of view of local as well as global environmental concerns, it is beset with other problems. These include the fact that the low-income groups will be required to use the more costly commercial fuels in the place of non-commercial fuels. According to one study, the expenditure on energy consumption by urban and rural lower income households amounts to 10 to 14% of total household expenditure. Increased dependence on commercial energy will, therefore, impose a heavier burden on the poor unless their purchasing power can be enhanced.

References

1. Report of the Energy Survey of India Committee, 1965, Government of India.

2. Report of the Fuel Policy Committee, 1974, Government of India.

3. Report of the Working Group on Energy Policy, 1979, Planning Commission, Govt. of India.

4. Report of the Fuelwood Study Committee, 1982, Planning Commission, Govt. of India

5. Towards A Perspective of Energy Demand and Supply in India in 2004-05, Advisory Board on Energy, 1985, Govt. of India.

6. Report of the Energy Demand Screening Group, 1986, Planning Commission, Govt. of India.

7. Sectoral Energy Demand in India, 1991, Study carried out by Planning Commission in co-operation with ESCAP, UNDP and Govt. of France. The report has been published by ESCAP.

8. Review of the Energy Planning Practices and Methodologies in India, 1992. Study prepared by E.A.S. Sarma, J.N. Maggo and A.S. Sachdeva for Asian and Pacific Development Centre, Kualal Lumpur, Malaysia.

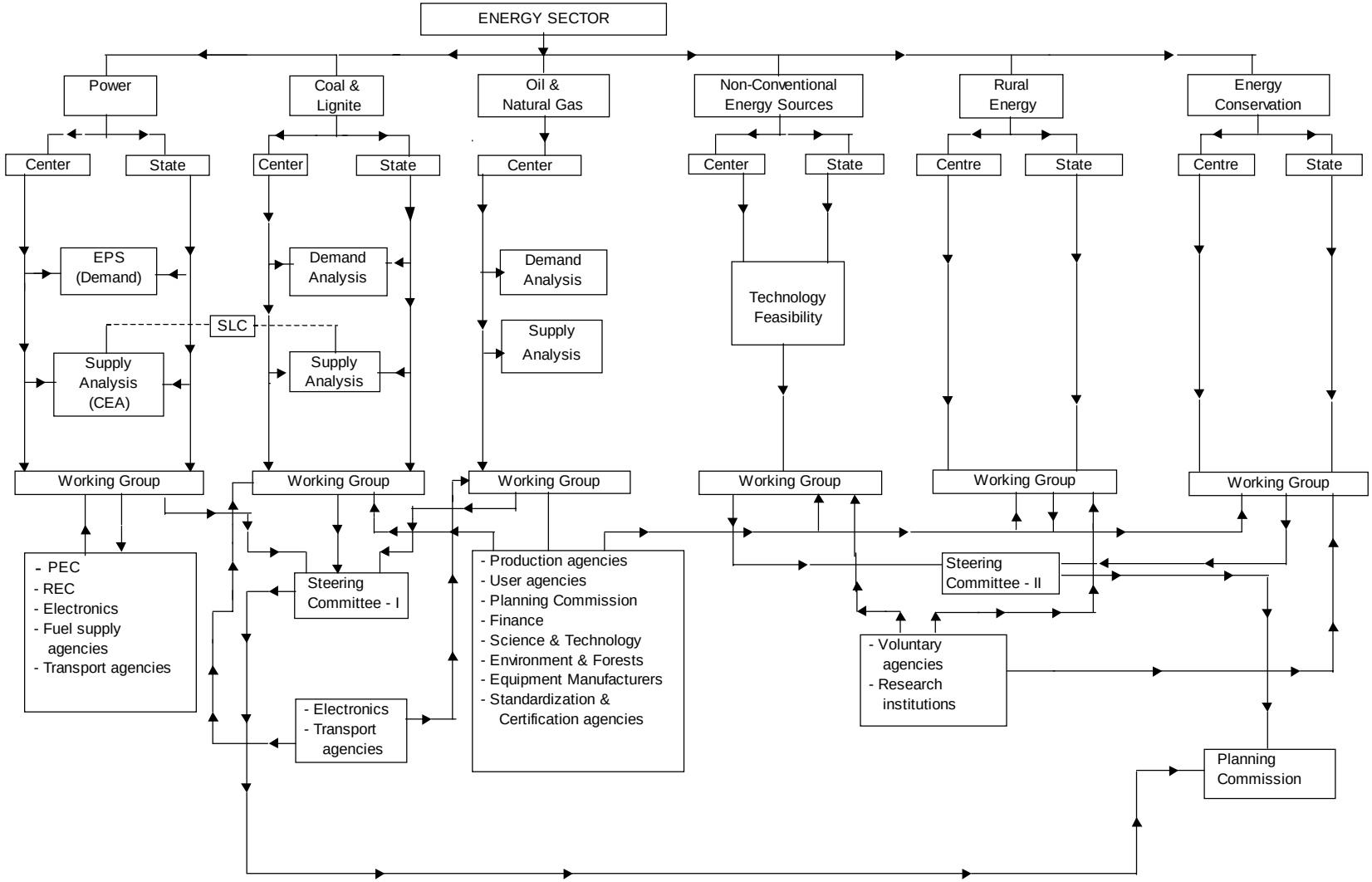
9. Sixth Five Year Plan, Planning Commission, Govt. of India.

10. Seventh Five Year Plan, Planning Commission, Govt. of India.

11. E.A.S. Sarma, J.N. Maggo and A.S. Sachdeva, Energy, Environment and Quality of Life, published in Science and Quality of Life, Ed. Dr. S.Z. Qasim, pp 105-122.

12. R. Bhatia and R. Sharma, 1986, Energy Pricing Strategies, Vol. II, India, Meeting Basic Energy Needs of the Poor, DEDP, UNDP/ESCAP/ILO/Asian Employment Program (ARTEP), Regional Office for Asia and Pacific, New Delhi.

FIGURE 1. ENERGY PLANNING PROCESS IN INDIA: A SCHEMATIC REPRESENTATION



FOREST RESOURCES ASSESSMENT AND PLANNING AT STATE LEVEL

By Sri M. Kamal Naidu, I.F.S.,
Principal Chief Conservator of Forests
Andhra Pradesh - Hyderabad

Andhra Pradesh is the fifth largest state in India with 275 thousand km^2 occupying 8% of the total land area. It is the third largest in terms of forest area comprising 63.8 thousands km^2, and is 23.2 % of the land area in Andhra Pradesh and 9 % of the total forest area in the country. The population of Andhra Pradesh increased from 33.1 million in 1956 to 66.5 million in 1992. The density of population increased from 115 to 242 persons per km^2, thus reducing the per capita forest area from 0.19 ha to 0.10 ha, as against the average for the country of 0.12 ha. However, the per capita forest area in other states of India ranges from as low as 0.01 ha. in Punjab, 0.02 in West Bengal, 0.03 in Bihar to as high as 6.0 ha in Arunachal Pradesh.

The productivity of forests as determined by the Forest Survey of India (F.S.I.) is 1.35 m^3/ha/year in the Deccan plateau as against the highest of 2.21 m^3 in the Western Himalayas to the lowest of 0.41 in the Dry Forests of the Indus Plains.

Forest management in Andhra Pradesh has a long history. The first systematic investigation on the availability of teak was carried out in 1800 in Malabar to regulate its supplies, and this covered the period up to 1806. In 1837 Mr. Munro, Superintendent of Forests, Travancore prepared the first simple form of Working Plan, when he assessed the annual potential for felling trees. In 1855 Dr. Cleghorn drew up a scheme for the management of forests. In 1856 Dr. Brandis introduced a 5-year plan for extracting timber after estimating the growing stock for prescribing yields. Thereafter several plans came to be written in India by Schlich, Ribbentrop etc. All these events have had their impact on forest management and planning in Andhra Pradesh.

In 1860 Col. Beddome suggested restrictions on timber extraction and grazing in Rayalseema, Andhra region, especially for Red Sanders, based on Cleghorn's scheme of 1856. In Telangana region Col. Davidson obtained the Conservancy Rules from Madras and Salar Jung II created the Forest Department in 1867. Thereafter 13 valuable timber species were controlled under a "licence and permit system" which remained in use until 1916.

In 1882 special fuel series were formed at Mamandur & Balapally of Chittoor and Cuddapah Districts adopting "coppice with standards" system with 20 standards per acre. This was the beginning of systematic annual working in Andhra Pradesh. In 1884 planning was centralised by Schlich the Inspector General of Forests. From 1894 the working plans were systematised based on D'Arcy's manual "Preparation of Working Plans in India." These plans were brief and simple, based mainly on areas, with volume being used sparingly. The document was prepared in two parts - the first part dealt with forest, growing stock, demands etc., and the second part dealt with future treatment and anticipated yields. These plans were prepared for blocks and ranges as the units of management. Such plans were adopted in Telangana region from 1914 (for some blocks in Nizamabad). Working Plans thus evolved from extensive simplicity to progressive concentrated intensity, emphasising grazing, fire control, artificial regeneration, hygiene felling, rotation, and silviculture systems

like Selection, Coppice with Standards, Simple Coppice, etc. The central control of the working plans ceased from 1920 when the post of Superintendent, Working Plans created in 1906 at F.R.I. Dehra Dun was abolished. Thereafter Working Plans came to be influenced by Trevor and Smythies' manual "Practical Forest Management". Later the Madras Forest Department Code prescribed the rules for the preparation of Working Plans and thus the first consolidated Working Plan was prepared in 1928 for Chittoor in the Andhra region and in 1938 for Nizamabad in Telangana based on Mr. Wahid's "Note on Working Plan Preparation". In 1949 the first Working Plan Circle was formed in Hyderabad to co-ordinate and guide Working Plans.

In 1962 a consolidated Working Plan Code was prepared by Mr. M.S. Khan for Andhra Pradesh and thereafter the Working Plan Circle was abolished in 1965, and the Working Plan started functioning under Territorial Circles, under the guidance of the Additional Chief Conservator of Forests. In 1973, the Research and Development Circle was created to guide and advise on Working Plans which were subsequently brought under the umbrella of the Project Formulation Circle in 1984. The Working Plans came to be called 'Management Plans' in 1983 with the Cuddapah Plan, emphasising the management rather than the working of forests, in keeping with the guidelines of the Working Plan Cell attached to the Inspector General of Forests, Delhi. The Working Plans came to be prepared for "Industrial Catchments" and were called the 'Regional Working Plan ' in the mid-Seventies. These are now being done for the Districts to link with the over-all planning process and the 5-year plans at the National level.

The Management of Forests is prescribed in a Working Plan document, and all the territorial divisions in the State have access to it. These Plans are prepared for a period of 10 to 15 years and are thereafter revised. The conventional Working Plan endeavoured to stock map the entire forest area, which is divided into forest blocks and compartments. But under the new Working Plans the area is divided into different working circles based on the stock map information and depending on the condition of the forests. The "production working circle" and the "protection working circle" are independent, and the "bamboo", "M.F.P." and "wildlife" working circles are overlapping. This was done in order to bring the area into a homogeneous class, so that a set of prescriptions for working could be applied to a particular working circle.

The yields of timber and fuel wood are mostly taken from the production working circle. These are the potential areas generally containing the mature and over-mature trees. The Working Plan describes these potential areas as 'felling series' and the annual-working areas as 'coupes'. The yields are estimated in these specific areas by strip sampling method only with 5 to 10% sampling by area. However, the yields are regulated by area, adhering to the principle of sustained yield. This principle has allowed the forester to remove the material to the extent of only allowable cut and has helped the management to prevent over exploitation.

In the last 3 to 4 decades, the demand for forest products has increased substantially with population growth. This has resulted in the denudation of forests, a reduction in the quantity of products and a reduction in the potential of the forest areas due to excessive biotic factors. Land hunger is another major cause of the depletion of the forest wealth and the shrinkage of forest areas. These adverse factors create a kind of "forest resources stalemate" and pose a serious challenge to the forester. Added to these factors, the paucity

of funds never allows the maintenance prescriptions of the working plan to be followed-up, resulting in a failure to regenerate felled areas and improve mismanaged areas.

The Working Plans prepared along the lines stated above never estimated the total potential of the forest area. The area under consideration was only a forest division and only the local needs were taken into account, without any consideration to the growing forest based industries. It is in this context, that the Government of India set up the "Pre-investment Survey of Forest Resources" at Dehra Dun in 1965 with regional offices at Simla, Nagpur and Calcutta, in collaboration with FAO.

In Andhra Pradesh the Pre-investment Survey Organisation undertook a survey of forest resources in East Godavari area for the first time in 1968 in collaboration with the State Government.

The total forest area covered under this first survey was 6,548 km^2 and the growing stock was estimated at 52.5 million m^3. This assessment resulted in the establishment of the Godavari Plywoods at Rampachodavaram in the private sector and also helped to augment bamboo and hardwood supplies to the A.P. Paper Mills at Rajahmundry.

The PIS carried out an assessment of growing stock along similar lines in Adilabad industrial catchment, covering an area of 6,340 km^2 during the mid-70s. This survey estimated the growing stock in Adilabad catchment as 33.4 million cubic meters and the growing stock was 52.78 m^3/ha. The State Forest Department also initiated this exercise in the 70s by taking up the Resource Assessment Survey of:

1. Nallamalies in the Districts of Mahabubnagar, Kurnool and Prakasam;
2. Warangal industrial catchment covering Warangal and Karimnagar Districts forests;
3. Kothagudem industrial catchment covering the entire Khammam District; and
4. Seshachalam catchment in the districts of Cuddapah and Chittoor.

Thus, in all, seven productive, contiguous forest belts termed “industrial catchments” were carried out.

The following table gives details of the industrial catchments, growing stock availability and volume per ha.

GROWING STOCK ASSESSMENT IN DIFFERENT INDUSTRIAL CATCHMENTS IN ANDHRA PRADESH

Sl. No.	Catchment	Growing Stock (in 1000 m^3)	Volume/Ha. (in m^3)	% to total growing stock of Andhra Pradesh	Forest Area (in km^2)
a.	**Inventoried**				
1.	Adilabad	33,464.55	55.78	20.89	6,340.42
2	East Godavari	52,507.00	80.19	32.78	6,548.00
3.	Mahabubnagar	4,457.40	22.98	2.78	1,939.91
4.	Nallamalai	13,064.00	25.32	8.16	5,166.67
5.	Warangal	19,966.30	33.60	12.47	5,941.71
6.	Kothagudem	16,540.00	35.66	10.32	4,638.42
7.	Seshachalam	6,500.00	12.00	4.06	5,417.56
8.	Bastar - Forestry and industrial development opportunities in Bastar based on FAO and PIS (Divisions of Bhadrachalam (N) and parts of Bhadrachalam (S)	13,680.00	50.60	8.54	2,703.81
	TOTAL:	1,60,179.25	41.40	99.10	38,690.53
b.	**Non-Inventoried**				
		1,459.00	4.69	0.90	3,113.58
	Grand Total:	1,61,638.25	38.67	100.00	41,804.11

Source: P.I.S.F.R. Reports

Apart from this, the resource surveys have provided information on species wise availability, their frequency of occurrence and their contribution to the total volume in the entire area as shown in Table I.

This information has been utilised in setting up of forest based industries like the Godavari Plywoods, the A.P. Rayons, the Rayalaseema Paper Mills, The Bhadrachalam Paper Boards etc. Added to this the real potential of natural forest was known to the forester for the first time. This database has also helped to regulating the supply of bamboo and hardwoods to the paper mills that were in existence prior to the commencement of the surveys.

The Indian Photo Interpretation Institute used aerial photographs separately in the survey of Karimnagar East division in 1974. In this survey, forests were stratified into various classes depending on the major species, density and crop height and the total growing stock was calculated. During the 80s the aerial photographs of Nallamalai industrial catchment were procured by requesting a special flight at the expense of the A.P. Forest Department. The Indian Photo Interpretation Institute was assigned with the job of surveying on a turnkey basis and stock maps stratifying the forests into various categories and growing stock estimations were prepared.

The resource surveys have to be carried out at intervals of not more than 10 years to observe dynamic changes in forest growth. However, repeated surveys have not been

carried out due to various constraints like lack of funds, and the unavailability of aerial photographs.

During 1976 the Forest Department carried out a rapid survey in collaboration with the National Remote Sensing Agency, Hyderabad to map forest resources. Although little ground checking was done and the techniques of remote sensing were very new at that time the survey produced some good results, particularly in terms of delineating bamboo areas, Red Sanders areas, etc., and the beginnings of a database were stablished. In Andhra Pradesh, as in many other states, almost 100 % of the forests have been covered under Working Plans. However, there are some states where this is not the case. For example, only 10% in Arunachal Pradesh, 2 % in Nagaland, 2.6% in Manipur, 40 % in Haryana and 53 % in Assam have been covered.

No precise estimates of total growing stock in the forest of Andhra Pradesh are available. However, using the estimates of PIS carried out in the early Seventies, which covers a great part of the state, and by extrapolating the data of growing stock, it was estimated at 200 million m^3 as shown below:

Particulars	**Forest Area (km^2)**	**Growing stock (million m^2)**	**%**	**Vol./Ha (m^3)**
Area Surveyed	41804.11	161.64	80.82	38.67
Not surveyed	21971.76	38.36	19.18	17.46
TOTAL:	63775.87	200.00	100.00	31.36

(From: Forest Resources of Andhra Pradesh - (1975), Y.Sudhakar Rao, Sovenier, A.P. & Central Board of Forestry XV Meeting)

These forests are distributed in the state as in Table II.

CURRENT WOOD FUEL SUPPLY SITUATION:

With the total growing stock of 200 million m^3, estimated to yield modestly at 1%, the annual yield is 2.0 million m^3. The current annual extraction, however, is about 22,776 million m^3 timber and 48,268 million m^3 fuelwood. Little data exists on the supply of fuelwood from private sources. Much of the fuel and timber are removed illicitly in rural areas and a fair amount is transported to urban centres.

THE OUTTURN OF FUELWOOD 1989-1994: (IN METRIC TONNES)

	1989-90	***1990-91***	***1991-92***	***1992-93***	***1993-94***
Forest Department	73,709	43,626	77,872	48,494	32,512
A.P. Forest Development Corporation	65,559	44,000	24,700	44,190	---
TOTAL	139,268	87,626	102,572	92,684	32,512

The estimated annual growth rate totals 16,803,000 cu m in Andhra Pradesh. This ranges from as low as 70,000 cu m in Nalgonda and 102,000 cu m in Anantapur to as high as 2,348,000 cu m in Khammam and 2,741,000 cu m in Adilabad, with forested areas varying from 6/'O' in Nalgonda to 54/'O' in Khammam.

ESTIMATED PRODUCTION OF WOODY FUEL FROM NON-FORESTED LANDS IN ANDHRA PRADESH

Type of areas	% of total land (Non-forest)	Crown Closure %	Area (000 ha)	Total annual production (000 m^3)
Misc. tree crops &	1	75+	263	1,144
groves	9	5-10	1,932	454
	26	5-10	5,421	741
	64	2-5	13,579	1,236
TOTAL:	100		21,195	3,575

The quantity of woody material produced varyied from 8,000 m^3 in Ranga Reddy, 93,000 in Warangal to 285,000 in Guntur and 271,000 in Prakasam.

On converting total biomass fuel produced in Andhra Pradesh in 1982 (55,567,000 dry tonnes) to dry metric tonnes of material produced in each district, the gross production ranges from 0.6 dry tonnes per capita(dtpc) in Ranga Reddy to 1.86(dtpc) in Adilabad, with an average of 1.07(dtpc). Total production varies from 1,947,000 in Ranga Reddy to 2,978,000 in Karimnagar and 3,239,000 in Chittoor. USAID (1981) estimated household consumption of biomass fuels as:

Type	Total consumption (Million tonnes)	Coal equivalent	Total coal replacement	% of Energy consumed	Coal replacement consumption/ capita (Metric tonnes)
Fire wood & Charcoal	0.81	0.95	0.77	45	0.14
Dried dung	1.19	0.50	0.60	35	0.20
Vegetable Waste	0.39	0.38	0.34	20	0.065
TOTAL	2.39		1.71	100	0.405

Converted to per capita basis, the above estimates indicate annual fuelwood consumption of 0.22 tonne per capita, dried dung 0.12 tonne and agriculture waste 0.07 tonne for a total of 0.405 ton of biomass fuel consumed by each person. This would convert to 2.5 tonnes per household consumption per annum of biomass fuels, assuming a household of 6 members.

In recent years, with the advent of social forestry, the private sector has greatly increased its organised planting and supply of wood resources through tank fore-shore planting, road-side, railway side and canal bank planting, waste land reclamation, field bund planting, marginal land planting, etc. These planting efforts are widely regarded as a form of social insurance for the people.

Increasing human and livestock populations have had a deleterious effect on the forest area and on the quality of forests. According to visual interpretation of Landsat Imagery at 1:1000,000 scale, during 1982-'83 and 1985-'87 the forest cover was estimated to have declined by 2283 km^2. On the basis of further comparative assessment of the density classes made in 1987 and 1989, the dense forest cover (over 40% crown cover) was seen to have declined by 3,045 km^2 and open forest cover (crown cover 10-40%) increased by 852 km^2. Details are given below:

1. Recorded forest area: 63,771 km^2
2. Actual forest cover: 50,194 km^2
   1987 assessment
3. Actual forest cover: 47,911 km^2
   1989 assessment

   a. Dense forest (crown cover over 40 %)
      (i) Based on : 28,580 km^2.
      1981-'83
      imagery

      (ii) Based on 25,535 km^2
      1985-187
      imagery

   b. Open forest (crown cover 10-40 %
      (i) Based on 21,119 km^2
      1981-182
      imagery

      (ii) Based on 21,971 km^2
      1985-187
      imagery

   c. Mangrove forests 405 km^2

This will have an adverse effect on the biomass energy sources in the long run unless appropriate steps are taken to set it right.

THE FUTURE SITUATION: Based on the expected population growth rates and the subsequent fuelwood demands, and bearing in mind future developments in alternative technologies which could act as substitutes for fuelwood, the projected demands are set out below (in '000 m^3 roundwood equivalent/year)

	1991	**2001**	**2011**
Domestic Fuelwood	15,000	18,830	23,640
Domestic Charcoal	320	400	690
TOTAL:	15,320	19,230	24,330
Wood Based Industry	2,115	3,561	5,920
Non-wood based Industry	2,690	4,020	6,742
GRAND TOTAL:	20,125	26,811	36,992

The per capita fuel consumption varies from less than 0.25 to more than 0.5 tonnes per annum in India. In Andhra Pradesh it is less than 0.25 tonnes. Fuelwood supplies 51% of the household energy budget, while agriculture wastes meet 28% and dried animal dung 21%.

The National Council of Applied Economic Research (NCAER) has stated that fuelwood is the dominant source of energy for cooking. In Andhra Pradesh nearly 76 % of the population (663 lakhs in 1991) live in rural areas where 68.5 % of the energy consumed is in

the form of fuelwood. In urban areas it accounts for 45.5 %. NCA (1976) estimated a consumption rate of 277 cu m/1,000 per capita up to 1985 and thereafter a decline of 1 % per annum. Thus by 2000 the figure would reach 240 cu m/1,000 per capita. This gives 185 kg (at 1.5 cu m = 1 tonne) and 160 kg/capita demand by 1985 and 2000 respectively. Based on these figures the consumption of fuelwood in log form is estimated at 63 kg and in twig form at 130 kg, giving a total of 193 kg (i.e. 32.5 % and 67.5 % respectively). This places the demand for Andhra Pradesh (1991 population) at 41.77 lakh and 86.19 lakh tonnes, totalling 127.96 Iakh tonne or 191.94 lakh cu m.

INSTITUTIONAL AND ORGANISATIONAL SET-UP:
The primary set-up of theForest Department, which is the main agency responsible for meeting the people's fuel and timber requirements, is as follows:

PRINCIPAL CHIEF CONSERVATOR OF FORESTS

- Chief Conservator of Forests (Social Forestry)
- Chief Conservator of Forests (Development)
- Chief Conservator of Forests (Production)
- Chief Conservator of Forests (J.F.M.)

- Conservator of Forests (R&D) (P.F)
- Conservator of Forests (Territorial)
- Conservator of of Forests

- Divisional Forest Officer (Territorial & Social Forestry)
- Range Officer (Territorial & Social Forestry)
- Forester (Territorial & Social Forestry)
- Forest Guard (Territorial)

In the private sector, the planning and management of energy resources takes two directions. Firstly, individual private land holders are gradually converting their marginal lands to tree crops as a social security measure. Secondly, government lands and village community lands are being afforested to meet local needs for firewood through thinning and pruning material. These efforts are being assisted by the Social Forestry Divisions, especially through the supply of seedlings to depressed classes of society and institutions like schools etc so that they can raise community nurseries.

PROBLEMS IN PLANNING: The main shortcomings, constraints and limitations encountered in planning are:

1. Stock maps are ocular, approximate and subjective;
2. They are not based on sufficient geo-referenced data (soil pH, nutrient status, soil moisture, erosion, topography, rainfall, geology etc.);
3. Preparation takes a long time - more than 2 years;
4. Local demand of villages required in micro-planning is not analysed causing stress zones and degradation;
5. There is a long prescription period of 10-15 years, therefore less flexibility;
6. No cost-benefit analysis (B/C ratio, present net worth of project, and Internal Rate of Return) is carried out.

These problems can easily be overcome by the use of the latest G.I.S. and M.I.S. techniques.

The older Working Plans never pictured the actual resources in the division for which they were prepared but only forecasted the yield for the plan period. The outlook of the plans was narrow due to the smaller forest areas under consideration and only local demand was considered. They never took a larger perspective, except when Industrial Catchment Plans were prepared with the advent of the Pre-Investment Survey. Further, there were no indications about:

- The maximum yield possible
- The amount to be supplied to the local people or the surplus
- Whether the material would be sufficient to meet the demands of a particular forest based industry.

Methods and Technique of Collection, Analysis and Organisation of Database (For Provisional Level Planning):

A lot of data can now be generated in a minimum of time by using aerial photography. This could not have been done by the old stock-mapping and inventory methods. The data are more reliable, more accurate and realistic.

Aerial photographs at a scale of 1:40,000 are recommended for carrying out reconnaissance surveys of inaccessible forests. These cost only half to two-third the cost of 1:20,000 scale photograph, only a quarter as many are required, and each covers 2800 ha as against 700 ha by the latter.

As a general rule a scale of 1:15,000 is recommended for high level forests and up to 1:25,000 for lesser values. Photographs at a scale of 1:10,000 are excellent where forest covers 175 ha and they can be used for forest classification and tree measurements.

However, photographs have to be supplemented with fieldwork to gain a clearer idea of principal species, forest type, heights, crown diameter, and density. Also, details below crown level like middle and under storey, age, growing rate, soil conditions, etc. have to be obtained by ground survey. These photographs can be used to delineate productive and protective forests when constituting working circles and forming felling series.

In the resource survey of East Godavari and Mahaboobnagar, aerial photographs on a scale of 1:60,000 have been used for mapping. The Indian Photo Interpretation Institute has used 1:40,000 scale for Karimnagar District of Warangal Catchment. The use of these aerial photographs reduces the field work considerably and gives a greater degree of accuracy in delineating vegetation, topography, density, age classes, etc.

For the estimation of growing stock, a systematic sampling was adopted by using the grids in the Survey of India sheet. Later, the aerial photographs of the entire area were procured and the forest area was stratified into low, medium and high volume areas, The sample plot information was thus stratified into these classes and volume estimates were prepared and projected for the entire area.

IN EAST GODAVARI CATCHMENT THE FOREST AREA IS STRATIFIED AS FOLLOWS:

	Area (1,000 ha)	**% of Total Area**	**Volume/ha. (m^3)**	**Total (million m^3)**	**% of Total volume**
High volume	3,192	49	98.6	31.5	60
Medium volume	2,129	32	70.9	15.1	29
Low volume	1,227	19	48.3	5.9	11
TOTAL	6,548	100		52.5	100

Topographically, 45% of the forest area either falls on plains or the lower 1/3 portion of hills, 21% in the middle 1/3, 22% on the upper 1/3 and only 4% on the ridge top. Utility wise distribution of the total value was assessed as follows:

Utility	**Total Volume (million m^3)**
Big timber	32.9
Small timber	6.80
Pulpable species	12.02
Fuel species	6.38

In Nallamalai catchment five major sub-types of forests were identified and their volume were estimated as follows:

Sub-type	Area (km^2)	% of Total	Volume/ha (m^3)
Nallamaddi	415	8.0	37.5
Teak	62	1.2	34.8
Anogissus	441	8.5	20.3
Yepi	325	6.3	15.9
Miscellaneous	3,918	76.0	25.2
TOTAL	5,161	100.0	25.0

From the frequency distribution of species by diameter class, it was determined that 84% of the trees were in the 10-20 cm. class, 13% in the 21-30 cm class and the remaining 3% were in the above 30 cm class.

BAMBOO BEARING AREAS COVERED 128,375 HA., CONSTITUTING 25% OF SURVEYED AREA, DISTRIBUTED AS FOLLOWS:

Type	Vol.Mt.	% of Total
Pure	637,000	80
Dense	103,000	13
Scattered	57,000	7
Total	797,000	100

The bamboo stock per ha is 7.3 tonnes, of which around 5.0 tonne is estimated as sound and the rest as dry or damaged.

In Seshachalam Catchment assessment of the frequency of occurrence of species by stem was carried out and revealed 61.9% Red Sanders, 11.0% Anogissus, 8.5/% Syzyzium, 5.6% Chloroxylon 3.7 Nallamaddi, 3.4% disturb Yepi. These species combined accounted for 49% of the growing stock by number of stems.

In almost all catchments, systematic cluster sampling was used. In the case of Warangal and Khammam, the sampling was based on the compartment and probability proportional to size was adopted by two stage stratified random sampling using 0.1 ha sample plots. In Warangal catchment total volume of growing stock was estimated at 19.97 million m^3 of which teak accounted for 9.2% by volume, Nallamaddi 13.9%, Tunki 7.3%, Anogessus 7.7%, Satin Wood 6.4%, Madhuca 6.4%. These species total 51% of growing stock by volume.

Recently, an attempt has been made by the Forestry & Ecology Division of NRSA to use data obtained by remote sensing by means of electromagnetic waves for the Srisailam-Nagarjuna Tiger Project. Remote Sensors record electromagnetic radiation (EMR) which travels at great velocity from the source directly by reflection or re-radiation. Remote sensing provides qualitative and quantitative data on the features of the earth's surface, and is a very powerful tool for mapping and inventory monitoring and assessment of natural resources. After several exercises it was found that the January data was considered to be the most suitable for vegetation mapping in Andhra Pradesh. Using a 1:250,000 topographical sheet, this remote sensing (using spectral bands of wavelength 0.45 to 0.86 microns) of the Tiger Project's 3569.89 sq km revealed the area statistics as a percentage of land cover classes in core, buffer, and total tiger reserve areas. These are as follows:

Land cover classes	Core Zone %	Buffer Zone %	Tiger Reserve %
Water Bodies	6.35	9.61	8.46
Agriculture	2.14	5.24	4.15
Barren	5.02	14.23	10.98
Fallow	2.96	12.00	8.81
Scrub	19.89	12.59	15.16
Close Forest	7.89	19.09	15.14
Open Forest	32.77	11.90	21.48
	23.06	11.90	15.83
	100.00	100.00	100.00
Area	1,200 km^2	2,369 km^2	3,569 km^2

Linkages of Provincial Plans:
The provincial plans are linked to the national plans. This is done through the allocation of funds for implementing schemes under the district plans. These funds are linked to the 5-Year Plan and Non-Plan provisions. As such, at present, there is no direct linkage of plans to control the quantity of production to meet the needs of the people. The provincial plans are however based on the allocation of funds, and control the Circle and Divisional Plans.

A significant transition has been underway in Andhra Pradesh since 1994 with the introduction of Joint Forest Management under the A.P. Forestry Project, which is financed by the World Bank. The hitherto top down approach is changing to a "bottom-up approach involving the local people in resource assessment and planning through participatory rural appraisal (PRA) and rapid rural appraisal (RRA). It was felt that there was a great need to have data on resources gathered through advanced technological procedures - hence the state has introduced the G I S, using experts from the FAO.

Already pilot studies are in progress in the two districts of Adilabad and East Godavari, where information on plantation features, cultural features, roads, vegetation, and boundary features are being digitised. Village data on latitude and longitude are being fed into the computer to help in village level planning in Joint Forest Management. Simultaneously, forestry inventories are being prepared to serve as databases for generating computerised information. It is expected to develop a sound information system on the forestry situation in Andhra Pradesh with the help of GIS. This will help not only in assessment and planning efforts but also in monitoring the ecological status of forests and in the process of decision making and sound forest management.

Planning is now gearing itself towards a 3 tier planning system in the state as follows:

- STRATEGIC PLAN: These are carried out at state level and clearly identify the policies and strategies of the government on investment in the forestry and non-forestry sector that interact with and are interdependent with economic development vis-a-vis wood based industries, employment creation opportunities, tribal welfare, development of infrastructure etc. On the basis of the plan's objectives, actions for all other managerial functions like organisation, staffing, directing and control are undertaken.

- TACTICAL PLAN: In this plan technical, economic and social criteria are evaluated and actions to be taken to achieve the objectives of the strategic plan are defined at district

level. Short term and long term forecasts on production are detailed quantitatively by area to volume, and qualitatively by species and diameter assortments.

- OPERATIONAL PLANS: or micro plans at village level under Joint Forest Management for execution of an annual plan of operation. These state targets to be achieved, financial requirements, local constraints and detail solutions for solving problems by people's participation. They also spell out the details of conversion and regeneration with desired species based on the growth potential of the site and the possibilities for its improvement by soil and water conservation works.

TABLE 1: GROWING STOCK BY SPECIES CLASSIFICATION

No.	Species	Local name	Growing stock (Volume in 000 m^3)	Percentage of total growing stock
1.	Tectona grandis	Teku (Sangavan)	25,70	12.85
2.	Terminalia tomentosa	Nallamadi, Maddi	25,645	12.82
3.	Pterocarpus marsupium	Bijasal, Yegisa	10,539	5.26
4.	Anogessus latifolia	Tirman, Chirumanu	12,517	10.26
5.	Adina cordifolia	Bandaru	689	0.34
6.	Sterculia arena	Tapai	3,175	1.59
7.	Boswellai Serrata	Anduk	6,270	3.14
8.	Lannea cormandelica	Gumpena	8,113	4.06
9.	Acacia sundra	Khair (Sundra)	2,513	1.26
10.	Mitragyna pervifolia	Battaganam	1,369	0.68
11.	Diospyros melonodylon	Anbnus, Tunki	12,095	6.05
12.	Cleistanthus collinus	Nalla kodsha	11,936	5.97
13	Chloroxylon swietenia	Satin, Billudu	6,858	3.43
14.	Dalbergia latifolia	Shisham, Jitregi	1,979	0.99
15.	Hardwickia binata	Yepi	4,858	2.43
16.	Albizzia lebbek	Dirshanam, Sira	292	0.15
17.	Salmalia malabaricun	Burgu	1,008	0.50
18.	Mangifera indica	Mango (aam)	26	0.01
19.	Xylia xylocarpa	Kondatangedu	15,678	7.84
20.	Pterocarpus santalinus	Redsanders	118	0.06
21.	Other Misc. species	---------	40,617	20.31
		TOTAL:	200,000	100.00

Source: Forest Resources Survey reports and the Working Plans.

TABLE 2: DISTRIBUTION OF FOREST AREA

	District	Land Area (km^2)	No. of Blocks	Forest Area (km^2)	Percentage	Population (in lakhs)
	Coastal Andhra					
1.	East Godavari	10.8	161	3.23	29.94	5.41
2.	Guntur	11.4	118	1.62	14.2	41.07
3.	Krishna	8.7	60	0.66	7.64	36.99
4.	Nellore	13.1	268	2.52	19.2	23.92
5.	Prakasam	17.6	130	4.42	24.1	27.59
6.	Srikakulam	5.8	79	0.69	11.9	23.21
7.	Visakhapatnam	11.2	188	4.41	39.3	32.85
8.	Vizianagaram	6.5	103	1.19	18.3	21.11
9.	West Godavari	7.8	50	0.81	10.4	35.18
	Sub-total	**92.9**	**1157**	**19.55**	**21.06**	**287.33**
10.	Anantapur	19.1	103	1.97	10.3	31.84
11.	Chittoor	15.1	184	4.51	29.9	32.61
12.	Cuddapah	15.4	154	5.04	32.7	22.68
13.	Kurnool	17.7	103	3.51	19.8	29.73
	Sub-total	**67.3**	**544**	**15.03**	**22.30**	**116.86**
	Talangana					
14.	Adilabad	16.1	235	7.22	44.8	20.82
15.	Hyderabad	0.2	--	--	--	31.46
16.	Karimnagar	11.8	201	2.55	21.6	30.37
17.	Khammam	16.0	356	8.43	52.7	22.16
18.	Mahaboobnagar	18.4	86	3.03	16.5	30.77
19.	Mekak	9.7	233	0.91	9.4	22.70
20.	Nalgonda	14.3	26	0.84	5.9	28.52
21.	Nizamabad	8.0	189	1.81	22.6	20.38
22.	Ranga Reddy	7.5	127	0.73	9.7	25.52
23.	Warangal	12.9	112	3.71	28.8	28.19
	Sub-total	**114.9**	**1,565**	**29.3**	**25.46**	**260.89**
	Andhra Pradesh	**275.1**	**3,266**	**63.81**	**23.20**	**665.08**

TABLE 3: FOREST SURVEY OF INDIA - 1995

QUALITY AND EXTENT OF FOREST COVER IN DIFFERENT DISTRICTS OF ANDHRA PRADESH

(Area Sq.km)

No.	District	Geographic area	Dense forest	Open forest	Mangrove	Total forest	% forest to geographic area
1.	Adilabad	16,128	4,002	1,614	-	6,496	40.28
2.	Anantapur	19,130	--	389	-	389	2.03
3.	Chittoor	15,152	155	1,162	-	1,317	8.69
4.	Cuddapah	15,359	686	2,766	-	3,452	22.48
5.	Godavari East	10,807	2,747	663	216	3,626	33.55
6.	Godavari West	7,742	602	244	-	846	10.93
7.	Hyderabad	217					
8.	Rangareddi	7,493	--	279	-	279	3.62
9.	Karimnagar	11,823	847	1,122	-	1,969	16.65
10.	Khammam	16,029	5,139	2,143	-	7,282	54.43
11.	Krishna	8,727	62	113	109	284	3.25
12.	Guntur	11,391					
13.	Nellore	13,076	2,609	3,724	53	6,386	10.69
14.	Prakasam	17,626					
15.	Kurnool	17,658					
16.	Mahabubnagar	18,432	813	1,184	-	1,997	10.83
17.	Medak	9,699	23	385	-	408	4.21
18.	Nalgonda	14,240	--	156	-	156	1.10
19.	Nizamabad	7,956	703	708	-	1,411	17.73
20.	Srikakulam	5,837					
21.	Visakhapatnam	11,161	3,111	4,380	-	7,491	31.83
22.	Vizianagaram	6,539					
23.	Warangal	12,846	2,629	838	-	3,467	26.99
	TOTAL:	**275,068**	**25,008**	**21,870**	**378**	**47,256**	**17.18**

ANALYSIS OF WOOD FUEL SUPPLY FROM NON-FOREST AREAS

Narayan Singh
Additional Inspector General of Forests (retired)

The country's energy requirements have been assessed by the Energy Survey Committee (1965), the Fuel Policy Committee (1974), the Working Group on Energy Policy (1979) and the Energy Demand Screening Group (1986). Most of these have assessed the demand on the basis of an energy requirement of 519 Kcal per capita per day. More specifically, the Planning Commission and Natarajan (1989) and Kaul (1992) have estimated the country's biofuel requirements. Table 1 below gives a comparative statement of the various estimates.

TABLE 1: ESTIMATED DEMAND FOR FUELWOOD (MILL. TONNES)

	Natarajan	Kaul	Planning Commission
1980	121.0	-	-
1985	133.3	154.0	-
1989	146.3	-	-
1990	-	165.1	-
1991	-	-	306.4
1995	-	176.3	342.8
2000	163.0	187.4	383.5
2005	-	198.6	-

As can be seen from table 1 the estimates vary widely. This becomes even more confusing if the consumption estimates produced by various agencies are also compared. Table 2 below lists three agencies:

TABLE 2: 1991 CONSUMPTION OF BIOFUELS IN RURAL AREAS (MILLION TONNES)

Agency	Fuelwood	Animal waste	Agri. waste
NCAER	93.3	83.2	36.7
IREP	169.0	54.2	62.8
TERI	252.1	106.9	99.2

The variations are a result of inadequate sampling. In some cases states have been sampled (NCAER), while in others agro-climatic zones are the sampling units. Samples sized have also been inadequate. The latest TERI estimates are based on a survey of 39,000 households in 638 villages spread across 17 states and 14 agro-climatic zones.

During the course of preparing the National Forestry Action Plan (NFAP), the present supply of fuelwood from forests was estimated at 54.71 million cubic meters and the demand in the year 1996 at 380.44 million cubic meters. The demand will rise to 409.69 in 2001, 439.74 in 2006 and 469.65 in 2011 (1 cubic meter = 0.7 tonnes). These figures are closer to the estimates made by TERI.

With the overwhelming dependence of the rural people on fuelwood and a vast gap between the supply of fuelwood from forests and the demand one is tempted to believe that

the gap is filled by unregulated felling in forest areas. The gradual decline in areas under forests and in crop density is no doubt attributable partly to this. However, India's efforts in taking forestry to the people beginning in the Sixth Five Year Plan (1980) and subsequent adoption of a new policy (1988), led to a massive planting effort both in and outside forest areas. But the first six plans achieved less than 8.7 million hectares. The results show that substantial quantities of timber and fuelwood are harvested from non-forest areas. A study conducted during the course of preparation of NFAP revealed that as much as 40% of industrial wood is coming to the market from land owned by individual farmers.

Two case studies in states as different as Kerala and Haryana, both in terms of physical distance and agro-climatic characteristics are revealing. But first, the states will be compared.

	Kerala	**Haryana**
Location	8 to 12 deg N	27 to 31 deg N
Area	3,886,300 ha	4,421,200 ha
Population	29 million	16.5 million (1991)
Forests	940,000 ha	170,300 ha
Growing Stock	99 mill. Cu m	1.4 mill. cu m
Climate	Wet	Semi arid

In Kerala, homestead farming is typically multi-layered and highly productive. A study carried out by the Kerala Forest Research institute in 1988-89 put the growing stock of homesteads in excess of 112 million cubic meters. It estimated that 92.6% of all timber removals are from non-forest sources. While recorded and unrecorded removals from forests amount to 740 thousand cu m, those from homesteads and estates are estimated to be 13.7 million cu m.

In Haryana, most of the forests are located close to the Northern boundary with Himachal Pradesh and the official removal of fuelwood from forests is around 0.1 million cu m. However, almost all available public lands have been planted with quick growing species. Private plantations have also been raised on a large scale. A study conducted by the National Council of Applied Economic Research (NCAER) in 1978-79 showed that twigs formed the bulk of the fuelwood in the rural sector. The figures being:

Fuel	**Rural**	**Urban**	**Total (Mill. Kg)**
Solid wood	222.0	79.4	301.4
Twigs	798.7	78.7	877.4
Animal waste	2,759.0	287.7	3,046.7
Agri. waste	1,158.4	40.0	1,198.4
Kerosene	8.4	36.9	45.3
LPG	0.4	34.6	35.0

Based on studies made by the Forest Survey of India, the National Sample Survey, NCAER and others states have been categorised on the basis of consumption of fuelwood. The following table gives average consumption figures in the states.

Firewood	Annual per capita consumption	
(in tonnes)	Rural	Urban
>0.25	Bihar, Gujarat, Haryana, Maharashtra, Punjab, Tamil Nadu, U.P. West Bengal, Delhi, Chandigarh, Dadra & Nagar Haveli. Kerala, M.P., Manipur, Pondicherry.	Andhra Pradesh, Bihar, Gujarat, Haryana, J & K, Karnataka, M.P. Punjab, Rajasthan, Tamil Nadu, U.P., West Bengal, Chandigarh, Delhi, Pondicherry. Assam, Himachal Pradesh, Kerala, Manipur, Meghalaya, Nagaland, Orissa.
0.25 to 0.4	Assam, Nagaiand, Orissa, Andaman & Nicobar Islands.	Tripura, Andaman & Nicobar Islands
0.4 to 0.5	Arunachal Pradesh, Himachal Pradesh, J&K, Meghalaya, Tripura, Lakshadweep.	Arunachal Pradesh, Mizoram.
Over 0.5		

Based on the above and the total production figures of States as shown in the following table, one comes to the conclusion that as much as 90 percent of the fuelwood in areas deficient in forests comes from common property resources (CPRs) and individual holdings. It is only in areas near the forests that people depend completely on forests for their fuelwood requirements. This is because fuelwood from forests can be removed free of any levy for domestic use.

Earlier it was mentioned that a study of the NFAP process revealed that as much as 40 % of the industrial wood comes out of non-forest areas. Logically, the same should hold true of fuelwood as about 50 % of a tree can be utilised as fuelwood. However, that is not the case because *Prosopis juliflora,* an exotic (and long considered a weed) has invaded vast tracts of wastelands in semi arid regions (it even grows well even in alkaline and saline areas). It is a good coppicer and thrives under adverse conditions. The fuelwood scenario has been transformed with this species, and the lowly *Lantana Camera,* another exotic weed from the same region*. Acacia nilotica , Dalbergia sissoo, both* indigenous species, *Eucalyptus, Cassia siamea, Casurina equisitifolia,* exotics again, have also played a significant role in alleviating India's domestic energy problems. A study needs to be undertaken on the contribution of these species towards meeting India's energy needs.

FUELWOOD SUPPLY IN STATES (MILLION M^3)

States	Natural Forests		Annual Increment		Plantations	Supply
	Closed	Open	Closed	Open	Increment	Million m^3
A.P.	224.80	91.70	2.79	1.14	0.101	4.031
Arunachal	475.99	59.34	5.90	0.74	0.004	6.644
Assam	136.39	35.66	1.72	0.44	0.017	2.177
Bihar	115.11	56.25	1.43	0.70	0.071	2.201
Goa	8.10	1.04	0.10	0.01	0.002	0.112
Gujarat	54.57	22.32	0.68	0.28	0.079	1.039
Haryana	3.00	0.77	0.04	0.01	0.028	0.078
H.P.	81.56	12.31	1.01	0.15	0.023	1.183
J. & K.	95.68	39.79	1.19	0.49	0.017	1.697
Karnataka	204.06	31.41	2.53	0.39	0.081	3.001
Kerala	71.90	8.03	0.89	0.10	0.045	1.035
M.P.	812.07	167.13	10.07	2.07	0.124	12.264
Maharashtra	225.43	75.57	2.80	0.94	0.076	3.816
Manipur	48.02	51.63	0.60	0.64	0.005	1.245
Meghalaya	27.51	52.26	0.34	0.65	0.005	0.995
Mizoram	38.64	60.63	0.48	0.75	0.020	1.251
Nagaland	31.79	45.54	0.39	0.56	0.013	0.963
Orissa	236.51	83.02	2.93	1.03	0.071	4.031
Punjab	4.39	3.61	0.05	0.04	0.019	0.109
Rajasthan	26.32	39.91	0.33	0.49	0.039	0.859
Sikkim	15.91	3.04	0.20	0.04	0.003	0.243
Tamilnadu	82.71	34.73	1.03	0.43	0.053	1.513
Tripura	16.59	15.59	0.21	0.19	0.008	0.408
U.P.	165.87	46.11	2.06	0.57	0.027	2.657
West Bengal	17.02	11.34	0.21	0.14	0.042	0.392