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

WOODFUEL PRODUCTION AND MARKETING IN PAKISTAN

NATIONAL WORKSHOP

Faisalabad, Pakistan

28 - 30 October 1997

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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FOREWORD

Traditional biomass fuels play an important role in the energy balance of Pakistan. They meet over 45% of the energy demand, of which the share of woodfuel alone is about 25%. The domestic and commercial sectors together consume about 50% and their demand is growing at a rate of over 3% per annum. Most of the rural and many urban households rely on traditional biomass fuels, primarily for cooking as well as space heating in cooler months. This makes the domestic sector the largest single consumer of traditional fuels in Pakistan, about 86%. Other users include rural industries and some commercial establishments.

Information on the supply side of woodfuels is quite striking. As only about 5% of the total land area is under forest and other wooded land categories, only 10% of the total woodfuel demand is being met from these two types of land. As much as 90% of the woodfuels is being supplied from non-forest land of different types which are under private, community or government ownership and/or management. In various parts of Pakistan, trees are an integral part of traditional farming systems, under specific land-types, management objectives and agro-ecological zones. Recently, the national program of Social Forestry Development has successfully integrated fast-growing multipurpose trees even in irrigated lands in virtually all Provinces (e.g. NWFP, Punjab and Sindh). Therefore, the supply potential of both wood and fuelwood from non-forest lands has expanded significantly in recent years. Various factors have contributed to the success of this new national program in Pakistan. Amongst them are the policy of the national government, the additional resources from donor agencies, the commitment and hard work of the Provincial Forestry Departments, as well as the technical assistance of the PFI-Peshawar and many other institutes related to R&D, training and education in forestry and agro-forestry.

RWEDP feels delighted whenever it gets an opportunity to link with these institutions and support the professionals in their efforts towards sustainable wood energy development in Pakistan. In the past years, RWEDP has collaborated mostly with the PFI at Peshawar and the PCAT at Islamabad, in activities related to wood energy development in Pakistan. One regional and two national training workshops were already hosted in Pakistan, covering different aspects of wood energy and their reports have been published.

The present publication on Woodfuel Production and Marketing in Pakistan reports on the national workshop in Punjab which was coordinated by Mr.T. Bhattarai, Wood Energy Resources Specialist of RWEDP. Two new institutions, the Punjab Forestry Research Institute (PFRI) and the Marketing Division (MD), University of Agriculture (UA), have collaborated in hosting the national workshop in Faisalabad, in October 1997. Important issues related to woodfuel production and marketing were discussed elaborately by the experts from agencies of the government and selected NGO's. The workshop has recommended a number of actions which will further strengthen the wood energy sector.

RWEDP expresses its sincere thanks and appreciation to Sahibzada M. Hafiz, Director of PFRI, and Prof. (Dr.) Qamar Mohy-ud-Din, Chairman of MD, UA, for successfully hosting the national workshop. Thanks are also due to the colleagues in PFRI for their time and effort in compiling the report.

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

PREFACE

In the South Asian and South East Asian Regions 30-80% of household energy consumed is of biomass origin. Presently there is a tremendous gap between the demand for and the supply of woodfuel, particularly in the rural household sector. The gap is likely to widen with a population growth rate of 2.9% - one of the highest in the world. The contribution of state forests to meeting woodfuel energy needs has been stagnating at about 10% for the last few decades, largely as a result of administrative and legislative failures in the management of state forests.

Intensive monoculture practices combined with the excessive use of fertilizer and pesticides have degraded the rural soil production potential thus making the net return negative with respect to some agricultural crops. To regenerate and sustain the productive capability of the soil in rural areas as well as to meet the wood fuel requirements of the rural masses, the integration of appropriately designed silvicultural practices into farming systems has become imperative.

Realizing this, the Regional Wood Energy Development Programme (RWEDP) in collaboration with the Punjab Forestry Research Institute (PFRI) and the Marketing Division of the University of Agriculture, Faisalabad organized a 3-day workshop on Woodfuel Production and Marketing at PFRI, Faisalabad from 28th - 30th October 1997. The major objectives of the workshop were to: assess the prevailing woodfuel production and utilization patterns; analyze the rural outreach strategies of forestry extension programmes and enhance the capabilities of government organizations and community based organizations to plan and implement integrated rural land resource management programmes. Nineteen papers were presented to the workshop participants by research scholars and professionals representing 8 different organizations engaged in forestry, agricultural, soil and environmental sciences. The conspicuous output of the course was a set of recommendations for follow-up action.

PFRI, Faisalabad, is highly indebted to RWEDP for its financial and technical support to organize this workshop. Mr. Tara N. Bhattarai's participation greatly contributed to the success of the workshop and I am grateful to him for giving so much of his time and energy. Thanks are also due to the Marketing Division of UAF, Faisalabad for its collaboration as a co-organizer.

Sahibzada Mohammad Hafeez
Director,
PFRI, Faisalabad

TABLE OF CONTENTS

List of Abbreviations

ABAD	Agency for Barani Areas Development
AKRSP	Agha Khan Rural Support Programme
CBO	Community Based Organization
FECT	Fuel Efficient Cooking Technology
FPDP	Forestry Planning & Development Project, Pakistan
FSMP	Forestry Sector Master Plan
HIES	Household Integrated Energy Survey
HESS	Household Energy Strategy Study
ITDG	Intermediate Technology Development Group
IUCN	International Union for Conservation of Nature and Natural Resources
JFM	Joint Forest Management in NWFP
KIDP	Kalam Integrated Development Project
LPG	Liquefied Petroleum Gas
MKDA	Murree Kahutta Development Authority
Mtoe	Million Tonnes Oil Equivalent.
MSF	Malakand Social Forestry Programme
MVSP	Mansehra Village Support Programme
NGO	Non-Government Organization
NRSP	National Rural Support Programme
NWFP	North Western Frontier Province
PFD	Punjab Forest Department
PFRI	Punjab Forestry Research Institute, Faisalabad
PFI	Pakistan Forest Institute, Peshawar
RWEDP	Regional Wood Energy Development Programme
SRSC	Sarhad Rural Support Corporation
UAF	University of Agriculture, Faisalabad
VSO	Voluntary Service Overseas

PROCEEDINGS

1. INTRODUCTION AND BACKGROUND

Traditional fuels account for 52% of the total 38.2 million tonnes of oil equivalent (Mtoe) energy consumed in Pakistan, and as much as 86% of the household energy consumed comes from biomass fuels. HESS studies have indicated that as little as 10% of the country's woodfuel supplies come from state forests, and have thus directed the attention of policy makers and planners to strengthening the production capabilities of private farming systems.The diversion of crop and animal residues presently accounting for about 30% of household energy consumption, back to the soil, will certainly improve the soil structure and production capability of the soil which has become degraded as a result of the loss of organic matter. The intensive monocultural practices need to be replaced by multicultural practices, i.e., by integrating silvicultural practices in farming systems. To improve the production potential and the sustainability of farming systems, as well as to cater for the woodfuel needs of the masses, Punjab Forestry Research Institute (PFRI) has launched a number of agroforestry research projects.

To coordinate these efforts among the extension services of the public forest departments, research scientists and community based organizations engaged in woodfuel production and marketing it was felt necessary to organize a workshop to enhance and integrate the institutional capabilities of government and private organizations involved in woodfuel production and marketing.

1.1 ORGANIZING INSTITUTIONS

The three-days workshop was organized with the active collaboration of the PFRI, the Regional Wood Energy Development Programme (RWEDP), Bangkok, Thailand and the Marketing Division of the University of Agriculture, Faisalabad. The workshop was held at the Punjab Forestry Research Institute, Faisalabad, Punjab, Pakistan from 28th - 30th October 1997 and was attended by research scholars, university professors, field professionals and community-based national and international organizations.

1.2 OBJECTIVES

The main objectives of the workshop were:

- to assess the production and utilization patterns of woodfuel and other bio-mass in the total energy consumption of the region;
- to analyze critically the prevailing policies, strategies and programmes pertaining to woodfuel production and marketing in the rural land based management systems;
- to enhance the capabilities of government organizations, private community based organizations, research scholars, field professionals and academicians involved in forestry, agriculture, soil science, environmental science and other related disciplines to understand the socio-economic and socio cultural complexities of woodfuel production in private farming systems and the status of marketing and utilization at trading and consumption points; and
- to identify the strategies for enhancing woodfuel production on a sustainable basis as well as to identify the hindrances in marketing/utilization through group discussion and come up with a set of recommendations for follow-up action.

1.3 WORKSHOP PARTICIPANTS

A total of 47 participants attended the workshop and nineteen participants presented technical papers. The following organizations were represented:

- Pakistan Forest Institute,(PFI), Peshawar,Pakistan
- Pakistan Agricultural Research Council(PARC) Islamabad, Pakistan
- Arid Zone Research Institute (AZRI), Bahawalpur, Punjab Pakistan
- Punjab Forest Department
- Sind Forest Department
- University of Agriculture, Faisalabad
- International Union for Conservation of Nature and Natural Resources
- (IUCN), Islamabad
- Punjab Forestry Research Institute, Faisalabad
- Punjab Wildlife Sciences Research Institute, Gatwala, Faisalabad
- Non-Government Organizations (NGOs).

Mr. Tara Bhattarai attended as an FAO Representative. Mr.M.I.Sheikh Ex-CCF, Punjab Forest Department, and Ex D.G. PFI Peshawar, Pakistan acted as resource persons for the duration of the course. Two progressive farmers also attended.

The participants included 7 persons with Ph.Ds, 28 persons with M.Scs, and 7 persons with B.Scs. 61% of the course participants were from research organizations, 25% from field departments, 10% from universities and about 4% from private organizations or were farmers. A full list of the participants is provided in part III of this publication.

1.4 WORKSHOP PROCESS

The workshop was designed for 3 days. Each day comprised 2 working sessions.The opening day also included the inaugural session. After the fourth working session on 29th October 1997 a field visit was made so that the participants could critically review the woodfuel production, flow and utilization systems at production and marketing/utilization points in a nearby rural suburb. The 1st, 2nd, 3rd, and 4th sessions were exclusively devoted to the presentation of 19 technical papers. Each presentation was followed by a question/answer session encompassing short discussions about the subject matter. On the final day, during the 5th working session, a set of recommendations on forest policy, production, management, marketing, and utilization was presented. These recommendations were the product of numerous small group discussion sessions. The workshop concluded with the award of certificates to the course participants and the Closing Address by the Chief Guest, and the Vote of Thanks by Sahibzada M Hafeez, Director PFRI.

Privately Raised Eucalyptus Plantation in Punjab (TB)

Farmer's woodlot of Eucalyptus in Punjab (TB)

Participants at a saw mill observing Fuelwood Production during conversion of logs into timber (TB)

Saw mill residues for sale as fuelwood (TB)

2. Summaries of the Technical Papers and Question and Answer Sessions

2.1 Woodfuel in the National Energy Balance

K.M. Siddiqui

In Pakistan woodfuel energy constitutes more than one third of the total energy consumed by all sectors of the economy. Dependence on woodfuel energy and use of traditional fuels remains high in spite of the shifting trend to use fossil fuels. But the data regarding the production, marketing, and utilization of fuelwood are either not available or are inaccurate and conflicting and are not regularly updated. Nevertheless, various studies indicate that 79% of households in rural areas and 48 % in urban areas use fuelwood for heating and cooking. On a country basis, more than 75% of the households use fuelwood. It has also been estimated that 90% of the woodfuel consumption takes place in the household sector, 5% in the commercial sector and the remaining 5% in the industrial sector. It is essential that the survey methodologies being adopted by various organizations/departments in the country is improved. It is also important that these agencies do not work in isolation. A more collaborative effort is needed so that the data collected are accurate and acceptable and can thus promote sustainable resource planning and development programmes.

Question and Answer Session

Q.1 (Dr.Ghulam Akbar). It seems that only sample data have been collected by the Punjab Forest Department and the figures quoted by PFI, Peshawar are from sources outside the forestry sector. Forest departments, PFI/PFRI should be a source of more authentic data. What can be done to achieve this?
Answer (Author). PFI, Peshawar is too small an organization to collect and analyze data on the multifarious aspects of forestry activities. Such an assignment is beyond the resources of the institute. However, this forum may recommend the appropriate provision of resources for PFI carry out such tasks in collaboration with provincial forest departments.

Q.2 (Malik Muhammad Khan). Internal rate of return IRR for fuelwood production is hardly 5% or even negative in some cases while it is 15% for timber production. Why?
Answer (Author). Low IRR is because of low productivity resulting from inefficient management and non-exploitation of the resource to the full potential.

Comments (Tara Bhattarai)
The basic issue is who collects data, when, where and at what cost and can we afford that? This is one aspect. The other aspect is that fuelwood plantations of shorter rotation, as in the West are not justified in South Asia unless the prices of substitutes, heavily subsidized in some cases, are left open to market forces. In South Asia combined rotations for 20% timber and 80% firewood are economically more desirable.

2.2 THE ROLE OF NGOS IN PROMOTING FUELWOOD PRODUCTION IN PAKISTAN

A.S. Bokhari

Due to several constraints it is not possible to increase the forest cover on state land. The new policy initiatives therefore have to concentrate on the promotion of tree growing ventures such as social forestry and the involvement of NGOs for this purpose. Of late, the farmers and other organizations have shown considerable interest in planting trees on farm and marginal lands. Still, to achieve the desired objectives wide-spread awareness has to be created among the rural communities and the NGOs can play an important role in achieving this. Fortunately, forestry-oriented NGOs have now made their appearance in the form of village level groups on a small scale as well as at the national level. Nevertheless, their objectives, institutional capabilities, technical expertise, modes of operation, efficiency and funding vary widely. In spite of a variety of hurdles, quite a few of these have been able to play a very effective role in greening the country's landscape.

Question and Answer Session

Q.1 (Rasheed Mehmood Randhawa). Fodder can be an important by-product of forestry, so why not to integrate livestock in forestry activities?
Answer (Author). Yes, we should.

Q.2 (Hakeem Shah). Can we not go for fuelwood plantations of shorter rotations in the public sector?
Answer (Author). By the year 2000 the already existing gap of 14 m3 is likely to widen in view of the population growth rate of 3%. Hence there is hardly any scope for fuelwood production in the public sector. Forestry activities in the private sector through NGOs and other micro-level organizations is the only solution.

Q.3 (Dr.Ghulam Akbar). Would you please comment on the credibility of the NGOs?
Answer (Author). To quote a specific case, 60 NGOs in Sukkur, Sind were registered but a survey of these revealed that 58 no longer existed and the remaining 2 were not willing to take up forestry operations. This is an extreme case. The situation is not that disheartening in other areas.

2.3 FORESTS AND FORESTRY IN PAKISTAN - STRATEGY FOR SUSTAINABLE DEVELOPMENT

Mahmood Iqbal Sheikh

4.26 million hectares of patchy, poorly-stocked slow growing forests scattered over only 4.8% of the total land area do not make any country proud. Far less Pakistan, where tree cover has to be an essential guarantee against erosion, land slides, movement of sand, crop damage, watershed depletion, and to assure food production and environmental stability. The per capita forest area is 0.05 ha compared to a world average of 1.0 hectare. Importing wood and wood products costs the resource poor country more than Rs.4,700 million annually. The reasons for this situation are both natural as well as man made. About 75% of the land area of Pakistan falls under the arid and semi arid zone and the lack of availability of moisture for growth and perpetuation of Pakistan of vegetation is a big constraint. Whatever vegetation has been available has been exploited mercilessly to meet the ever increasing demand of a fast growing population. Heavy incessant grazing and lopping does not give any respite to natural regeneration or young saplings planted in afforestation/reforestation campaigns. Forest sites have deteriorated almost to the point of no return due to misuse and mismanagement. The people living in the watersheds and deserts are forced to cut trees for their survival as no substitutes are available for heating, cooking, construction of huts, and for rearing their livestock. To cap it all, forestry projects are given low priority by people who matter and there is sub-optimal investment in development programs. There is total lack of awareness of the problem and there is weak, ineffective ill-equipped extension service to motivate the people to plant and protect trees.

If requisite funds and manpower are made available, against the current very low productivity of 0.7 and 4.0 m^3/ha/annum from the coniferous forests and irrigated plantations, it is possible to increase to yields of upto 1.5m^3 and 15m^3/ha/annum, respectively.

Several approaches could be made for conservation and development of the resource. These include ensuring adequate regeneration; protection of the growing stock; management on a sustained yield basis; genetic improvement of specific/tree species; reduction of waste generated in harvesting and conversion; treatment of wood before use; standardization of end products and use of substitute materials. Other measures could be purchase and extinction of rights, discouraging encroachment and demarcation of forests. Several kinds of incentives could be provided to people duly backed up by extension programs to encourage tree planting on private lands. Side by side the existing forest policy and legislation have to be revised to bring them up to par with the current requirements of forests, forestry, and ancillary disciplines.

The present critical situation of the tree cover in Pakistan is thus the result of the combined affect of climatic, biotic, edaphic and socio-economic factors on the one hand and administrative and political disinterest on the other. It is high time to take forthright and practicable decisions, as suggested above, to perpetuate and develop this fast dwindling but renewable resource.

Question and Answer Session

Q.1 (Rai Rafiq). Whom do you think responsible for misuse and mismanagement of public forests?
Answer (Author). Inadequate provision of funds, low level of technical input and, partly, pressure on state forests by local communities.

Q.2 (M.Faisal). Please comment on the privatization of irrigated plantations?
Answer (Author). Trial privatization of any problematic IP for a certain period could be carried out and a comparison made with a state controlled IP. This will possibly provide a guideline for the future course of action.

2.4 WOODFUEL PRODUCTION IN SIND WITH REFERENCE TO *"HURRIES"*

Dr. G.R. Keerio

Century-old traditional system of *HURRY* raising has received priority due to increased population and reduced fuelwood supplies in Sind Province. *HURRY* planting is an agroforestry system, in which Acacia nilotica seed is directly sown at close spacing on private farmlands with low initial input and subsequent nurturing. These short rotation block plantations are mainly raised in Southern Sind for producing fuelwood, mining timber and improving degraded and over-cultivated agricultural lands. The paper describes fuelwood production from *Hurries*, its distribution, marketing, problems encountered and recommendations for improvement.

Question and Answer Session

Q.1 (Malik Muhammad Khan). Can we not increase spacing to get pit props at an earlier rotation?
Answer (Author). Greater spacing is likely to make the trees more branchy and hence would effect the quality of pit props in addition to requiring extra expenditure on pruning.

Q.2 (Malik Muhammad Khan). How many rotations are usually obtained from one site?
Answer (Author). Only one rotation is obtained.

Q.3 (Shahid Rasheed Awan). Are revenues per year calculated for comparison with the agriculture crops?
Answer (Author). Yes, farmer's concerns are addressed on such issues.

2.5 DEVELOPMENT OF SALT-AFFECTED WASTELAND FOR WOOD PRODUCTION IN PAKISTAN

M. Aslam, R.H. Qureshi, S. Nawaz, J. Akhtar & M. Nasim

In Pakistan about 6.3 million hectares of land is salt-affected and approximately half of this area is wasteland due to very high salinity. About 56% and 81% of the affected soils of the Pakistan and the Punjab, respectively, are saline-sodic and the rest are saline. Reclamation is usually the first choice for the rehabilitation of the salt-affected soils. However, reclamation measure can not be adopted or are unsuitable for extremely salt-affected and salt-affected dense soils with low permeability. Apart from this, scarcity of fresh canal water and the brackishness of ground water in irrigated and other areas also limits the scope of adopting reclamation measures. Presently, salt-affected waste lands described under categories iv-ix produce mesquite (*Prosopis juliflora*) or Lana (*Sued fruticosa*) etc. These areas can easily be utilized for growing salt tolerant trees such as *Eucalyptus, Tamarix, Acacia spp*. or salt bushes such as Atriplexe which can be a good source of fuel wood in the villages. Thus the development of the waste lands and saline water resources for tree cultivation is specially important in a country like Pakistan where the population is increasing at a rate of 3% each year and the annual domestic energy requirements till the end of 20th century will be equivalent to 61.0 million m^3 fuel wood. Further, salt tolerant woody tree species are expected to alleviate energy problems and the related social problems of the rural communities.

Question and Answer Session

Q.1 (Liaquat A. Gill). Which tree spp. so far have proved most successful in your field experiments on saline soils?
Answer (Author). Both Eucalyptus and Acacia nilotica.

Q.2 (Amjad Ali). Can we not combine salt tolerant grasses with tree spp. in reclamation efforts?
Answer (Author). Yes, in soil reclamation efforts we can.

2.6 PATTERNS AND PROBLEMS OF FUELWOOD CONSUMPTION AND PRODUCTION IN SALT EFFECTED AREAS

Dr. Ishfaq Mann, Mrs. Kishwar Ejaz & Mr.Saif-ur-Rehman

The study was conducted in four villages of Satiana Markaz of Tehsil Jaranwala and was aimed at looking into the patterns and the problems of fuelwood consumption and production in salt effected areas of Faisalabad. A sample of 109 respondents was interviewed. The data were analyzed and the results have been presented in this paper. The results indicate that fuelwood is preferred over alternative sources of energy for cooking and heating purposes in rural Faisalabad. The consumers/respondents were also highly satisfied with the efficiency of woodfuel compared to the other alternatives like dung cake, crop residues, electricity, kerosene oil etc. The people preferred Eucalyptus over Atriplex as fuelwood. Farmers' participation is crucial to make the plantation programmes a success on public and private wastelands and to meet fuelwood requirements of the rural communities in the region.

Question and Answer Session

Q.1 (Yousaf Paracha). How about the planting of Acacia nilotica (Kikar) in the salt effected areas?
Answer (Author). Kikar has also been proposed for planting by the forestry professionals at PFRI.

Comments (S.M.Hafeez). Kikar will be a better option both for soil reclamation and as a fuelwood.

2.7 WOODFUEL TRENDS AND PROSPECTS IN PAKISTAN

Muhammad Naseer Zia

The acute scarcity of fuelwood has not attracted much world attention as the shortage is essentially localized and is limited in consequences to the actual user. The scarcity is likely to further increase with the population growth. Pyramids of hand-moulded dung putties drying in the sun are commonly seen in our rural landscape. Trees need to be planted on a vast scale to overcome the fuelwood scarcity and to allow the crop residues and dung putties to serve as organic nutrients for farm fields. The need to enhance woodfuel production is imperative in view of the scarcity and escalating prices of alternative fossil fuels which are burdening the public exchequer in terms of expensive imports. Fuelwood is comparatively easy to produce without any complication of foreign exchange, international commerce or sophisticated trade network. The fuelwood can be produced on community wastelands as well as private farms in shorter rotation periods and even crooked, pronged and branchy species can be used. The woodfuel scarcity issue needs to be addressed through a 3 pronged approach of demand management, supply enhancement and the development of alternatives. An efficient and trained extension service can help in addressing the scarcity issue through better outreach techniques. Appropriate selection of species in terms of convenience for growing and other multipurpose benefits may be taken into account in social forestry extension programmes.

Question and Answer Session

Q.1 (Aziz-ur-Rehman Dogar). The marketing and sale problem associated with Eucalyptus has not adequately been dealt with. The farmer is getting as low as Rs.17/40 kg at stumpage and hence there is lot of hue and cry by the private growers for having been lured to expect roaring profits. Even the Forestry Department has not been able to appropriately transfer the harvesting technology to the growers. Recently it has been learned that harvesting of Eucalyptus in winter would not lead to the wood developing cracks and wooden patties of Eucalyptus have been used in the cone/wrapping sections of the textile industry.
Answer (M.I. Sheikh). The marketing problem exists partly because of non-completion of Farooqi Paper Mills at Gujrat and Kamalia Paper Mills at Kamalia and some inbuilt bias against the use of Eucalyptus wood as fuel and for some other possible uses.

Q.2 (Aziz-ur-Rehman Dogar). People usually prefer Shisham over Eucalyptus for use as fuelwood. Please comment?
Answer (Author). There is not much difference in the calorific value of both species. The issues seems to be more of a socio-cultural nature.

Q.3 (Dr. Kereo). Coordination among the research organizations and field extension formations is lacking, is it not?
Answer (Author). Yes sir. A close link between these is needed for the quick dissemination of the research generated knowledge.

Comments (K.M. Siddiqui). Winter cutting and appropriate seasoning through stacking, particularly in the case of fast growing species, would generally reduce the development of cracks in the wood. Properly seasoned Eucalyptus wood can find a use not only in the furniture industry but also as electricity transmission poles. This use has been demonstrated at PFI Peshawar and at Changa Manga.

Although the proposed pulp and paper industries referred to have not yet started functioning, as a matter of fact the import figure of pulp and paper has been standing at Rs.4 billion for the last 10 years indicating a stagnant literacy rate and the future scope for expanding the printing and publishing industry in this country.

Comments (Tara Bhattarai). The information system between wood producers and the users requires a lot of improvement in this part of the region.

2.8 FUELWOOD DISTRIBUTION SYSTEM IN SINDH

Dr. Lekhraj Kella

In Sind, fuelwood is mainly produced in the state forests along river banks, in the irrigated plantations, as canal or roadside avenues and on wastelands. Several species such as Acacia nilotica and Prosopis cineraria with high calorific value grow in these areas. Trees grown on farmlands are another source of fuelwood and charcoal. In spite of an increase in the use of fuelwood by about 2% per annum, the distribution system has remained almost the same for villages, towns and cities. Pack animals, bullock carts, tractor trolleys, trucks, trains and even buses are used for the transportation of wood from the production to the consumption areas. Due to increases in the transportation cost, the prices of fuelwood have jumped but the poor tree farmer still does not get much due to the stranglehold of the contractors on the wood markets. These rural wood producers ought to be helped by providing technical and financial inputs and motivated by creating awareness regarding the value of this green gold they are producing.

Question and Answer Session

Q.1 (A. Khaliq). How can we reduce the role of the middleman in the flow chain?
Answer (Author). The middleman will always be there; however, we can reduce the profit margin of intermediaries by bridging the communication gap in the marketing information system.

Comments (M. Mushtaque). Improvements in the communication system and in the networking of consumer sales points well scattered in rural areas will certainly have a positive effect on the marketing system and ultimately on the returns to the tree farmer.

2.9 NGOS AND FUELWOOD PRODUCTION DEVELOPMENT PROJECTS

Raja Tariq Mehmood

NGOs are essentially nonprofit private organizations. They pursue activities to promote the interests of the poor, to relieve suffering, to protect the environment, and they also undertake community development. These can thus be operational or development NGOs and advocacy NGOs operating at local, national or international level. The inherent strengths of NGOs lie in their autonomy, flexibility, participation, transparency, bottom-up approach, credibility and trust.

Fuelwood is the main source for meeting the energy requirements of an overwhelming proportion of the rural population and a sizable proportion of the urban population. As the consumption of fuelwood exceeds its sustainable production in Pakistan by 19.55 m3, substantial efforts are needed to reduce the gap by promoting fuelwood plantations and introducing fuel efficient cooking methods. About 90% of the demand of fuelwood is met by private land owners and thus the scope for increased fuelwood supplies also lies in the private sector. NGOs are the most suitable organs to promote the increased production of fuelwood as people are wary and suspicious of the intentions of government functionaries. The success stories of various NGOs in Pakistan in promoting the growing of fuelwood trees include the Agha Khan Rural Support Programme (AKRSP), Kalam Integrated Development Project (KIDP), Sarhad Rural Support Programme (SRSC), Forestry Planning & Development Project (FPDP), National Rural Support Programme (NRSP) etc.

In NWFP and Punjab (ERNP), the overall objectives are environmental rehabilitation, natural resource management and socio-economic development on a sustained basis through community participation. The project includes planting approximately an area of over 31,000 hectares of fast growing tree species on private, communal and state lands through village organizations (Vons). In this way it is hoped to resolve the problem of fuelwood shortages in the area where its requirement is very high.

Question and Answer Session

Q.1 (Ashore Faro). Most of the NGOs are foreign funded. Why is the local public sector not active in offering financial help to the NGOs involved in development programmes?
Answer (Author). In the forestry sector community based wastelands can be definitely better afforested by involving NGOs and the participation of local masses in public sector development programmes.

Q.2 (Yousaf Paracha). To what extent are plantation programs carried out with the help of NGOs successful?
Answer (Author). Community participation ensures better subsequent protection, hence greater success.

2.10 PRODUCTION, UTILIZATION AND DISTRIBUTION OF FUELWOOD IN THE DESERTS OF PUNJAB

Ghulam Akbar

Enormous quantities of dung are being consumed for heating and cooking leading to the loss of valuable plant nutrients and organic matter which could be used for the production of food. Additionally, natural vegetation is being ruthlessly destroyed in all parts of the country, especially for livestock feed, and for heating and cooking. The trees planted by farmers are sold standing to eager contractors who transport the material to cities for domestic consumption. The erratic rainfall is a great hurdle in the recovery of the natural vegetation or the raising of new tree crops. This has triggered an endless process of desertification. Several measures such as efficient use of water; introduction of suitable tree species; raising of village energy plantations; creation of awareness among communities etc. are required to be taken to stabilize the desert ecosystem on the one hand and to ensure wood production on the other.

Question and Answer Session

Q.1 (M.I. Sheikh). Have you tried the reseeding of Haloxylon?
Answer (Author). A limited success rate was obtained with trials. Seed is actually already there in the soil; only an appropriate moisture level is needed for germination.

Q.2 (M.I. Sheikh). The local communities while collecting fuelwood stub out the roots of Haloxylon species as well. Would you consider fencing some protected areas for perpetuation of this species which is being overgrazed?
Answer (Author). In my opinion the fencing will have very little effect on protection.
The fencing will have to be put in the minds of the people. Actually the participation of local communities in the conservation measures will be needed.

2.11 MANGROVE FORESTS - AN IMPORTANT WOODFUEL RESOURCE OF THE COASTAL BELT

Najamuddin Vistro

Mangroves are a diverse group of predominantly tropical trees, shrubs, and associated flora and fauna growing in the marine intertidal zone in harsh, restrictive and dynamic conditions. Mangroves, legally a protected forest, are a source of fodder and fuelwood for the inhabitants of the coastal belt. The economic importance of the mangrove can be estimated from the fisheries these forests harbor and from foreign exchange earnings made through exports - primarily of shrimp. The decreased flow of silt and water due to construction of upstream reservoirs and the effluent waste flows of the industrial sector have degraded the conditions of mangrove forests. However, rehabilitation measures are being undertaken by Sind Forest Department in collaboration with international development agencies.

Question and Answer Session

Q.1 (Malik Muhammad Khan). To what extent has the depletion of mangroves has effected the harvesting of fish?
Answer (Author). To quite a larger extent.

Q.2 (Shahid Rasheed Awan). Is there any participation by the local communities in the rehabilitation effort?
Answer (Author). Not at this point of time. However, it is being planned for future projects.

2.12 RURAL WOMEN AND WOODFUEL ENERGY

Mrs.Nighat Mushtaq

In the predominantly rural society of Pakistan, women are the most burdened creatures in so far as collection of wood for domestic use is concerned. In addition to being responsible for a variety of arduous household chores they are required to collect fuelwood from the waste lands and forests. They also inhale a lot of poisonous smoke in the house while they are cooking food for the rest of the family. It is, therefore, quite evident that it is the women who have to undergo physical torture to collect wood and then are exposed to severe health hazards afterwards. With some improvements millions of rural women could be given some respite.

Question and Answer Session

Comments (M.I.Sheikh). Improvements in stoves to ensure better burning efficiency is required as a safeguard against possible health hazards during fuelwood burning.

Author. I agree, improvement in the efficiency of wood stoves is the need of the hour.

Comments (Mr.Tara Bhattarai). A comparison of wood burning with burning of alternatives, including fossil fuels, should have been elaborated in the paper. The related issues may also be listed by policy makers, planners and researchers. Improvement in kitchen conditions and in the efficiency of wood stoves is of paramount importance but the real issue is how to coordinate social forestry programmes and stove improvement related issues, and the role of PFRI and PFI in this regard may also be streamlined in clear objective terms.

Comments (M.I.Sheikh). Both PFRI and PFI may include the development of efficient fuel combustion stoves in their research programme.

2.13 ROLE OF IRRIGATED PLANTATIONS IN THE PRODUCTION OF WOOD FUEL IN PUNJAB

Mian Riaz-ul-Haq

Fuelwood is very scarce in the Punjab. The current consumption of about 25m3 will increase to about 27m3 by the turn of the century, primarily due to an increase in the population. The urban demand for fuelwood may decrease due to the use of fossil fuels, but the rural demand will increase by 2% per annum. The rural people will continue to use crop residues and valuable cow-dung. Sources of woodfuel supply in the rural area include the trees planted by farmers, irrigated plantations and riverine forests. Although the social forestry programmes are gathering momentum, there is a decline in the productivity of state forests due to the inadequacy of inputs. The share of the Forest Department in the provincial ADP shows an alarming state of affairs, from 2.7% in 1988-89 to just 0.49% in 1995. The erratic and poor supply of canal water, poor protection, non-availability of labour are other major constraints which need to be overcome to bring the irrigated plantations to the optimum level of production.

Question and Answer Session

Q.1 (Shams-ur-Rehman). Has the Forestry Act of 1927 been revised ?
Answer (Author). There is only one amendment regarding encroachment.

Comments (M.I. Sheikh). It is an admitted fact that the legal cover against theft, particularly in irrigated plantations, is ineffective.

Q.2 (K.M. Siddiqui). Would you please let us know the possible agencies for inclusion in the participatory management of forests?
Answer (Author). Industries and NGOs can take part in participatory management.

Q.3 (K.M. Siddiqui). Please comment on the participation of beldars.
Answer (Author). As far as my opinion goes, I do not find any harm in including the beldars in the participatory management of the forestry plantations.

Comments (M.I. Sheikh). The production potential of irrigated plantations is continuously declining. There are no double storey or triple storey plantations any more. Let us admit our administrative and management failures. As regards marketing, it should not be a problem as end users would take care of the market by themselves in an open market economy.

Q.4 (K.M. Siddiqui). 50% of areas under the control of the Forest Department is lying vacant. The situation in the irrigated plantations (IPS) is not any different. How about privatizing irrigated plantations?
Answer (Author). In my opinion it would be better to go for participatory management rather than total privatization.

Comments (Tara Bhattarai). A Dutch scientist has put forward the hypophesis that by the turn of next centuary wood for cooking may not be available in the Third World given the present pace of deforestation. IPS were perhaps justified in the good old days. Policies and strategies in respect of IPS need to be revised. Privatization/deregulation might be compared with the alternate systems of management. Less allocation of funds to the forestry sector is a worldwide phenomenon but the fact remains that its contribution to revenue has also been continuously declining.

2.14 SOCIAL FORESTRY AND THE WOODFUEL CRISIS
Shahid Rasheed Awan

Woodfuel production is one of the main objectives of social forestry programmes as wood is the major source of energy in rural areas of Pakistan. The already existing scarcity is likely to increase by the year 2000. Switching to fossil fuels in the future does not stand any chance in view of depleting non-renewable fuel reserves and possibly sky-rocketing costs required to extract the non-renewable reserves. Social Forestry is thus the simplest solution to the forthcoming energy crisis. Effective social forestry strategies will have to be devised with the active participation of the local communities as they are the ultimate beneficiaries. The social forestry programmes will have to be very carefully integrated into the socio-economic and socio-cultural environments of the rural masses. The landless are equally important and their participation should also be sought to make woodfuel production programmes on private lands a success. The main constraints in woodfuel production such as inadequate information regarding marketing, and the lack of awareness of the public regarding projects under implementation in their areas need to be adequately addressed. Socio-economic and demographic studies of the social forestry project areas will have to be integrated into the planning and implementation stages of woodfuel production programmes on private farmlands.

Question and Answer Session

Q.1 (K.M. Siddiqui). In the case of community forestry is an appropriate survey required to be carried-out to determine the area available and quantity of inputs required?
Answer (Author). Yes, it would be appropriate to quantify the required inputs beforehand.

Comments (Tara Bhattarai). In India social forestry on private lands has been quite successful compared with forestry on community lands. Individual needs are addressed in both. What is important is participation by individuals, communities, NGOs etc.

2.15 STRATEGY FOR ENHANCING FUTURE WOODFUEL PRODUCTION

Malik Muhammad Khan

Woodfuels continue to be the major source of household energy in Pakistan. Ninety percent of rural people and 60% of the urban people use woodfuel for their household needs. Pakistan is a forest poor country with only 0.03 ha of forests per capita compared to the world average of 1 ha per capita. This average is declining due to population growth at the rate of 3% per annum and the steady degradation of the country's natural forest resources. More than 500,000 heads of livestock also depend on forest resources. The shortage of woodfuel is partly being met by burning valuable cow dung to cook meals instead of using it to maintain and improve soil fertility in the rural areas. The trees on 29 million ha of range lands and the 330 million trees on 19.3 million ha of farmlands contribute greatly to meeting the woodfuel demand in Pakistan. HESS estimated during 1990-91, with the help of satellite imagery, that 240 m3 of wood was being produced giving 135.572 m3 of woodfuel with an estimated household demand of 43.495 m3 (56% of the requirement) - 6.917 m3 in urban areas and 36.518 m3 in rural areas. The woodfuel demand will be much greater if the cow dung is used as farm yard manure, instead of as a source of household energy. The population is likely to double by 2018 with a proportionate increase in the woodfuel requirement. It is proposed that the country adopt a long term policy and a streamlined strategy to enhance production and make it compatible with the increases in population and demand. The farmlands are producing 90% of the woodfuel and 55% of the timber at present. If suitable steps, proposed in this paper, are sincerely taken to develop agroforestry, farm forestry, social forestry, community forestry, participatory joint management of public and communal lands, and to improve the density of public forests, the situation can be handled successfully.

Question and Answer Session

Q.1 (K.M. Siddiqui). How far do the prescriptions of the Forestry Sector Master Plan and the National Conservation Strategy differ with particular reference to woodfuel production?
Answer (Author). The emphasis in both is on privatization of the forestry business.

2.16 MARKETING OF WOODFUEL IN PAKISTAN

Qamar-Mohy-ud-Din

Wood constitutes nearly 1/2 of the fuel used for cooking and heating. The figure is a staggering 80% in rural areas. Animal dung and agriculture waste are used to supplement wood. The three major chains in the fuelwood marketing and trading system in Pakistan are producers (i.e. farmlands and government forests), traders and consumers. 90% of the share in the case of firewood comes from private farmlands, while the share of the state owned forests is nominal. More than 70% of the profits are earned by the traders, contractors, wholesalers/retailers acting as agents between producer and consumer. It has been estimated that half of the fuelwood produced is traded in the markets while the rest constitutes a free supply rendering the source as an open access resource. The prices in real terms seem to have been stable or slightly rising in the recent past. To secure needed improvements in fuelwood marketing, the information systems on pricing in the marketing chain need to be transferred to the producers on a consistent basis. Taxation and octroi levies also needed to be standardized. Market committees in wood markets may be introduced to frame and enforce regulations in woodfuel trading. Training facilities at the imparting institutions must also be adequately capitalized for pre-service and in-service training of agriculture and forestry services.

Question and Answer Session

Q.1 (M.I. Sheikh). Would you please let us know about the constituent members of the market committees?
Answer (Author). Produce growers, consumer clientele, traders and a representative of the Agricultural Department are the members of the committee, which is headed by an Ex-Assistant Director of the Agriculture Department.

Q.2 (Mr. Riaz-ul-Haq). Since members of the market committee are nominated and not elected, they do not seem to have any say in the affairs of the committee. Is that so?
Answer (Author). Though the members are usually nominees they do have a say in the affairs of the committee.

Q.3 (M.I. Sheikh). Powder post beetle and other pests account for more than 50% of post harvest losses. Would you please recommend some anti-pest measures to reduce such losses?
Answer (Author). Yes, anti-pest measures are required to be adopted to reduce such losses.

2.17 ENVIRONMENTAL IMPACTS OF ENERGY PRODUCTION FROM BIOMASS

Imtiaz Ahmad

In Pakistan there are three major sources of biomass energy: fuelwood, agricultural residues, and livestock manure. As a matter of fact biomass meets about 86% of the total domestic energy requirements. 90% of the rural and 50% of the urban population depend on biomass fuels. Fuelwood accounts for 50% of the total biomass fuel supply. It has been widely accepted that the production and conservation of biomass, especially forests, considerably improves the environment. Its ruthless exploitation greatly damages the land and water resources of a country and strangles its aesthetic values, leading to total destabilization of the ecological landscape.

Question and Answer Session

Comments (Mr.Tara Bhattarai). Wood fuel is environmentally friendly compared with the burning of fossil fuels. A scientific comparison of these two could have been incorporated into the paper.

2.18 BIO-ENERGY FOR MEETING GROWING ENERGY NEEDS

Sahibzada Mohammad Hafeez

The world is in the grip of an energy crisis which is being exacerbated by the ever increasing human population. Wood is the most commonly used source of energy in the world. By the year 2000 the world woodfuel deficit is expected to reach 960 million cubic meters a year - the energy equivalent of 240 million tonnes of oil a year. The solution to the woodfuel problem is more woodfuel and the reason is that providing energy in the form of renewable wood solves far more than drastic energy shortages. A few ways to overcome the energy crisis are: increasing the productivity of existing resources through sound management practices; creating new resources with the involvement of people; improving woodfuel distribution and marketing; and improving conversion and utilization technologies. The objective should be to create a people's movement where all activities relating to the production, conversion, utilization and conversion of biomass will be implemented on a decentralized basis to meet the local needs to a significant extent.

Question and Answer Session

Q.1.(K.M. Siddiqui). Why aren't trees growing on farmlands recognized as commercial commodities and included in revenue records?
Answer (Author). Such a step is likely to raise legal complications which might serve as a disincentive to the private farmland tree growers.

Comments (Tara Bhattarai). National policy on rural wood energy development is missing. An adequate support system is required to be developed instead of hasty studies since there is a higher dependence on woodfuel among rural folks. A strategy for the future may also be incorporated into national policies.

Comments (Naseer Zia). At present, legislation in respect of trees growing on private farmlands is non-existent.

Comments (Malik Mohammad Khan). Legal coverage may be extended to the private lands.

Comments (Author). Some legislative measures for private farmland may be required.

2.19 FUELWOOD PRODUCTION FROM PUBLIC AND NON-FOREST AREAS IN PAKISTAN

Hakeem Shah

About 70% of households in Pakistan use wood as a fuel. HESS studies and the Forestry Sector Master Plan have indicated a gap of about 14 million m3 between the production and consumption parameters. The public forestry resources are in the process of continuous degradation on account of ill management combined with the absence of an appropriate financial input. Furthermore, about 90% of fuelwood and 60% of timber wood comes from private farmlands. Fuelwood, being a preferred species compared to other alternatives, is likely to widen the already existing huge gap. The only alternative is to focus on private farmlands for the production of wood. At present only 2% the land is under trees and this figure can safely be increased to 10% without any harmful effects on agricultural crop yields. However, technology transfer and dissemination of knowledge to the wood producers and farmers is required to be strengthened from nursery raising, tree planting and management to marketing to bridge the gap by the year 2010.

Question and Answer Session

Q.1 (K.M. Siddiqui). It was proposed that Thermal Energy Plants should plant a minimum 10 acres of land in the vicinity of the plants. Is this being implemented?
Answer (Malik Muhammad Khan). Pc-1 Schemes are being revised accordingly. The planning commission in Islamabad has reportedly decided to take care of the issue while approving the projects.

Comments (Tara Bhattarai). Provision will have to be made as a recommendation at provincial level in respect of feasibility of investments in social forestry to provide an economic incentive to the tree growers.

3. FIELD EXERCISE

3.1 PARTICIPATORY APPRAISAL

On 29th October a field excursion was undertaken by the workshop participants to the farm of Mr. Dastgir of Tibbi Karrianwala in Khurrianwala Markaz. A participatory appraisal was conducted with the tree crop producer to better comprehend the concerns of the farmer in the production/marketing system. The framework used to guide the field excursion is provided in Annex 10.

(a) Production

Mr. Dastgir had raised a compact plantation of Eucalyptus on an area of 6 acres at a spacing of 2 x 2m 1990 under a social forestry scheme launched by Punjab Forest Department. At the time of planting the area was partly saline and waterlogged though at the time of the visit the area appeared to have been reclaimed. The planting was about 90% successful. However, about 30% of the stock did not attain the standard growth as required of the species in a period of 7 years. Eucalyptus trees at the edges obviously had achieved better growth. No intermediate fellings had been done to facilitate the growth by opening up the canopy or to bring in some revenue for the producer. During the course of the discussion with the farmer it was revealed that the extension service of the Punjab Forest Department, after having helped to raise the plantation through the provision of nursery stock and guidance for planting did not make subsequent visits to advise on technical inputs in tree management and the disposal of marketable stock - a link still missing in almost all of the social forestry extension programmes currently being implemented.

(b) Marketing/Utilization

The wood was purchased by Mr. Sharif, a contractor from Pauliani Jaranwala Markaz, during 1997 at the stumpage price of Rs.17/40 kg. He then sold it at a price of 34/40 kg to the retailer. Although the farmer earned Rs.1,80,000/ - from the sale of 5 acres in a period of 7 years he was not happy about the returns and complained of having been given figures of roaring returns by the extension field staff of Punjab Forest Department at the time of planting. He also quoted a figure of Rs.1,15,000/ - which he incurred for the maintenance of the planting (he had employed a full time field servant). It was felt by the course participants that though the returns made by the farmer were quite comparable with the returns from agricultural crops, the profit of the intermediary was a little on the high side. The expenditure incurred for the maintenance of the plantation also looked inflated.

The course participants also visited a sawmill owned by Mr. Allah Ditta of Khurrianwala. The mill owner has been in the business for 10 years and stated that he would happily purchase good quality Eucalyptus timber for upto Rs.60/40 kg at the mill site*. He had recently purchased 36 Eucalyptus trees ranging in girth between 90-100 cm at Rs. 18,000/- The mill owner confirmed that harvesting Eucalyptus in winter and seasoning it under shade minimizes the occurrence of cracks in the wood. According to the mill owner, properly seasoned Eucalyptus wood is equally good for making furniture. The saw mill owner also supplies wooden rafters for roof construction. The participants noted with interest that wooden putties (36"x1.5") made of Eucalyptus wood were supplied (for Rs.1.5/E) to the textile industry for use in cloth bolts.

(c) Extension And Training Services

As mentioned in the previous section, during the course of the visit to the plantation and saw mill the course participants learned that the extension service had failed to make subsequent contacts with the tree producer to address the issues of tree management and marketing. This failure resulted in subsequent poor management and low returns to the tree grower in terms of both the quality and quantity of the wood produced. There is a tremendous gap between the supply of wood and the demand from the consumer. At the end of the field trip the participants felt very strongly that the extension service is neither adequately trained nor has the resources to help bridge this gap. The extension service needs to be strengthened to address the concerns that were identified.

4. GROUP SESSIONS AND RECOMMENDATIONS

On the final day of the training course, three separate groups were formed to deal with Forest Policy, Production, Management; Marketing, and Utilization, respectively. After a good deal of in-depth discussion and brainstorming each group came up with a set of recommendations for follow up action. The constituent members of the individual groups are listed below:

GROUP I

Forest Policy, Production and Management

- Malik Mohammad Khan (Chairman)
- Dr.G.R.Kereo
- Dr. M. Aslam
- Mr. Imtiaz Ahmed
- Mr.Shahid Rashid Awan
- Miss Shaheena Ramzan
- Miss Aqeela Mobeen Akhtar
- Malik Muhammad Nazir
- Ch.Bashir Rana
- Abdul Khaliq
- Aziz-ur-Rehman Dogar.

GROUP-II

Marketing

- Dr.Qamar Mohy-ud-Din (Chairman)
- Dr.Ghulam Akbar
- Dr. Asfaq Mann
- Rai Muhammad Rafique
- Mr.Hakeem Shah
- Mr.Muhammad Faisal
- Malik Muhammad Mushtaq
- Mr.Nadeem Quraishi
- Mr.M.Sajjad
- Mr.Liaqat Ali Gill
- Mr.Barkat Ali
- Mr.Amjad Ali

GROUP- III

Utilization

- Dr.K.M.Siddiqui (Chairman)
- Mr.Najam-ud-Din.Vistro
- Dr.Muhammad Arshad
- Dr.Khalid Mustafa
- Raja Tariq.Mahmood
- Mr.Obaidullah Niazi
- Mr.Tariq Mehmood
- Mrs.Nighat Mushtaq
- Mr.Mahboob Ali Bhatti
- Mr.M.Y.Paracha
- Mr.Muhammad Muslim
- Mr.Rasheed Kamboh
- Mr.Naseer Zia.

Mr. M.I.Sheikh coordinated the group discussions and acted as facilitator for the formulation of the recommendations.

Recommendations

Forest Policy, Production and Management

- In order to ensure effective implementation of the National Forest Policy, it is highly desirable that strong political support should be extended to the cause of forest resource development and duly reflected in a larger and sustained allocation of funds.
- The current legislation is regulatory in nature and is entirely protection-oriented. It does not meet the requirements of development and extension forestry. The restrictive provisions unduly discourage tree farmers. They have to obtain a permit on payment and also have to pay a variety of taxes in the form of Zila (District Council) Tax etc. The laws have to be persuasive and not punitive. The Forest Act of 1927 and other regulations and laws should be revised and a committee should be set up to do the job.
- A review of country-wide Zila Octroi and the Forest Department's taxation structures should be undertaken to make these more flexible for the farmers. Additionally, as is the case in agriculture, market committees should be created and entrusted to perform functions like granting of licenses, and formulation and enforcement of rules for the sale of wood.
- Woodlots should be raised in close vicinity of the villages to alleviate the problems faced by women in the collection of wood and cow-dung.
- The irrigated plantations are producing much less than their potential due to, inter alia, the absence of site specific land use planning, lack of financial resources, inefficient delivery of irrigated water, poor protection, encroachment and over-grazing, non-availability of labour at reasonable rates and of course administrative failures. The government should adopt some remedial measures to enhance woodfuel production from this highly valuable resource.
- In view of the critical insufficiency of fuelwood, the involvement of local people as well as of NGOs in forestry development programmes should be given importance to achieve positive results.
- Techniques have been developed for planting saline and waterlogged sites in the country. Suitable species have also been identified. Returns from wood per unit area have also been worked out which are much better than the returns from agricultural crops from similar lands. It is, therefore, desirable that large scale programmes of planting trees on such marginal lands is undertaken to put these to proper use and revert these back to productive agriculture after reclamation.
- Bioenergy occupies a dominant place as an energy source, particularly in the rural sector. In order to meet basic minimum energy needs, a bioenergy programme should be given top priority and suitable motivational programmes should be part of this.
- Since there is no possibility to earmark more state lands for afforestation, it is essential that the planting programme be extended on private farmlands and waste lands. This will require motivating the farmers.

- Concept of *Hurries* - Acacia nilotica as block plantations (in vogue in Sind since 1858) - may be promoted in other parts of the country with a similar environment as it is a very profitable business for the farmer. The concept may be replicated with other species where possible.
- Due to heavy grazing and excessive cutting in the arid and semi-arid areas, desertification is taking place at a fast pace. In order to rehabilitate the deserts and to improve fuelwood production, studies should be undertaken to improve water use efficiency; introduction of suitable tree/shrub species; establishment of wood energy village plantations and mobilization of the communities to achieve the desired objective.
- The fact has to be recognized that the most important cause of the destruction of the tree cover is the socio-economic conditions of the people living in watersheds and the arid and semi-arid lands which force them to cut the trees. A major effort is needed to improve these conditions by providing them with alternative sources of livelihood. Several kinds of incentives such as provision of subsidies, cash payment, enhancement of employment opportunities, development of local cottage industries, exemption from land revenue, water tax etc. should be provided and duly backed up by well-planned extension programmes.
- Much research has been done in the country and elsewhere on the tree-crop interface and the agro-silvopastoral system of land management and wood utilization. The results should be passed on to the end-user in easily understandable language with a mechanism for feedback.
- In the Himalayas a reasonable tree cover is a must to protect the catchment areas and ensure a sustained supply of water. However, broad-leaved tree species which are a natural associate of the conifers have disappeared over time due to intensive cutting for fuelwood and lopping for fodder. A project should be prepared to reintroduce the broadleaved trees in the Himalayan regions.
- The mangrove forests cover thousands of hectares along the coast of Pakistan and represent the sixth largest mangrove block in the world. Forests are under great stress due to over-cutting for woodfuel; browsing by camels; reduction in the annual flow of fresh water from the river Indus and pollution by effluents from the industrial areas of Karachi. Since these forests are not only a multiple source of fuelwood and fodder but also play a very important role in sustaining the aquatic flora, special coordinated efforts should be made to preserve and develop the forest resource.
- To achieve the objectives, it is essential that the PFRI is declared a centre of excellence for agroforestry systems, production, marketing, and technology transfer.

Marketing

- Research on fuelwood markets along the lines of the HESS study should be repeated with necessary improvements.
- Collection, interpretation and dissemination of market information, including prices and buyers in the marketing chain, should be entrusted to an independent organization.
- A review of Zila, Octroi and Forest Department taxation structures should be carried out to ensure transparency, simplification and standardization. The recently proposed Zila tax in Punjab may be reduced from Rs.300 to Rs.100 per truck.

- Market committees should be associated with the regulation and supervision of timber markets. These committees should grant licenses to commission agents and formulate and enforce the rules for the auction of fuelwood.
- The market committees should display the prices of fuelwood on notice boards in timber markets, agricultural produce markets, at bus stands and railway stations.
- Forest production and management on private land should be declared an industry. Loans should be advanced by institutional sources for increasing production and purchasing improved means of transportation and handling.
- The subject of wood energy/fuel trade should be included in the training courses at forestry and agricultural training institutions. Refresher courses in woodfuel production and marketing should be offered to the field staff of forestry and agriculture departments.
- Supporting the price of wood like agricultural, commodities may be considered to encourage the tree growers.
- A platform at district level should be provided for private tree growers, wood contractors/traders, industrialists and wood consumers to streamline the affairs of production and marketing of timber/fuelwood.

Utilization

- There is a need to bridge the existing gaps between wood producers, the middlemen and wood consumers.
- Research on efficient uses of fuelwood should be undertaken to facilitate the utilization system.
- A close and efficient linkage between researchers, extension workers and farmers should be established in the course of technology transfer.
- Woodfuel alternatives like biogas, ethanol, fossil fuel, solar energy should be given due consideration.
- To minimize harvesting losses, storage and pest control techniques should be devised and disseminated through effective out-reach extension programmes.
- Credit facilities and other appropriate incentives should be extended both to tree growers and wood based industries.
- Women, being the primary users of fuelwood for cooking, should be involved at the planning and implementation stages of forestry extension programmes and stove design programmes. Awareness programmes regarding possible health hazards of fuelwood combustion should also be introduced for them.

5. COURSE EVALUATION

5.1 PARTICIPANTS' EVALUATION

To evaluate the course with reference to the achievement of its objectives a course evaluation questionnaire was given to the participants on the concluding day. In general the participants were satisfied with the course structure and contents. However, according to the opinion of some of the participants, a number of subjects could have benefited from elaboration, e.g. production/consumption gap, excessive profits of middleman in the market channel, woodfuel alternatives, participatory planning and management of public forest lands, tree-crop interface and authenticity of data. Some participants were also of the view that if representative wood producers and consumers had also attended the course it would have more beneficial and would have achieved its objectives to a greater extent. The papers which were of particular interest to the participants were: "Rural Women and Wood Fuel Energy", "The role of NGOs in promoting fuelwood production in Pakistan", "Mangrove forests - An important woodfuel resource of the coastal belt", "Patterns and problems of fuelwood consumption and production in the salt effected areas of Faisalabad" and "Woodfuel production in Sind with reference to *Hurries*."

All the participants desired to have frequent contacts with PFRI regarding scientific information on woodfuel production and marketing for continuous interaction and feedback. The participants would also like to attend this kind of workshop in the future.

The evaluation also addressed the issues of whether the course had led to enhanced professional knowledge among the participants, whether the group sessions had been instructive/informative and the extent to which the course was seen as being helpful in carrying out work assignments. A graphic representation of the results is given on the following page.

PART II: TECHNICAL PAPERS

1. WOODFUEL IN THE NATIONAL ENERGY BALANCE

by

K.M.Siddiqui, Director General, Peshawar Forest Institute

1.1 INTRODUCTION

Each year the Hydrocarbon Development Institute, Ministry of Petroleum and Natural Resources, Government of Pakistan, Islamabad, publishes the Pakistan Energy Yearbook. This contains detailed information about the primary commercial energy situation in the country during the previous year and includes information on energy supplies, demand and development. This is the only authentic official publication on the subject. On the initiative of Dr. W. Hulscher and with the financial assistance of Regional Wood Energy Development Program (RWEDP) of the Food and Agriculture Organization of the United Nations, the 1996 yearbook also, for the first time, contained biomass fuel data. The biomass fuel data are those of the Pakistan Household Energy Strategy Study (HESS) which was carried out between 1991-93 with field survey and data collection undertaken in 1991. The Commercial energy supplies data however, pertains to 1995-96. Further, fuelwood energy has been treated separately from commercial energy supplies and no attempt has been made to determine the extent of woodfuel energy in the total national energy balance. The data about these two types of energy e.g. traditional and modern, have not been integrated. Data regarding woodfuel use in commercial and industrial establishments is also missing in this yearbook. There are cogent reasons for this state of affairs.

Up-to-date data about the supply of and the demand for commercial energies (indigenous and imported fossil based fuels and electricity) are readily and easily available as these are in the formal sector of economy. Their consumption in different sectors of the economy is properly recorded. Most of woodfuel production and trade, on the other hand, is part of the informal economic sector. Most woodfuel is produced and consumed in the rural areas of the country. Because of numerous difficulties in collecting data from the informal sector, the statistical organizations usually do not cover it. The HESS was the first serious attempt in this regard but its data have not been updated so far despite the fact that more than five years have passed since its initial collection.

1.2 SELECTION OF BASE YEAR

In order to determine the share of woodfuel in the national energy balance of Pakistan, one could choose 1991 as the base year for which data for commercial energy (Energy Yearbook 1996) and woodfuel (HESS, 1991) for the domestic sector are available. But data regarding commercial and industrial uses of woodfuel are missing in both reports. Such data were collected in 1989 by Mr. I. A. Qazi. His study does not give any future projections and the data cannot be incorporated into the 1991 woodfuel data of HESS. The biggest drawback of woodfuel studies are that they do not project future changes in woodfuel production and consumption with time and with respect to population growth, social and economic development and the substitution of woodfuel by commercial fuels. An exception is the Forestry Sector Master Plan Project of 1992. Whilst there is a lack of fuelwood data, past growth rate of production, import and consumption of commercial fuels as well as future projections are available in numerous reports.

1.3 NATIONAL ENERGY CONSUMPTION

Pakistan's national energy consumption is rapidly increasing due to increases in the population and economic development. On an annual compounded growth rate basis, it was 6.4% per annum during the last 5 years for commercial energy sources for all sectors of the national economy. Data for energy consumption by different sectors as well as in the domestic sector, source-wise, are reproduced in Tables 1 and 2 below:

Table 1: Energy Consumption Sectors

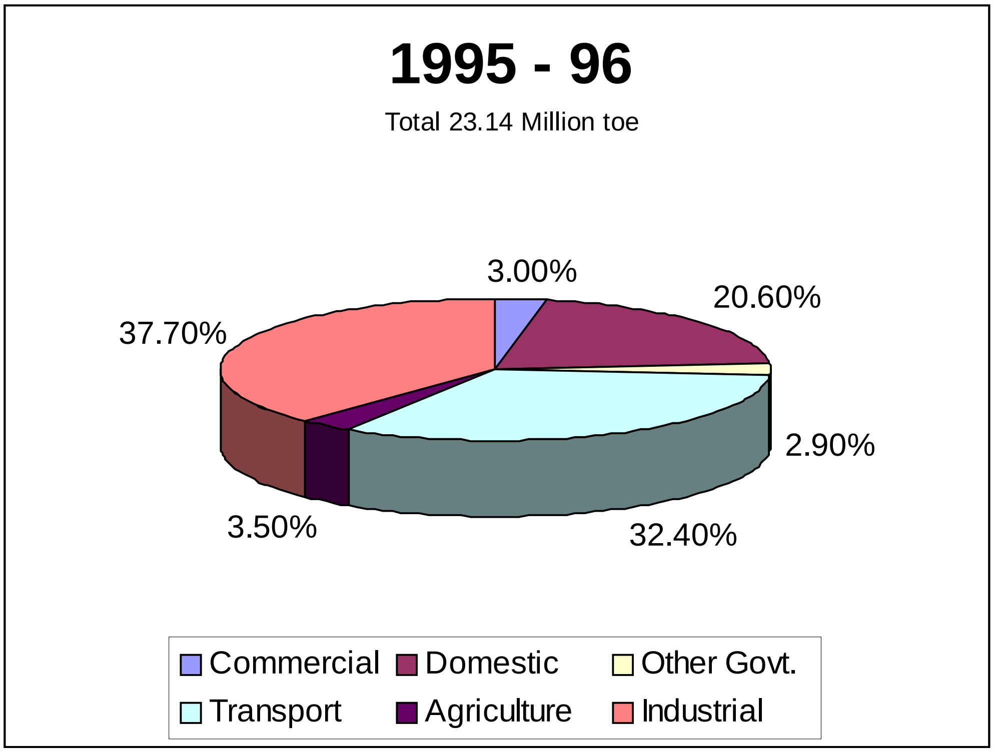
Sector	1990-91 AGGR	1991-921992-931993-94 1994-95	1995-96
Domestic	3,505,666 6.3%	3,330,3743,598,133, 778,0094,296,889	4,758,871
Commercial	496,668	515,317,561,536 593,180640,144	695,483 7.0%
Industrial	6,611,361 5.7%	7,004,0677,561,8757,896,9447,881,219	8,721,304
Agriculture	734,003	769,487758,120790,693 788,978	805,804 1.9%
Transport	5,097,478 8.0%	5,915,1396,421,2256,744,2876,984,357	7,496,164
Other Govt.	521,188	510,122 559,605558,269569,726	659,457 4.8%
Total	16,966,364 23,137,083	18,044,50619,460,49220,361,383 6.4%	21,161,313

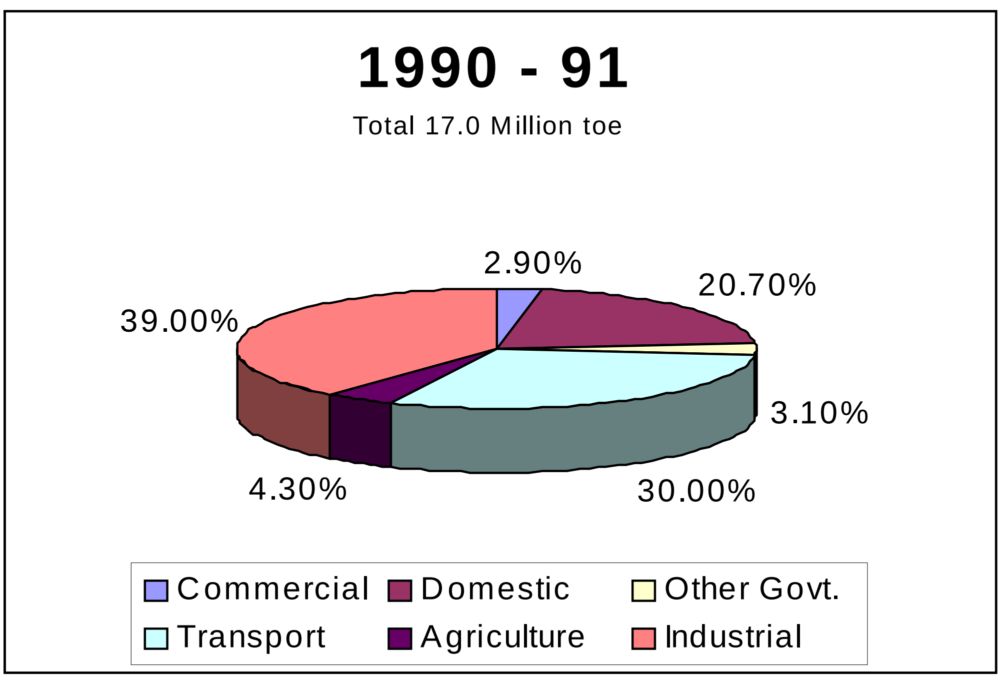
Table 2: Energy Consumption in the Domestic Sector

Source	1990-91 AGGR	1991-921992-931993-94 1994-95	1995-96
Oil*	1,093,214	738,851750,750695,935 755,468	787,112 6.4%
Gas	1,563,050 10.5%	1,655,3301,773,3311,929,5822,270,843	2,576,413
Electricity**	847,709 10.5%	933,140 1,072,6041,151,0111,269,129	1,393,965
Coal	1,6933,053	1,4461,481 1,449 1,181	4.0%
Tota	3,505,666 6.3%	3,330,3743,598,1313,778,009 4,296,889	4,758,871
Annual growth rate	2.27%5.00%	8.04%5.00% 13.73% 10.75%	

** includes 75% of total LPG supplies*
*** @ 3412 Btu/kWh.*
Source: Pakistan Energy Yearbook 1996.

Energy Consumption by Sector





*Gas consumed as energy fertilizer industry

The highest increase (7.0%) in energy consumption was observed in the commercial sector and the lowest in the agriculture sector(1.9%). The domestic sectors consumption showed the second highest rate of increase (6.3%). Among the different types of fuels, natural gas was dominant and constituted 44.6 to 54.1% of the total energy consumption in the domestic sector during this period. It also exhibited the highest annual compounded growth rate of 10.5%. This was followed by oil including 75% of total liquefied petroleum gas (LPG). On the whole, the per capita domestic energy consumption is very low in Pakistan.

1.4 ROLE OF WOODFUEL

Woodfuels are mainly used in the domestic sector to meet the energy requirements for cooking and space heating. In addition, commercial establishments such as restaurants, tea shops, bakeries and ovens also use woodfuel, but the quantities are small in comparison with those of the domestic sector. A limited quantity of wood is used in various industries such as tobacco curing, brick kilns, lime kilns, preparing evaporated milk, etc. It is estimated that 90% of the woodfuel consumption takes place in households, 5% in the commercial sector and the remaining 5% in the industrial sector (Siddiqui and Amjad,1993).

According to the Housing Census of 1980, the majority of households, both in urban and rural areas, depend on wood to meet their energy requirements for cooking. The proportion of households using fuelwood was 79% in rural areas and 48% in urban areas. The HESS of 1991 also confirmed a high level of fuelwood consumption in the country. More than 75% of the country's households use fuelwood. The figures for rural and urban areas are 91% and 52.2% respectively.

The HESS data for domestic energy consumption by fuel type is reproduced in Table 3 for rural, urban and country levels. These data are somewhat different than those given for domestic energy in Tables 1 and 2, which may be due to the fact that domestic energy data in Table 3 are based on sampling whereas the data in Tables 1 and 2 are based on officially recorded consumption figures. The share of fuelwood energy, including charcoal, is 38.3, 58.5% and 53.8% in urban areas, rural areas and in the whole of Pakistan respectively. These shares, of course, increase considerably if other biomass fuels (dung cake and crop residues) are also considered together with woodfuel. The data show that dependence on domestic fuelwood energy is very high. This situation is also expected to continue in the future because the current pace of economic development in the country is not high enough to facilitate a shift from traditional (firewood, charcoal, dung cake and crop residue) to modern fuels (electricity, natural gas, LPG and Kerosene). However, quantity-wise, natural gas ranks second in domestic energy consumption, next to woodfuel.

In order to compute the share of fuelwood in the total energy balance in Pakistan, the 1990-91 data of the Pakistan Energy Yearbook 1996 were combined with those of the HESS data. The data are presented in Table 4.

Table 3: Domestic Energy Consumption by the Fuel Type

	Annual Consumption (toe)		
	Urban	Rural	Total
Number of Households (000)	4,960	11,040	16,000
Average Household Size (Persons)	7.12	7.28	7.23
Energy Consumption: Electricity	474,561	376,179	851,392
Natural Gas	1,358,923	-	1,415,929
LPG	56,685	35,507	92,246
Kerosene	89,636	352,727	442,461
Charcoal	16,733	102,267	118,999
Firewood	1,708,141	8,925,93	10,637,395
Dung Cake	511,261	3,102,516	3,613,395
Crop Residues	286,467	2,529,438	2,815,898
Total Energy Consumption	4,502,407	15,424,571	19,987,506
Of which: Modern fuels***	1,979,805	764,413	2,802,028
Traditional fuels ****	2,522,602	14,660,158	7,185,478

*.***Include Electricity, Natural Gas, LPG and Kerosene*
*****Include Firewood, Charcoal, Dung Cake and Crop Residue*
Source: Pakistan Energy Yearbook 1996

The data in Tables 3 and 4 give the share of fuelwood (including charcoal) energy in the total national energy budget as 33.1%. This does not include woodfuel energy used in commercial and industrial establishments, which, as mentioned above, consume about 10% of total woodfuel energy. If the same is included then the share of woodfuel energy would increase from 33.1% to 35.7%. The dependence on woodfuel energy remains high in spite of the fact that the number of natural gas consumers has increased more than 12% per annum, which is much more than rate of population increase in Pakistan. Thus, although people are switching from traditional to modern fuels at a high rate, the number using traditional fuels remains high.

Table 4: Energy Consumption by Sector during 1990-91

Sector	**Energy consumption (toe)**
Domestic	19,987,506*
Commercial	496,668**
Industrial	6,611,361**
Agriculture	734,003 **
Transport	5,097,478**
Other government	521,188 **
Total	33,448,204**

**HESS data ** Pakistan Energy Yearbook 1996 data*

1.5 CONCLUSION

A large quantity of woodfuel is consumed in Pakistan every year and it plays an important role in the household economy, especially in the rural areas. Woodfuel energy constitutes more than one third of the total energy consumed in the country for all sectors of the economy. In spite of its importance, information on its production, marketing and utilization are not available. Consequently, the available data are neither accurate nor up-to-date. Only one systematic study - the Household Energy Strategy Study (HESS) was carried out in 1991. This needs to be updated. Lack of information has resulted in few resources being allocated for the development of this commodity in the country. The result is widespread deforestation, depletion of forest resources degradation of the environment, high price and deforestation, depletion of forest resources degradation of the environment, high price and scarcity of fuelwood, poor health. (especially of woman folk in rural area) etc. Surveys of woodfuel production and consumption should be carried out at intervals of 5 years. It may be mentioned here that the Federal Bureau of Statistics, Economic Affairs and Statistics Division, Government of Pakistan has recently started collecting household fuelwood consumption and related socio-economic data on a weekly basis for its Household Economic Integrated Survey (HEIS) which it publishes annually. A consumption figure of 1,370,706 tonnes of firewood in households during 1990-91, equivalent to 552,704 toe, was reported by the HESS which is much lower than that reported by HEIS for the same year (see Table 4). If we are to collect woodfuel data regularly then the survey methodology of this department should be improved to ensure availability of correct data.

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2. THE ROLE OF NGOS IN PROMOTING FUEL WOOD PRODUCTION IN PAKISTAN

by

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2.1. INTRODUCTION

Pakistan's standing forests cover a very small percentage of its territory. They occupy about 4.22 million ha on roughly 4.8% of the country's total area of 87.98 million ha. Their capacity measured in terms of productivity (nearly 0.49 million m^3 against the present requirement of 3.32 m^3) is highly insufficient to meet the needs of the country's over 130 million population which is growing at the rate of 2.8 % per annum. The performance of the forestry sector during the last four decades shows that while the area under forest has remained more or less the same, the growing stock has deteriorated both qualitatively and quantitatively. Obviously the various steps which were taken in the past to optimise the use of existing resources and to create new assets through community afforestation programs have proved inadequate.

After reviewing the vital role of forests in Pakistan's economy, the National Commission on Agriculture (1988) made an assessment of the forestry sector's ability to meet the country's future needs for timber, fuelwood and industrial raw material. It observed that the country was heavily populated and faced an energy crisis. Out of 45.9 million tonnes oil equivalent of the nation's energy needs, the state controlled forests contributed only 5.3 million tonnes of oil equivalent from 2.0 million cubic meters of fuelwood at that time[1]. As such there was an urgent need to devise measures for meeting the energy requirements of the agricultural and industrial sectors. As there was little scope for expanding the area under the state forests, it was recommended that new policy initiatives should concentrate on the promotion of social forestry by integrating farming with tree planting on private lands. The need to strengthen NGO networks at the national and local levels was also emphasized. It was hoped that they would be able to motivate people to get involved in afforestation activities as without such activities it would be difficult to narrow the gap between wood demand and wood supply.

During the last couple of decades, priorities in the forestry sector have changed quite considerably. New priorities have emerged as a result of: (i) increased demand for fuelwood brought about by the energy crisis; (ii) need for the protection of critical watersheds to safeguard downstream agriculture productivity; (iii) sustained management of forests at an increasing level of productivity so as to produce energy and raw material for wood based industries; (iv) conservation of forest resources to maintain genetic diversity and environmental quality; and (v) the adoption of a participatory approach to forestry development. The changing priorities have made it necessary that social forestry, as a development strategy for biofuel production, should be adopted and the concept of people's participation put into practice on a large scale.

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[1]The per capita domestic energy requirement in Pakistan is equal to 0.4 m^3 of firewood. Fifty percent of it is met from wood and the rest from commercial fuels such as gas, kerosene oil, coal (18%) and agriculture waste plus cow dung (32%). On this basis, current consumption for a population of 130 million works out to 26 million m^3 of fuelwood. Assuming that the domestic energy requirements of any additional population will be met entirely from firewood, the total demand for firewood by the year 2000 would be about 60 million m^3. If 50% of the demand is met from fuelwood, 30 million m^3 of firewood will be required against the present production of 25 million m^3.

2.2 SOCIAL FORESTRY

Although social forestry as a development strategy for fuelwood production is a relatively new activity it has gained popularity during the last couple of decades. Almost everywhere in the world trees on farm lands are an important source of fuelwood and timber to supplement production from state forests. With the tremendous increase in the demand for various forest products, social forestry plantations have become fully justified from the point of view of closing the gap between the wood supply and demand. Unlike government programs to raise trees outside forest areas, social forestry programs involve people raising trees on private lands. Fortunately, farmers have expressed an interest in planting trees on marginal and degraded lands as it provides additional employment and income to the rural communities besides meeting their domestic needs for fuelwood fodder and small timber. And the planting technology is already well-known among all ranks of tree farmers. In fact, the Forestry Planning and Development Project has adequately demonstrated to the farmers of Punjab, NWFP and Sindh the usefulness of forestry operations on proprietary lands.

2.3 COMMUNITY PARTICIPATION IN SOCIAL FORESTRY

Forestry has so far continued to be a government program. The concept of people's participation has not been put into practice on an appreciable scale. Given the significance of social forestry schemes and the issues related to their management, it has been recognized that in the long run, the program cannot afford to remain predominantly a government concern. One of the problems hindering the speedy expansion of forestry to private lands is the reluctance of the people to bring their own land under tree cultivation. This is partly because of the long gestation period needed for forest crops and partly because of the lack of immediate gains. Unfortunately, government priorities do not seem to reflect due concern about these realities confronting the farmers.

Since the Forest Department is not institutionally well structured to motivate the farming community in this regard, there is a need to generate widespread awareness regarding social forestry and its objectives by: (i) involving people in better land use planning; (ii) achieving local self sufficiency in fuel and fodder and; (iii) creating non-agricultural sources of employment and income. It is here that the Non-government Organizations (NGOs) have a role to play.

2.4 RATIONALE OF INVOLVING NGOS IN FORESTRY

The rationale of involving self-sustaining participatory institutions outside the government hierarchy in the overall development process is based on the following premises:

- Pakistan is a society which is subject to powerful forces of social fragmentation and political polarization. It desperately needs consensus on development issues. This is possible only through a participatory approach - the NGOs have considerable expertise in this.
- Government resources are scarce in relation to human and financial investments that are needed for sustainable development. NGOs provide a necessary mechanism for mobilizing resources for economic and social development.

- The Government has no delivery system at the grassroots level. It cannot reach a large number of small farmers on an individual basis. NGOs provide an effective means of reaching the small communities in remote areas.
- The state apparatus is governed by rules and regulations which are either too rigid or too weak to respond to the challenges of development. NGOs are flexible and adopt simple, innovative, and inexpensive means to reach a large number with fewer overheads.
- NGOs are small and operate in a single place. It gives them advantage over other organizations. Being small, they rarely face the problem of hierarchy and bureaucracy that restricts official development agencies.
- Being local based, the NGOs are aware of the local environment and are responsive to it.

2.5 HOW NGOS PERCEIVE THEIR WORK

The NGO community in Pakistan believes that its main task is to create social and political awareness among various groups of people and to encourage them against exploitation and material deprivation. NGOs believe that in the area of forestry development, they are handicapped in terms of budget, resources and technical capacity. They further believe that they cannot achieve much without government backing. Thus, under the circumstances they only aim to complement government efforts to improve the situation by developing workable models through experimentation. However, in view of their commitment to ameliorating the country's energy crisis, the scope of NGO involvement in forestry operations is gradually increasing.

2.6 THE ROLE OF NGOS IN PROMOTING FORESTRY

In considering the role of NGOs in forestry, two points have to be kept in view. Firstly, traditionally forest management in Pakistan has been the exclusive preserve of the Forest Department. None of the NGOs has been actively engaged in forestry operations. However, with the advent of social forestry some NGOs have become involved in promoting tree planting on private and non-forest lands. Secondly, the polity of the country and the pattern of development since independence has been such that although the government bureaucracy has never denied that the NGOs have a role in development, in practice they have not promoted the idea of mobilizing NGOs for development.

The number of NGOs involved in forestry activities, particularly social forestry, has grown significantly in the past few years. They range from small village groups to national coalitions. Their objectives, institutional capabilities, technical expertise, mode of operation and funding vary widely. With support provided by the government and donor agencies, NGOs have improved their ability to integrate forestry with agriculture within the overall context of rural development. Accordingly, their objectives are to:

i) Organize farm forestry extension campaigns that will stimulate farmers to grow commercially valuable trees in conjunction with agricultural crops;

ii) organize the supply of suitable planting material near the doorsteps of the farmers;

iii) transfer relevant technology in the production of nursery stock to the tree farmers;

iv) train members of the farming community in cultivating, protecting and maintaining trees according to their silvicultural requirements;

v) organize harvesting and marketing of forestry produce to ensure maximum economic benefits to the growers;

vi) create awareness about the effect of wind breaks, shelter belts and compact plantations in improving the quality of environment in the plains and the watersheds;

vii) establish linkages between tree farmers and fuelwood 'dealers' to make the agro-forestry operations sustainable;

viii) impart knowledge about the economics of growing trees vis-a-vis agricultural crops.

It is gratifying to note that some of the NGOs are trying to demonstrate that trees provide versatile raw material suitable not only for fuelwood but also for a number of manufactured products.

3. Forests and Forestry in Pakistan: Strategy for Sustainable Development

by

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3.1 Land Degradation in Pakistan

Pakistan, with an area of 87.98 million hectares and a fast growing population of more than 126 million people, is afflicted with a serious problem of land degradation. This is due to deforestation and the resultant wind and water erosion on one hand and the twin menace of waterlogging and salinity in the fertile Indus basin on the other. Apart from climatic and edaphic factors, the removal of vegetation and over-grazing are the two crucial biotic pressures which have played a very significant role in degrading the land mass of Pakistan.

3.1.1 Arid and Semi-Arid Areas

In Pakistan about 57.10 million hectares are arid and 17.11 million hectares are classified as semi-arid. This is based on the relative severity of climatic elements such as low and erratic precipitation and high temperature, non-availability of moisture, etc. The infertile soil, mobile sand dunes, over-browsed sparse vegetation, scorching winds, and high temperature combine to form a vast desert canvas complete with emaciated livestock, an ill-fed, ill-clad pastoral population and medieval habitations. This situation is not entirely due to the action of man though he is responsible for this state of affairs to a considerable extent due to his unwise land use practices. Other factors have also played an important role. These include less than normal water availability caused by a high evapotranspiration rate, the absence of humid air streams, high temperatures, reduced ground water recharge and decreased river flows. Additionally, the high velocity sand laden winds cause physical damage to crops, people, animals and property. The sand storms block the roads and rail tracks, choke the irrigation channels, engulf the villages and encroach upon rich agricultural lands. The process of desertification continues, carrying in its wake misery and poverty (Sheikh, 1986 b).

The socio-economic conditions obtaining in these lands have played a very significant role in the deterioration of the forest and range resource. Communities living here have a largely agricultural and pastoral economy.

The needs of the people and the vegetation conservation plans have always clashed. Due to faulty agricultural practices and incessant grazing the production potential of these soils has deteriorated. The people eke out a living from their meager agricultural resource and pastoral activity. The situation is becoming even worse with the heavy increase in population, both human and cattle. They need fuel for cooking and heating, fodder trees in times of scarcity as livestock feed, material for thatching, some timber for agricultural implements, some household items, doors, windows, and persian wheels etc. Apart from that, they need trees for shade and shelter around their dwellings. Vegetation cover is also needed for the protection and propagation of wildlife. A very important factor to be taken note of is the constant migration of the people of these areas to the cities in search of better jobs and comfortable living conditions (Sheikh, 1986 c and 1987 b).

3.1.2 Northern & Western Moist and Dry Lands

The vast watersheds in the north and northwest of Pakistan are the only source of a perpetual supply of water. Unfortunately, the fact that the forests make an enormous contribution to environmental stability and play a very significant role in food security for millions of people has gone unappreciated. Due to arid and semi arid conditions and erratic rainfall, the agricultural and industrial economy of Pakistan is entirely dependent on a sustained supply of water from its rivers and reservoirs, and from the efficient working of the canal system which is the biggest in the world. If the water level goes down beyond a certain level in the reservoirs, sufficient water cannot be released for power generation and productive agriculture. Without the hydro-electric power, which is required to run the tubewells and the industrial units all over the country, the whole system could come to a sudden halt. Due to the shortage of water in the reservoirs, the government has to resort to loadshedding for long periods resulting in colossal losses in industrial and agricultural production and in demonstrations by the affected people (Sheikh, 1985 b;1986 a; 1987 a).

In those areas where the trees have been removed and pastures have been over-grazed and there are no dams or similar structures to regulate the flow of water, flash floods cause very severe damage to roads, railway lines, telegraph and electricity poles and put the food delivery system into total disarray. The major floods in Pakistan have caused losses worth billions of rupees and are responsible for food shortages and subsequent higher food import bills. The Tarbela catchment erosion has been measured at the rate of 2-4 kg/sq meter. Soil at the rate of 4-7 thousand tonnes/sq mile is carried annually by the Chenab and Jhelum rivers. The Mangla reservoir is being silted at the rate of 48.27 million m^3 per year and the Tarbela reservoir at the rate of 167.75 m^3/year. Due to sedimentation in the two most vital reservoirs of the country, the nation is losing some US$ 130 million every year. This estimated loss is due to reduced storage capacity, erosion of fertile soil, slowing down of industrial production, reduction in agricultural production and heavy expenditure on maintaining of the infrastructure. This of course does not include the high opportunity cost and high social cost.

3.2 THE FORESTS AND RANGE LANDS OF PAKISTAN AND THEIR CONDITIONS

The forest area under the control of the forest department is 4.26 million ha. The per capita forest area is less than 0.028 ha as compared to the world average of one ha. The main reason for such a meager forestry resource is that 70-80% of Pakistan falls in the arid and semi arid zone where precipitation is extremely erratic and unable to support the existing vegetation or to enable afforestation/reforestation measures. Due to the diverse ecological conditions a vast variety of forest types exists in the country. Some of these are natural forests and are located in the moist, temperate, dry temperate zones and low foot hills in the north. At the other extreme are the mangroves in the mouth of the Indus delta and the Arabian sea. The man-made forests are the irrigated plantations and to a major extent the riverine forests. Out of 4.26 million ha only 1.12 million ha, or about 26%, produce timber and fire wood; the rest are conservation forests whose purpose is to keep the watersheds and erodable lands intact.

The forest resource has been eroded gradually over a long period of time. Starting with the invasion of this sub-continent by the Central Asians, a chain of battles and wars pushed the people of the plains to the distant areas for refuge where they made heavy inroads into the forests for their dwellings, agriculture, grazing, etc. The scientific management of the forests in the Himalayas began more than a century ago. Had the requisite silvicultural and management measures been adopted the forest cover would be in a much better shape today. During the First and Second World Wars, the accessible forests were over-exploited to feed the war machine. Also at the time of land settlement certain rights of the local population were admitted for timber, fuel-wood, grass cutting and grazing, Since these rights have multiplied with the growth in population, they are no longer compatible with the resource potential. Thus, when Pakistan was created, the forests in this part of the subcontinent had already been depleted to a very large extent. The situation was further aggravated by mass migration of the people from across the border in 1947. The meager resources had to bear the pressure of an accelerated construction boom to cater for housing, schools, colleges universities, hospitals, offices and shopping plazas, etc. The development of modern infrastructure reduced the distance between the markets and the hinterland, whereby the once virgin forests became approachable and trees could be cut and transported without much difficulty. The axe fell more heavily on private forests. In need of ready cash landholders sold the trees at rock bottom prices, much to the delight of the forest contractors who made tons of money on account of increasing prices of timber at the cost of the poor needy consumer and, of course, the resource. All these climatic, biotic and socio-economic factors have, together, very adversely affected the status of the country's forests leading to serious environmental degradation (Sheikh,1987,a,c).

3.3 ACHIEVING SUSTAINABLE DEVELOPMENT

Several approaches to forest conservation and development are possible: ensuring adequate regeneration; protection of growing stock; management on sustained yield basis; reduction of wastage in logging; treatment of wood before use; standardization of end products; use of substitute materials. Social and demographic approaches, research training and extension and administrative and legal support etc. are other possibilities (Sheikh,1988).

3.3.1 Conservation and Development Approaches

(a) Ensuring adequate regeneration/afforestation

After harvesting mature crops the existing forest areas are regenerated naturally or artificially through seed sowing or by planting nursery raised stock. The annual rate of regeneration is about 28,500 ha while the rate of afforestation is about 23,000 ha/annum. In view of the rapidly growing population and rising demand for wood products and the limited resource, this pace of afforestation/regeneration falls far short of what is needed. At the current rate it would take about 20 years to add another one million ha of forests. It is highly desirable that afforestation programmes are accelerated by removing physical, legal and financial constraints. A higher priority must be given to forestry programmes in the country's economic planning, especially because it takes scores of years before the crops become harvestable due to their long gestation period. Per unit area production of wood from irrigated plantations and natural forests in hills could be increased significantly by ensuring reasonable inputs for their development.

(b) Protection of growing stock

The forests are subject to grazing and lopping and illicit cutting. Insects, diseases, wild animals and fires too cause a lot of damage. The maximum damage to the forest is done by man and his livestock. As a matter of fact, this is a socio-economic problem and the people who live in or near the forested land are forced to cut the trees for timber, fuel, fodder, and to carve out some land for cultivation. The only way out is to provide alternative livelihoods to these people to enable them to survive while minimising the damage done.

(c) Management on a sustained yield basis

To perpetuate the important forest resource, it is essential to manage it scientifically and regenerate and reforest it properly. There are several forest types in the country, from Alpine pasture to mangroves. Different methods have therefore, to be employed for their management. The regeneration methodology, growth behavior and other life processes of the trees have to be studied to provide the basis for more intensive silvicultural management. It is necessary to improve management techniques such as weeding, cleaning, scientific thinning to regulate spacing and growth rate and pruning must be done to improve the quality of timber and to establish proper crop composition. There is need to expedite the preparation/revision of volume and yield tables for different species and the compilation of rotation age data and other related information for regulating the yield at optimum level.

(d) Preparation of management plans

About 45% of the forest area is covered by management plans. Each plan contains a description of the area, local conditions, analysis of the growing stock, yield prescription, the silvicultural systems to be applied along with the sequence of areas to be harvested/regenerated and other development works to be undertaken. To work on a sustained yield basis, it is imperative that the management plans are prepared for all the existing forests and that the plans are religiously implemented.

(e) Establishment of a data bank

The country is woefully short of data pertaining to forests, forestry and ancillary disciplines. Whenever there is a need for authentic figures, the provincial governments are requested to collect and send them to the Pakistan Forest Institute Peshawar (PFI) for compilation. But usually these are not received in time for dispatch to the indenting foreign or local organizations or contrast significantly with the figures supplied earlier. In most cases the figures these appear to be imaginary rather than based on the actual situation. It is, therefore, imperative to set up a Central Data Bank in the PFI to have something to fall back upon for future planning and development.

(f) Demarcation of forest areas

With a view to checking encroachment on forest lands all forest areas should be properly demarcated and their boundaries clearly defined through construction of boundary pillars. In fact, the renovation and maintenance of old boundary pillars, and the fresh demarcation of areas where boundary pillars are missing, have been shifted or defaced should become a permanent feature of the strategy of the forest departments. In areas where forests have not yet been demarcated, the work should be given top priority so as to check further damage to forests.

(g) Confining travel routes of livestock

Millions of livestock, sheep, and goats leave the Alpine pastures and high hills to spend winter in the plains. En route and on their way back they pass through forest areas damaging the young crops by trampling and browsing. It is highly desirable that livestock routes be clearly defined and the movement of livestock confined to these routes. They should not be allowed to roam around in the forests. The "Gujjars" - graziers - also do a lot of damage to the roadside trees and the scrub vegetation by lopping for fodder. This has to be strictly controlled by positioning additional staff on defined routes during the migratory period.

(h) Tree planting on saline and water logged soils

In the Indus basin, according to available reports, 1.5 and 5.5 million ha of land are waterlogged and saline respectively (Chaudhry et al, 1978). Almost all traces of vegetation have disappeared from such lands due to the removal of wood for heating and cooking, and the over-grazing and degradation of site conditions. Biological amelioration of these sites is considered highly possible and desirable. Afforestation projects in such areas would not only provide the much needed fuel for heating and cooking but also improve the socio-economic conditions of the people living close by. They would get job opportunities as well as enough wood and fodder from trees, shrubs and grasses planted there.

(i) Making the legal position of range lands clear

The illegal position of rangelands in most cases is not clear. Extensive areas in Baluchistan and Sind province belonging to the government have been grazed by the livestock owners for a long time without payment of any grazing fees. Graziers in fact think that they are the owners of such range lands. The legal position of these ranges should be ascertained immediately and efforts made to introduce scientific management.

(j) Discouraging leasing of state forest lands

Cultivation leases given in the irrigated plantations and the riverine forests have resulted in the areas shrinking and tree growth deteriorating. Water is diverted from trees to agriculture. Lessees, who are normally influential people, do not comply with the terms and conditions of the agreement and the leased areas are not planted/regenerated according to schedule. In several cases adverse possession has continued for years and ultimately the lessees have become the owners of the land.

3.3.2 Economical Use of Wood and Wood Products

(a) Reduction in logging wastage

Wastage of wood in tree felling and conversion could be minimized by improved techniques. For centuries the axe was the only tool used for felling trees. This tool, besides being laborious, was also very wasteful, causing about 7-10% timber losses. The axe has now mostly been replaced with handsaws which in addition to reducing timber losses have made tree felling and conversion work very easy and productive. Timber wastage with saws is not more than 1%. Timber is also wasted in breakage due to improper felling. This loss on average is about 2%. Wastage due to breakage can be minimized by felling the trees in the proper direction - always uphill in mountainous areas. In difficult situations directional felling can be practiced by the use of mechanical devices.

(b) Treatment of wood before use

Not all timber is naturally durable. Some is destroyed within only one year of contact with the ground while some can withstand the attack of biological agencies for more than 15 years. Non-durable timber when used under exacting conditions is very quickly destroyed and needs very frequent replacement. As the number of naturally durable types of timber is not very large some means need to be adopted for increasing their service life. This can be achieved through the treatment of wood with preservatives. Preservatives are applied to wood by both non-pressure and pressure methods depending upon the nature of the wood and the degree of protection needed. Preservatives are applied as a solution in water or organic solvents depending upon their nature. A treated wood can endure for two to three times longer than a non-treated wood. Treatment of wood before use can therefore contribute significantly to reducing pressure on the resource.

(c) Standardization of wood products

In construction, wood is used as a solid or in the form of constituted wood products. Timber logs, the basic raw-material for different end uses, are sawn into lumber which along with wastage generated in sawing goes to different conventional and non-conventional uses. If the end products to be manufactured are standardized with the exact dimensional requirements, the lumber can be sawn exactly to the requirements of end-products thus avoiding wastage during the manufacturing process. Although the Pakistan Standards Institution does exist it is not in a position to enforce its recommendations on the manufacturers. The standards in the manufacture of a variety of end products such as plywood, particle and fiber board are not maintained therefore, and this results in a lot of wastage at the manufacturing stage and poor quality end-product. Use of such a material involves repeated replacement and repairs and consequently additional wood is required.

(d) Use of substitute materials

In Pakistan, it is now quite common to see metallic frames for doors and windows, steel furniture, steel electric transmission poles and cement concrete railway sleepers etc. This is a very welcome change and has essentially saved lot of wood. This tendency should be promoted and the people motivated to use substitute material for construction. Similarly, wood cement composites like cement bonded particle board and wood-cement blocks are useful in fabricating low cost housing and in the building industry for panelling. These products are made from low quality woods and manufacturing waste, are resistant to termites, fungi, fire and weather elements. Their widespread use would result in the conservation of good quality woods.

People in the hilly areas consume lot of timber to construct their houses. Because of winter snow and rains the houses need repeated repairs. It would be useful to provide CGI sheets at a subsidized rate. This experiment has been tried in the Murree Hills and Azad Kashmir with success and should be further extended.

The sustained supply of kerosene oil and gas cylinders in the hilly areas or even the supply of firewood from the plains should help to save the valuable coniferous and broad leaved trees used for heating and cooking. Improvement in the design of firewood stoves could also save lot of fuel.

3.3.3 Social and Demographic Approaches and Provision of Incentives

(a) Involvement of people in forest protection, production and management

By and large the approach of foresters has been to conserve the resource. This has resulted in traditional rivalry between the people living around the forest areas and the foresters. Although under the Forest Act of 1927 people are required to protect the forests and help the foresters to protect them, the response has always been lukewarm.

People have to be made to realize that they have a key role to play in the maintenance and improvement of the forest resource and that without their willing involvement, cooperation and contribution, it will not be possible to make any headway. They should be involved at all levels of decision making so that they feel important and are helpful. No project can succeed unless people feel that proper management and perpetuation of the resource is in their interest as well as in the interest of their children and their children's children.

(b) Promotion of Social Forestry Programme

The concept of raising private wood lots is very old. As far back as 1860 a system of raising block plantations of Babul/Kikar(Acacia nilotica) known as *Hurries* was started in Sind when upto 4 ha of land was given to a family free of cost to raise plantations. The major incentives and attraction were free land with no taxes and bumper crops when land was reverted to agriculture (Sheikh, 1987d). The concept does exist in other parts of the country where block plantations of Shisham (Dalbergia sissoo) mulberry (Morus alba), poplars and eucalyptus have been planted. This has so far been done on an individual basis. If it could be taken up in the form of cooperatives, block plantations would be a better proposition from the management point of view.

The factory owners are always complaining of the shortage and erratic supply of raw material. They could also induce some progressive farmers to plant trees for them, and sign a contract to purchase the same at maturity at the prevailing market price (Sheikh, 1994)

(c) Reduction of livestock population pressure

The over grazed pastures and forests can no longer sustain the increasing livestock population. Unless specific measures such as reduction in their number, rotational and deferred grazing, improvement in breeds, culling the sick and emaciated animals are undertaken it will not be possible to save the forests from future destruction.

(d) Discouraging encroachment on forest lands

One of the very serious problems responsible for the erosion of the resource is constant encroachment on the state forests by the locals. This is done to extend their land holdings, pushing the forests further back till in certain cases the trees completely disappear. In order to discourage encroachment on forest land for cultivation, increased vigilance by the protection staff and regular checking and maintenance of boundary pillars is urgently required.

(e) Creation of conservation societies

As mentioned earlier, involvement of the people is a must if conservation and protection measures are to be implemented successfully. In this context it would be very useful to establish conservation societies or conservation corps at divisional, district and tehsil levels. Knowledgeable citizens of all ages can be motivated to join such organizations. This would not be an unusual step. Such organizations are fully functional even in those countries which have more than 60% area under trees. A forest-poor country like Pakistan should have embarked on this programme long ago.

(f) Provision of subsidies, grants and loans

In order to encourage investment in the creation of new forest resources, it is essential to provide incentives to the prospective investors. The provision of planting stock free of cost to the intended investors has been in force for several years. However, only those who own land have benefited from this. As the tree crops give financial benefits after many years, it is desirable that the tree growers be given reasonable subsidy at the time of planting and thereafter an annual grant till the harvesting of the crop. This would motivate the farmers to take up the planting of trees. Trees in the hilly areas prevent soil erosion and help maintain the productivity of agricultural lands in the plains. In these areas the provision of tree cover confers benefits on the farmers downstream. It is therefore desirable that liberal subsidies be granted to the landowners in hilly areas to keep their lands under tree crops, to carry out proper terracing and motivate them not to use the land for purposes for which it is not fit.

(g) Support price for wood

Tree farmers often face serious marketing problems. The middleman who provides facilities for felling, conversion and transportation to the ultimate consumer does not pay an adequate price to the grower. Besides, wood prices are depressed drastically once production exceeds the market demand. These problems discourage the farmers, especially the small ones, from planting trees. In order to ensure a fair return to the farmer, it is desirable that a system of support prices for wood be introduced as has been done in the case of many agricultural commodities.

3.3.4 Research, Training and Extension

(a) Research strategy

Future research programmes should include further studies on: proper site preparation; introduction of nitrogen-fixing trees and multipurpose trees; arid and semi arid zone afforestation; growing of trees in conjunction with agriculture; environmental degradation assessment; use of saline water for raising tree crops; forest genetics; setting up of seed orchards; silvopastoral development; establishment of experimental watersheds; development of recreation areas; study of pollution problems; extent of ecological deterioration in different parts of the country; effect of harvesting practices on natural regeneration; use of indigenous species for pulp and paper; new end-uses of trees; forest product marketing; biological control of forest insects and diseases; plant bio-chemistry and wood chemistry; production and protection of medicinal plants; development of sericulture (including mulberry plantations selection and involvement of pure lines) silkworm pathology and diseases. Field stations for outreach should be set up in different ecological zones (Sheikh, 1989).

(b) Public relations and transfer of technology

Apart from providing regular technical services on technical matters to forestry professionals, the government should assist farmers and others interested in forestry and allied disciplines through on the spot instructions, by establishing demonstration centres and of course by correspondence. Special refresher courses in nursery techniques, afforestation, silviculture, forest management, range-land development, watershed improvement, wildlife surveys, protection and production, forest road-building, chain-saw operation and maintenance, felling and extraction, wood preservation, timber technology and identification, silviculture, etc. should be arranged.

The research findings must always, if not immediately, at least gradually trickle down to the people who are to use it and it should be convincing enough to be acceptable. For instance, no farmer is going to be motivated to plant trees if he does not understand to what extent trees compete with agriculture crops for water, sunlight, nutrient etc. They are not interested in whether the research findings are significant at the 1% or 5% level. Without extension of research results new technologies would be meaningless.

While planning the measures to transfer the tested technology, several factors need consideration. These include proper identification of the persons/group to whom the message is to be delivered, their requirements, constraints and potential, the language they easily understand, and the education and comprehension levels of the audience. The manner of packaging the requisite information to be disseminated is important. Equally important is the information diffusion mechanism. It is absolutely imperative to train the requisite manpower, obtain the desired publicity equipment, set up extension wings, include extension forestry systems in school syllabus and to constantly monitor and evaluate the programmes. Use of media such as T.V. radio, film strips, slides etc, can go a long way to convince the people regarding the important role vegetation plays in soil and water conservation and improvement of the landscape. Specially prepared pamphlets and brochures duly illustrated and written in local languages would help the people understand the importance and role of the trees in improving their socio-economic conditions. Additionally, scientifically laid-out demonstration plots of multipurpose tree species can have a very convincing effect.

Face to face communication with individuals or groups or a whole community has long been practiced in the rural society of Pakistan and getting together in the evening in the "Chopal", "Dera" or "Baithak" to exchange ideas has always been very popular. A well trained extension worker appropriately equipped with good teaching materials, with initiative and a persuasive way of talking is fully capable of delivering the goods. Since, people are often allergic to the advice given by government employees the mosque can be used as the forum for transferring knowledge. The people are intensely religious and they can be better convinced by the preaching of a "mullah". (Sheikh, 1992).

3.3.5 Administrative and Legislative Changes Required

In order to achieve sustainable development in the forestry sector, the existing administrative and legislative arrangements need to be revised. These are discussed below.

(a) Forestry Policy

A comprehensive and workable forest policy is an essential prerequisite for conservation and development of forest resources. The forest policy statements and directives issued from time to time in the past need to be thoroughly examined, revised and a new comprehensive policy promulgated. It must be based on a clear perception of the needs of the society and its priorities which ought to be spelled out and followed. The reasons for the non-implementation of the previous policies also need to be identified so they can be avoided in the future. The role of the federal government up till now has been confined to issuing policy directives. It must be entrusted with a more dynamic role. The planning, coordination, monitoring and valuation of watersheds and range management, energy plantations and afforestation should be made the responsibility of the federal government while these activities should be executed by the provincial government.

In order to ensure effective implementation of forest policy strong political support should be extended to the cause of forest resource development and this should be duly reflected in a much larger allocation of funds to the forestry sector. The politicians as well as the administrators must realize that the country is faced with a situation which needs their immediate attention. Several committees and sub-committees have been constituted in the past to improve the forestry situation in the country but their recommendations have not been implemented. Nobody appears to have time to follow up or perhaps even read these reports. It is time that somebody goes over these recommendations and tries to implement them. Another problem which is to be addressed by forest policy is the issue of the role of the private and -public sectors in the development of forest resources. The private sector must be given a bigger role in the forest development efforts. (Sheikh and Khattak, 1987).

(b) Forest Legislation

The existing forest legislation is a legacy of the British period. Of the various Acts, Rules and Ordinances promulgated before and after independence, the most important is the Forest Act 1927. The legislation is regulatory in nature and is entirely protection oriented. It does not meet the requirements of development and extension forestry. The restrictive provision of the legislation unduly discourages the farmers to grow trees on their farmlands. The necessity to obtain permission from the forest department for cutting trees from the hilly areas owned by the people and also for movement of the produce is not very helpful. It imposes undue hardships on the people. The entire legislation needs to be revised so as to make it more persuasive rather than punitive. Measures are also needed to ensure effective implementation of the laws. In spite of the fact that the laws are primarily protection oriented, these have failed to control the damage to the forests. The ineffectiveness of the laws is due to political and administrative reasons; the judicial system in vogue; the extremely large jurisdiction of the law enforcing staff, lack of facilities to apprehend the offenders, and of course the desire of the people to become rich overnight. Thousands of forest offense cases are lying pending in the courts. It would help if either special magistrates are appointed to deal with the forest offences or magisterial powers are conferred on the forest officers. (Sheikh and Khattak, 1987).

3.4 EPILOGUE

The meager forest resource of Pakistan has been under constant stress due to several biotic, edaphic and climatic factors on the one hand and administrative and political pressures on the other. Intensive management in the form of large scale afforestation/reforestation efforts, application of sustained yield principles, scientific harvesting practices and better utilization have improved the situation to some extent but the non-availability of requisite inputs leaves much to be desired. A real impact can be made only if the planting effort is accelerated by allocating substantial funds to be utilized by a highly trained dedicated corps of foresters and extension workers duly supported by a forceful and practicable forest policy and forest legislation. To stop further degradation, proper land management is required to be introduced in the watersheds, the flood plains and deserts. Furthermore, tree planting has to be taken to the farm and marginal lands with a much bigger thrust through motivating the involvement of the people by assuring them of reasonable returns and marketing facilities, through the provision of incentives, establishment of cooperatives and user societies. The fact has to be recognized that an important cause of destruction and degradation of forests and consequent destabilization of the environment is the socio-economic conditions of the people living in these areas. A major effort is, therefore necessary to remove this imbalance by providing alternate sources of livelihood to these communities.

A policy directive has to clearly identify the national priorities for the forestry sector.

Moreover, it has to be understood that the environmentalists cannot act without political support, which should be translated into providing the money needed to tackle the problem. The issue must, therefore, be taken to the political forum where policy matters are fully debated and decided.

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4. WOODFUEL PRODUCTION IN SINDH WITH REFERENCE TO *HURRIES*

by

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4.1 INTRODUCTION

Sindh, the lower part of the Indus Basin, is a predominantly agricultural area irrigated through one of the world's largest contiguous irrigation networks. The total land area of the province is 14.09 million ha, which accommodates over 30 million people. Climatically it is semi-arid with an average rainfall of 125mm during summer and the temperatures during summer and winter reach 45 and 7 ^{0}C respectively. Only 5% of Sindh's land area is under forests, and productive forests occupy only 2.3% of the total land area. Forest resources in Sindh are rapidly dwindling, resulting in shortages of the essential wood products needed for domestic and industrial purposes. Due to increasing population and limited sources of energy, the demand for fuelwood is increasing while the supply is continually decreasing. The state forests meet only 10% of the wood demand and 90% is contributed by private farmlands. Thus, it is considered necessary to incorporate tree planting into the agricultural systems in order to ensure a sustainable supply of wood. Due to the scarcity of state controlled forest resources and limited wood production the demand for fuelwood is primarily met from the private farmlands where trees are grown in different forms and configurations.

Rural farmers of Sindh practice agroforestry with different tree components for accomplishing a variety of objectives. Acacia nilotica, locally known as Babul or Kikar, is a predominant tree component in agroforestry practices. One of the agroforestry practices in the province is the growing of Babul in *Hurries*, which may be defined as block plantations of Babul trees on private farmlands ranging in size from 1 to 4 ha with close spacing for short rotation of 7-8 years for multi-purposes. This is a traditional agroforestry system that has been used by the farmers of Sindh for over a century. This system was reintroduced by Sir Bartley Frere, Commissioner of Sindh, in 1858 to meet the fuelwood requirements of the local people and ensure conservation of agricultural lands.

Hurries are raised like agricultural crops. After leveling, establishing an irrigation system, and preparing 100'X100' plots, Babul seeds are broadcasted and irrigation water is applied. The water is frequently applied (3-4 times a month in the first 6 months), but later on as the trees mature and the Babul roots become established and can utilize the soil moisture the frequency is reduced. Some farmers also grow cotton in *Hurries*.

4.2 *Hurry* ROTATION AND ESTIMATES OF WOOD PRODUCTION

Hurry rotation is fixed by the farmers according to their objectives. When the objective is wood production for industrial purposes the *hurry* is harvested in the 6th or 7th year. If the objective is soil improvement the rotation is continued for a few more years. The yield curve constructed from the data obtained from 8-years old *Hurries* is presented in figure 1 and shows that a total quantity of 122 m^3 of wood material is produced, of which about 2/3 (82 m^3) is mining timber (wood used in coal mines) and the remainder (41 m^3) is fuelwood. The *HURRY* yield depends upon the quality of land and availability of water.

4.3 *Hurry* PRODUCTION AREAS

Hurry plantations are concentrated in the order of priority in Hyderabad, Sanghar and Mirpurkhas districts of Sindh province, which are considered the main production centers. Initially the farmers of Hyderabad district adopted this system for fuelwood production and later on, with the development of coal mining industries in Sindh and Baluchistan and the emergence of land degradation problems due to waterlogging and salinity in the cultivated lands, the *Hurries* were raised for mining timber and soil improvement, respectively. Districtwise, the areas under *Hurries* in 1996 were as follows:

District	Area (ha)
Hyderabad	12,500
Sanghar	716
Mirpurkhas	585
Badin	318
Thatta	295
Nawabshah	183
Other districts	Less than100

Soaring population, increased demand for fuelwood, degradation of fertile lands and the need for immediate financial returns are the main factors for raising more *hurry* plantations on farmlands.

4.4 *Hurry* WOOD DISTRIBUTION SYSTEM

Hurry wood is sold on a per ha basis. Number of trees/ha, age of *hurry* and the proximity to market are the factors considered when estimating per ha value. After reaching the settlement of sale value, the *hurry* wood is harvested/converted by the purchaser according to the specifications of the coal mining industry. The wood is then transported to a bulk depot where grading and sorting is carried out. These mining pit props, locally known as gatoos are sold to the coal mine owners directly or through agents. About 90% of *hurry* fuelwood is used in the shape of billets 1.0 to 1.25 meters long, the rest in the form of gutkas (sawn pieces). The *hurry* fuelwood is transported to towns and cities, especially Karachi, Hyderabad and Quetta. The mode of transportation depends on the distance from the producing area/depot to the marketing areas. Usually for distances upto 10-15 kms, small vehicles such as pick-ups and tractors are used, but for longer distances trucks are used.

4.5 *Hurry* Wood Marketing System

The *hurry* fuelwood trade is dominated by the retailers. The growers, middlemen, retailers, industrialists and local households are beneficiaries of *hurry* wood. The roadside retailers in towns and cities conduct the fuelwood market business. The wood from *Hurries* is in demand in small and big markets due to its good quality. Due to its high calorific value (4870 kcal/kg), Babul fuelwood is preferred in the market and fetches a higher price than other species.

4.6 Actions Taken by the Government to Expand of *Hurries*

Hurries have been included as a component in all government development projects. Under the Sindh Forestry Development Project, 1,000 ha have been selected for planting under *Hurries* throughout Sindh province. The farmers involved have received a subsidy of Rs.2,500 per ha. and all the required expertise is provided to them free of charge.

4.7 Problems in *Hurry* Production, Distribution and Marketing

The problems encountered in raising, distributing and marketing of fuelwood from *Hurries* are similar to other fuelwood production systems. Some *hurry*-specific problems are:

- *Hurries* have not been very common in the province due to the large size of land holdings.
- Involvement of 2-3 middlemen limits the profits of *hurry* growers.
- Taxation structure at local council level also reduces the profit to the grower.
- Land owners are the sole beneficiaries of the *hurry* and tenants are deprived of the benefits.
- Trivial targets of *hurry* raising have been kept in the social forestry component of the development projects.

4.8 Recommendations

Research should be conducted to determine why the *Hurries* have not become popular even after a century.

- The involvement of middleman in the *hurry* fuelwood trade should be minimized.
- Social Forestry Programs should give priority to *hurry* raising.
- Incentives of subsidies, payments in cash, and exemption from land revenue should be provided to *hurry* growers.
- Fuelwood trade should be tax free.
- Land and tree tenure should be changed, so that the tenants can also benefit from *hurry* production.

Figure 1: Yield cure of Acacia nilotica (Hurry plantation)

5. DEVELOPMENT OF SALT-AFFECTED WASTELANDS FOR WOOD PRODUCTION IN PAKISTAN

by

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5.1 INTRODUCTION

Pakistan faces a serious energy crisis and heavily depends on imported crude oil to meet its requirements. The consumption of energy for domestic purposes accounted for 14.5% (2.22 million tonnes of oil equivalent) of the total consumption during 1982-83 and rose to 18.2%(4.39 million tonnes) during 1988-89 (Economic Survey of Pakistan, 1989-90) indicating a 10% annual increase in the requirements for energy during this period. Further, the energy requirements till the end of 20th century will be equivalent to 61.01 x 106 m^3 fuel wood (Government of Pakistan, 1988).

Wood meets half of the total domestic energy requirements of the country. The census of 1980 showed that 70% of households in Pakistan use wood for cooking and heating, while in rural areas the figure is 80% (Sandhu ,1993).

Due to the high price of wood, charcoal and alternate fuels, people are indiscriminately cutting and felling trees on a large-scale, thus despite the scarcity of forests, (Pakistan has less than 4% forest cover whereas 25% is required for economic viability), about 2834 ha are cut down every year, creating many environmental problems such as land degradation, increase in CO2 in the atmosphere and low humidity and consequently, desertification. On the basis of population growth and using the existing per capita consumption rates, fuel wood demand is expected to rise by approximately 55% by the year 2000 (NCA,1988).

The two main sources of fuel wood supply are private farmlands and the state controlled forests which supply about 90% and 10% of the fuel wood consumed, respectively.

The rehabilitation of marginal lands through afforestation has thus a special significance for Pakistan where about 33% of the total cultivated area is salt affected and half of this is wasteland (Qureshi, 1993). Reclamation of these wastelands through chemical or engineering approaches is difficult and expensive. Since there is a severe reduction in the yield of different agricultural crops due to high salinity, it is not economical to grow these on such lands (Aslam et al, 1997). The cheaper alternative is to restore these wastelands by cultivating selected salt tolerant plant/tree genotypes. Tree based land utilization strategies for wastelands can not only contribute significantly to making them productive but also in controlling the further spread of salinity. The species required for revegetation will vary greatly because of the great differences in the nature and severity of the salinity problem, groundwater quality and the ranges of geographic, edaphic and climatic regions over which it occurs.

The major determinants of the successful redevelopment of wastelands - land quality, water availability and quality, climatic conditions, plants species suitable for adverse lands - are discussed below and their potential for converting wastelands into forest lands for fuel and timber wood production is highlighted.

5.2 SALINITY PROBLEM

Extent of Salt-affected Soils

The total area of Pakistan is 80.5 million hectares (Mha) out of which over 20 Mha are cultivated. About 16.2 Mha of this are irrigated, of which canals irrigate 11.42 Mha and the rest is irrigated by tube wells and other means (Government of Pakistan, 1988). The salt-affected area is about 6.3 Mha which is mainly confined to the irrigated parts of the Indus Plain (Khan, 1993).

According to another estimate, of the 5.8 Mha salt-affected area, 3.16 Mha are within the canal commanded area (CCA) and 2.64 Mha are outside the CCA, while 2.93 Mha are cultivated (0.73 Mha are under irrigation while 2.2 Mha are likely to be irrigated) (Rafiq, 1990).

A large part of the salt-affected area of Sind is not cultivated and is lying barren at present. Due to the fine texture of these soils, they are not easy to reclaim. According to Mohammad (1973) about 81.0% of the salt-affected soils of Punjab are saline-sodic/sodic and the rest (19.0%) are saline, whereas, 50.7% of the salt-affected soils of Sind are saline sodic or sodic and 49.3% saline.

Irrigation Water

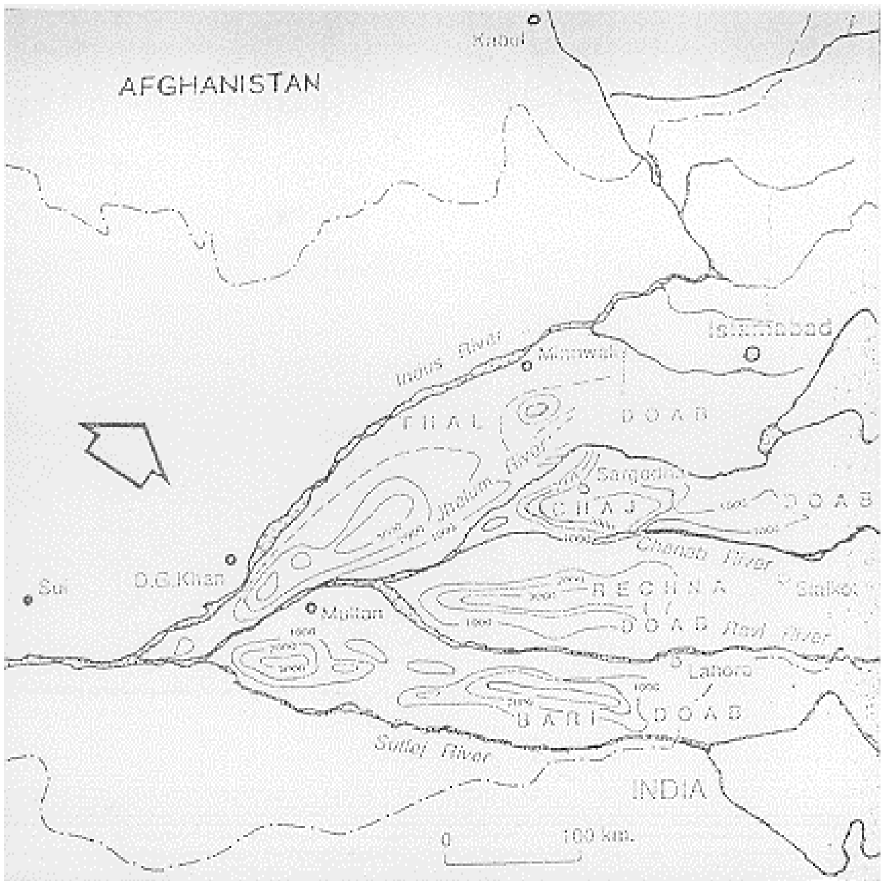
The annual river flow in Pakistan is 172,868.29 million m^3, of which 27,658.93 million m^3 flows during the winter months of October to March. The summer flow is 145,209.36 million m3. The major flow (98,041.02 million m3) is during June, July and August (Ahmad and Chaudhry,1990).

The annual requirement for irrigation water is 158,051.01 million m3. The total withdrawals from river systems are around 128,416.44 million m3 but the annual supply at the farmers' fields is only 86,866.32 million m3. Canal water is supplemented with 25,930.24 million m3 from underground supplies but this still leaves a net deficit of 45,686.62 million m3 (WAPDA,1979).

Ground Water Quality

Groundwater quality throughout the Indus Basin aquifer varies depending on the climatic parameters, nature of the surface flow, topography, extent of seepage and irrigation practices. Generally, the quality deteriorates as one travels the plain from upstream to downstream towards the Arabian Sea. Fresh groundwater with a salinity of less than 1000 mg L-1 occurs in the upper north-eastern part of the interfluvial region, where the precipitation is relatively high. Fresh groundwater is also found in belts parallel to the major rivers of the region, where infiltration from rivers crossing the present flood plains provides recharge (Figure 1). Zones of saline groundwater are found in the central and lower parts of the interfluvial regions. In the lower Indus Plain and particularly in Sind province groundwater quality is poor and in large areas TDS values are greater than 3000 mg L-1 (Ahmad and Chaudhry, 1990).

Figure 1: Average groundwater salinity (in mg L^{-1} TDS) to the depth of 100m (Ralhur, 1987)



Recharge of the aquifer by rainfall and irrigation water is about 594,54.34 million m^3, of which 40,747.53 million m^3 is usable. The remaining recharge of 18,521.61 million m^3 occurs on saline soils and into saline aquifers. Recharge into non-saline aquifers can be pumped directly, while fresh water overlying the saline aquifer could be exploited through shallow skimming wells. Pumping from saline aquifers may cause saline intrusion into fresh water sources and deterioration in water quality.

According to Malik et al (1984) 25% ground water is suitable for agricultural crops, another 25% is marginal in quality while 50% is hazardous.

It is obvious that at the present rate of exploitation of the fresh underground water resources there is only a limited scope for extending irrigation facilities.

Waterlogging

According to the Water and Power Development Authority (Government of Pakistan, 1988), 2.1 million ha of the irrigated land in Pakistan has water tables within 1.5 m of the surface in spring (April). This area increases to 4.9 million ha in autumn (October). Figures vary from year to year.

Types of Salt-affected Land

Although saline lands are very heterogeneous, some characteristic land types can be identified:

i. Cropping (irrigated) lands with saline/sodic patches - this type covers an area of approximately 3 million ha (Rafique,1990);

ii. low-lying moderately salt-affected lands originally used for rice growing (0.83 million ha) (Qureshi et al, 1990);

iii. salt-affected areas with the associated problem of waterlogging (watertable within 1 m) - this type covers about 1.16 million ha (Ahmad and Chaudhry, 1990);

iv. high-lying fields within the irrigated area left uncultivated due to water shortage and high salinity;

v. salt-affected desert areas with sandy soils and no irrigation supplies but saline underground water - this type has a total area of about 11 million ha;

vi. coastal salt-affected areas and coastal sands with brackish underground water.

vii. mildly saline, unirrigated and degraded range land;

viii waterlogged area (water table within 0-5 feet during October 1980) is 4.9 Mha (Ahmad and Chaudhry, 1988); and

ix. uncultivated land is lying barren at present, because of the fine texture of its soils it is not easily reclaimed.

5.3 RECLAMATION AND OTHER ASPECTS

According to Rafiq (1975) reclaimability assessment of the soils showed that there were 0.89 million hectares of dense saline-sodic soils, 1.42 million hectares of porous saline-sodic soils, 0.72 million hectares of porous saline-sodic with surface salinity/sodicity and 2.44 million hectares of strongly saline soils (mostly containing gypsum) with severe problems. The last category is apparently wastelands since there is not enough irrigation water to reclaim these soils.

Similarly Muhammad (1973) claimed that a large part of the salt-affected area of Sindh was not cultivated and lying barren at present. This is not easily reclaimed, especially because of limited water supply. Some of the soils of Badin are flooded by sea water during high tides and partly affected by sea water intrusion.

As water deficit and soil salinity are two very important interlinked problems of Pakistan's irrigated agriculture, the Government has spent over 90 billion rupees (Rs.44= 1 US$) to reclaim the salt-affected land using an engineering approach. So far there has been little success.

5.4 YIELD OF CROPS ON MODERATELY SALT-AFFECTED SOILS

Since soil salinity and waterlogging are amongst the most important problems that threaten the sustainability of agriculture and society in general in Pakistan, utilization of saline lands and lower quality water resources appear to be a necessity. At present, the losses in fields of wheat, rice, cotton and sugarcane cultivated in the moderately salt-affected areas are about 64, 68, 59 and 62% respectively, while the annual per hectare losses due to salinity in rice-wheat rotations are estimated at Rs.10 billion (Qureshi,1993).

5.5 COMPARISON OF SALINITY TOLERANCE BETWEEN CROPS AND TREE SPECIES

Table 1 shows those tree species which have high promise for extremely salt-affected lands since the reduction in growth is initiated at much higher external salt concentrations. So cultivation of highly salt tolerant crops such as barley and sugar beet may not be recommended on highly salt-affected waste lands, not because they cannot grow there but because their cultivation is uneconomical and development and maintenance of the agro eco-system in such highly salt-affected lands will be easier and more profitable with perennial plant species such as trees.

The most salt tolerant higher plants include famous woody forage halophytes such as Eucalyptus, Tamarix, Prosopis spp.Casuarina spp. Acacia spp. (Aronson,1990). More than 1600 halophytes have been listed so far and all have the ability to survive and produce on highly to extremely salt-affected wastelands.

5.6 PERFORMANCE OF TREE SPECIES UNDER ADVERSE CONDITIONS

Studies on some Tree Species Under the Saline Sodic Conditions of Pakistan

The actual biomass yield of representative plants of the selected species is given in Table 2. Data very clearly indicate that E.camaldulensis, Acacia nilotica, Albizia and Leucaena produced the maximum timber; their total fresh weight, height and stem diameters were also greater than other species. Thus, these species appear to be the most successful ones for wood production. Leucaena was very aggressive and spread quickly all over the place through natural seed distribution and seedling establishment.

Data in Table 3 clearly indicate that Eucalyptus and Acacia showed a mortality of 11 and 25%, respectively followed by shisham (Dilbergia sissoo), while Arjun (Terminalia arjuna) showed the maximum mortality (50%) followed by Tamarix aphylla (44% mortality). The growth was best in the case of Eucalyptus which was statistically similar to Acacia and Tamarix compared with the other species which were at par with one another. Thus Eucalyptus, Acacia and Tamarix can be considered very successful in a dense sandy clay loam soil with a hard pan at about 30cm depth.

Another study conducted on Eucalyptus camaldulensis under salt-affected and waterlogged conditions (Table 4) reveals that E. camaldulensis has the ability to tolerate the dual stresses of salinity and waterlogging.

Nevertheless, from studies in India and Pakistan several species have been identified as being either highly salt-tolerant (Prosopis juliflora, Prosopis chilensis, Prosopis alba, Tamarix aphylla) or moderately salt-tolerant (Acacia tortilis, Eucalyptus camaldulensis, Casuarina equisertifolia, Azadirachta indica, Eucalyptus tereticornis, Eucalyptus microtheca, Acacia auriculiformis and Acacia nilotica) (Jain et al, 1985; Sheikh 1987; Singh 1989;Yadav 1989; Qureshi et al,1990 and 1993).

Performance of tree species planted in salt-affected soils, Sultanate of Oman

Eight tree species each 6 years old were compared for their performance under saline sodic condition (Table 5). No irrigation was supplied to the plantation for two years prior to the comparison. The area near the coast was very occasionally inundated (less than once a week) with rain water. Amongst the tree species, Prosopis juliflora and Acacia toritilis were performing extremely well (although the growth rate of Acacia tortilis was slow) followed by Prosopis cineraria and Parkinsonia(Table 6).

A significant improvement in the growth of Zizyphus and Prosopis cineraria was observed when the distance of plantation from the coast increased. This could partly be because of decreasing soil salinity and partly due to the light texture of the soil and because of improved soil drainage. Another useful observation in respect of plant mortality was noted; plant mortality was higher in the case of trees planted in large and deeper pits as opposed to surface planting. This was specially notable near the coast. This increased mortality of trees in deeper pits could be because of the inundation of pits with flood water, the richness in salts and poor drainability characteristics of the localized area in the pits. The overall ranking order of tree species at the site was Prosopis juliflora=Acacia tortilis> Parkinsonia=Prosopis cineraria> Zizyphus(see Aslam,1996).

Ranking of some Australian species for their salinity tolerance

Table 7 presents a list of Australian species reported to be moderately to highly salt-tolerant on the basis of field evaluation and observation. Species which have been observed to be tolerant of moderately to highly saline and saline-sodic soils include Acacia ampliceps, A.stenophylla, A.machonochieana, A.salicina, Eucalyptus microtheca, Melaleuca halmaturorum and Casuarina glauca and C. Abesa (Marcar et al, 1993).

5.7 ECONOMIC ASPECT OF AFFORESTATION ON WASTELANDS

The figures given in Table 8 indicate high gross returns from plantations of E.camaldulensis, followed by Acacia spp., Albizzia spp., and Leucaena spp. calculated on the basis of a prevailing market price of Rs.0.50 per kg of wood and zero mortality (1000 plants per acre). The expenses incurred for appointing one watchman for 25 acres, felling, cutting, transporting wood, initial irrigation and rent of land could probably be covered from the sale of twigs/small branches and foliage for fodder purposes. Even a high rate of 50% mortality would not make it uneconomical to grow trees in such lands as the net returns are as high as from a wheat-cotton rotation in good lands (Qureshi et al, 1993).

5.8 TARGET AREAS FOR DEVELOPING WASTELANDS INTO AFFORESTATION AREAS

The saline land types described under categories iv-ix are entirely unfit for growing conventional agricultural crops but can be successfully redeveloped by planting salt tolerant tree species of economic value. Besides the above types of saline land, there are a few areas which show particular promise and should be targeted in rehabilitation programs.

Non-irrigated land surrounded by canal irrigation

Although surrounded by irrigated land, these areas are not irrigated because of their elevation. This land belongs to the state or farmers and is in parcels of 0.5 to 20 ha or more. It is generally left unattended and exists in all parts of the country. It supports some grass and low bushes in the monsoon season together with perennial salt tolerant trees like mesquite (Prosopis juliflora).

Non-irrigated land underlain by poor quality groundwater

The total area of the rangeland is 3-4 million ha divided among the districts of Jhang, Shorekot, Multan, D.I.Khan, Bannu, Mardan and the North West Frontier Province (NWFP). It consists of large contiguous blocks of land (40-400 ha) belonging to the government or absentee landlords(looked after by tenants). These lie uncultivated because of high salinity and lack of canal irrigation. The underground water is generally moderately to highly saline. Regions with great potential for tree based agricultural uses are:

Adverse soils of D.I. Khan

D.I. Khan district approximately where 0.5 million ha of the soils on the piedmont slopes are considered saline. This area is underlain by mildly saline groundwater, 12-21 m below the piedmont.

Desert areas of Thal, Thar and Cholistan

This vast land resource of 11 million ha (Akram et al., 1990) consists of great tracts of sand dunes, which in places are interspersed with sparsely vegetated clay flats. In many cases soil is salt-affected and the scarce underground water is highly saline.

Palatable plant species are over-grazed(both annual and perennial) resulting in a general decrease in perennial vegetation cover. There is no organized forest management. Management of these areas could be improved by increasing drinking water supplies and starting a program of growing salt-tolerant, drought-resistant and palatable trees/shrubs using saline underground water for irrigation on the sandy dune soil.

Arid coastal sandy areas

The light textured soils occur along the 880 km coastal line and are separately vegetated with woody shrubs, particularly mesquite (Prosopis juliflorus). The underground water in this region is saline, but salinity decreases with distance from the sea.

5.9 CONCLUSION

There is a large area (6.3 million ha) under salt-affected soils. Good quality irrigation water is scarce, ground water quality is poor. Energy requirements are increasing. Afforestation on good lands is not economical because of the competition with high yielding crops on precious land with fresh irrigation water. Conventional crops produce uneconomical yields on salt-affected lands, but salt-tolerant tree species are easy to establish.

The restoration and revegetation of salt-affected waste lands with salt tolerant tree spp. of economic significance (Table 9) will not only provide substantial fuel/timber wood and pulp for industrial use but also have a positive effect on the environment and the social sectors, e.g. minimize the spread of salinity, restore ecological balance and sustain agro-development in salt-affected wastelands even with brackish water resources.

Table 1: Comparison of Salinity Tolerance of Selected Crops and Tree Species

Crop	Salinity threshold (dS m-1)
Wheat	6
Barley	8
Cotton	7.7
Sugarcane	1.7
Rice	3.0
Sugarbeet	7.0
Trees	-
Eucalyptus hybrid	7
Acacia nilotica	8
Prosopis juliflora	30
Prosopis nigra	20
Prosopis tamarngo	20
Casuarina	7

Table 2: Biomass Produced by Representative Plants of Different Species Under Salinity Sodic Soil Condition after 11 Years of Growth

Species	Fresh wt (kg plant)	Timber (kg/plant)	Length Main stem (m)	Dia–1	Dia–2 (cm)	Dia-3
Leucaena Leucocephala	150	90	7.32	15	11	8
Terminalia arjuna	140	35	3.96	15	10	6
Pangamia pinnata	135	38	3.66	15	10	7
Parkinsonia aculeata	150	38	2.44	16	7	6
Albizzia lebbek	207	99	6.10	26	13	7
Acacia nilotica	230	150	7.32	17	14	7
Euc. Camaldulensis	400	203	7.92	23	19	13
Tamarix aphylla*	85	35	4.57	17	11	6
Prosopis cineraria	100	52	4.27	15	9	6

**=5 1/2 year of growth (Study no.3)*
Dia.1=diameter at the base of the stem.
Dia.2=diameter at the middle of the stem
Dia.3=diameter at the top of the stem

Table 3: Performance of Tree Species in Dense Saline Sodic Soil (Mean of 6 Replications)

Tree species	Depth (cm)	EC (dS m-1)	pH	SAR	Visual Score	Mortality age (%)
Euc. Camaldulensis	0-30	48.3	8.00	127.5	8.16a	11
	30-60	18.75	8.00	46.3		
	60-90	10.65	8.10	29.7		
Leucaena leucocephala	0-30	35.82	8.05	70.0	5.18b	39
	30-60	18.50	7.95	43.0		
	60-90	8.69	8.00	17.5		
Acacia nilotica	0-30	19.38	8.00	56.8	7.00ab	25
	30-60	9.40	8.65	24.4		
	60-90	5.08	8.45	12.6		
Frash (Tamarix aphylla)	0-30	83.88	7.95	66.4	7.40a	44
	30-60	33.57	7.90	66.8		
	60-90	19.60	8.35	42.5		
Arjan (Terminalia arjuna)	0-30	25.80	8.85	45.8	5.12b	50
	30-60	5.49	9.00	25.0		
	60-90	4.37	8.85	12.8		
Shisham (Disbergia sisso)	0-30	17.64	8.15	38.4	5.06b	28
	30-60	15.86	8.10	27.7		
	60-90	9.22	8.00	15.7		

**Analysis of composite samples between the furrows.*

Table 4: Interactive Effect of Salinity and Waterlogging on Biomass Production (G Plant-1) of Euc. Camaldulensis

	Salinity level			
	Control	15	30	Mean
Aerobic	921.17a	555.555c	1700.90e	549.21A
Waterlogged	655.65b	288.58d	104.41f	349.55B
Mean	788.41A	422.07B	137.66C	

Means with different letter differ significantly according to least significance test at P<0.05.
H1= Aerobic
H2= Waterlogged
S1= Control (5 = dS m-1)
S2= 15 dS m-1
S3= 30 dS m-1
**Average of two years.*

Table 5: Edaphic Characteristics of Majees (Oman) Area Under Tree Plantation

				Parameters			
Site	**Depth (cm)**	**Ece dS m-1**	**PH**	**SAR**	**CI (meL-1)**	**Texture**	**Depth (m) of waterable & its salinity (dS m-1)**
Majees	0-5.0	110					8 (10)
	0-15	877.5	34.4	82.0		Sandy loam	
	15-30	55	7.4	24.4	430	Sandy loam	
	30-60	59	7.4	24.4	380	Silty loam	
	60-90	42	7.5	22.8	240	Silty clay loam	
	90-120	28	7.7	22.0	225		

Aslam, 1996

Table 6: General Condition and Growth Performance of Different Tree Species Planted in Majees, Oman

Site with area under plantation (ha)	Plant species	Mortality (%)	Overall condition	Mean plant ht.	Mean girth (cm/plant)	Mean canopy Area (m2/plant)	Remarks
Majees (79)	Zizyphus spina christi	25	Moderate	2.6	14.67	5.89	Fruiting
	Prosopis cineraria	15	Good	3.8	39.00	15.30	Flowering
	Prosopis juliflora	3	Excellent	2.47	28.67	47.20	Heavy pod formation
	Prosopis tamarugo	7	Moderate	1.53	11.67	3.16	-
	Acacia tortilis	8	Excellent	2.73	20.67	16.75	-
	Parkinsonia	6	Good	3.4	26.67	17.74	-

Aslam, 1996

Table 7: Australian native tree species ranked as salt tolerant on the basis of survival, growth and observations in field trials or natural occurrence (temperate to subtropical zones)

Eucalyptus	Acacia	Melaleucas	Casuarinas
E.camaldulensis	A.ligulata	M.lanceolata	C.glauca
E.brockwayi	A.salicina	M.halmaturorun	C.obesa
E.astringens	A.farnesiana	M.alternifolia	C.equisetfolia
E.largiflorens	A.pendula	M.armillaris	
E.leucoxylon	A.stenophyla	M.bracteata	
E.occidentalis	A.saligna	M.linariifolia	
E.sargentii	A.papykicarpa	M.quinquenervia	
E.spathalata	A.auriculiformis	M.thyoides	
E.microtheca	A.ampliceps	M.glomerata	
E.kondininensis	A.maconochiena	M.accaciodes	
E.cadocalyx	A.victoria	M.adnata	
E.platypus var, heterophylla	A.sclerosperma		
E.diptera	A.cuspidifolia		
E.wandoo			
E.loxophleba			
E.tereticornis			
E.halophila			
E.rudis			
E.incrassata			
E.salicola			
E.myriadena			
E.coolabah var hodoclada			

Table 8: Economic returns from different tree species grown under saline-sodic soil conditions

Name of spp.	Wt. of wood (kg/tree)	Price of single plant (Rs. 0.50/kg Timber)	Return from one acre (1000 trees)**	Gross return per annum (Rs.)***
Leucaena leucocephala	90	45.0	45,1000	6,000
Terminalia arjuna	35	17.5	17,500	2,333
Pongamia pinnata	38	19.0	19,000	2,533
Parkinsonia aculeata	21	10.5	10,500	1,400
Albizzia lebbek	99	49.5	49,500	6,600
Acacia nilotica	150	75.0	75,000	10,000
Euc. Camaldulensis	201	120.0	1,20,000	16,107
Ziziphus jujuba	32	16.0	16,000	2,133
Tamarix aphylla	35	17.5	17,500	3,182
Prosopis cineraria	52	26.0	26,000	3,467

**Price is Rs. 0.60 kg 1 timber*
***1000 plants were planted per acre*
****Expenses for protection, uprooting, cutting, transportation, rent of land. Etc are for each species and may besubtracted for calculating the net income.*
Source: Qureshi et al, 1993.

Table 9: Tree Species Suitable for Different Soil Characteristics

Type	Soil Characteristics	Species
A	Well drained soils, high salinity/sodicity, occasional irrigation	Leucaena leucocephala (Ipil Ipil) Acacia nilotica Kikar) E. camaldulensis (Suphaida) Terminalia arjuna (Arjan) Acacia ampliceps Prosopis cineraria
B	Poorly drained, high salinity/sodicity	E. camaldulensis Casuarina equesatifolia (Casuarina) *Tamarix indica/T. aphylla Terminalia arjuna (Arjan) Salix alba Prosopis picigera/Prosopis cineraria
C	High salinity, drought conditions	Ipil Ipil Acacia nilotica Tamarix spp
D	All	E. camaldulensis Tamarix spp **Prosopis juliflora (Mesquite)
E	Fruit tree suitable for saline soils	Zizyphus jujuba (Ber) Grewia asiatica (Falsa) Eugenia jambolana (Jaman) Guava (for mod. Salinity and poorly drained areas) Date palm Chico

**Recycles salts concentrating these on the soil surface.*
***a. Suitable lines need to be explored (some work at NIAB is in progress)*
b. Suitable machinery for bundling the bushy thorny crop needs to be developed
Source: Qureshi et al, 1990

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6. PATTERNS AND PROBLEMS OF FUEL WOOD CONSUMPTION AND PRODUCTION IN SALT-AFFECTED AREAS OF FAISALABAD

by

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6.1 INTRODUCTION

Wood meets half of the country's total domestic energy requirements. The Census of 1980 shows that 70% of the total households in Pakistan use wood for cooking and heating, while in rural areas the dependency rate is 80% (Sandhu, 1993). Due to the high price of wood, charcoal and alternate fuels, people indiscriminately cut and fell trees on a large-scale which creates many environmental problems such as land degradation, increase in CO2 in the atmosphere and low humidity which may lead to desertification. Dung is another major source of fuel for domestic use. In Pakistan about 50% of the animal droppings are burnt as dung cakes which amounts to about 34.55 million tonnes of dung per year (Sandhu,1983).

The two main sources of fuel wood supply are private farm-lands and the state controlled forests. It is estimated that the state controlled forests supply about 10% of the fuel wood consumed. The supplies from the state controlled forests take the form of recorded production, biomass obtained during the conversion process and the illicit cuttings by the local inhabitants. The remaining 90% is supplied by private farm-lands. The latter supplies are estimated at no more than 12 million m^3 on a sustainable basis. This means that excessive cutting is taking place to the extent of 5 million m^3.

On the basis of population growth alone, using existing per capita consumption rates, the fuel wood demand can be expected to rise by approximately 55% by the year 2000. Failure to meet this demand will accelerate excessive cutting; thus further exacerbating damage to forest resources. Soil erosion, damage to watersheds and reservoir silting will lower agricultural productivity in the Indus Plains as a consequence (NCA, 1988).

In Pakistan about 6.3 million hectares of land is salt-affected and approximately half of this area is wasteland due to very high salinity (Qureshi, 1994). About 81% of the salt-affected soils of the Punjab are saline-sodic and the rest (19%) are saline (Muhammad, 1973). Presently, this area produces pahari kikar (Prosopis juliflora) or lana (Suaeda fruticosa) etc. This area can be easily utilized for growing salt tolerant trees such as Eucalyptus or salt bushes such as Atriplexes which can be a good source of fuel wood in the villages. Introduction of this technology is expected to alleviate the energy problems and the related social consequences for rural women. Therefore, the main objective of this paper is to present the authors findings on the pattern and problems of wood fuel consumption and production in salt-affected areas of Faisalabad.

6.2 METHODOLOGY

The study was designed to be conducted in the action area of the Satiana Pilot Project undertaken by the University of Agriculture, Faisalabad. Four villages were randomly selected to constitute the universe for these investigations.These were Chak No. 26 G.B., Chak No. 117 G.B., Chak No. 77 and Chak No. 433 G.B. in Faisalabad District.

The pilot project area of Satiana is located in Jaranwala Tehsil, Faisalabad District and comprises one Markaz which is under the jurisdiction of an Agricultural Officer of the Punjab Agriculture Extension Department. The area is located approximately 25 km south-east of Faisalabad, and is near the Faisalabad-Tandlianwala road which bisects the main junction town of Satiana. The project area covers 66,379 acres and consists of eight Union Councils with 37 villages. Approximately 57 percent of this area suffers from waterlogging and another 43 percent from salinity/sodicity (Ijaz and Davidson,1997). Stratified random sampling techniques were adopted to select four villages. Then a list of farmers from each selected village according to land holdings was prepared. For this purpose respondents were randomly selected from each village to constitute a sample of 109 respondents. The respondents were female heads of households or the females active in household management. An interview schedule was devised and was pretested before the data were collected.

6.3 RESULTS AND DISCUSSION

Consumption of Fuel Wood

Table 1: Percentage Distribution of The Respondents According to Type of Energy Used for Cooking

Source of Energy	Response							
	Not at all		Mostly		Occasionally		Total	
	f	%	f	%	f	%	f	%
Dung cake	27	24.8	63	57.8	19	17.4	109	100
Firewood	4	3.7	93	85.3	12	11.0	109	100
Coal	104	95.4	1	0.9	4	3.7	109	100
Crop waste	26	23.9	5	4.6	78	71.6	109	100
Kerosene oil	98	89.9	5	4.6	6	5.5	109	100
Electricity	103	94.5	1	0.9	5	4.6	109	100
Others	96	88.1	1	0.9	12	11.0	109	100

Table 1 reveals that firewood was the most popular burning material for cooking; in fact firewood (prunings, twigs etc.) was easily available and was described as a relatively cheap fuel source. The majority of the respondents (85.3%), mostly used firewood for cooking meals. The remaining 11% occasionally used firewood and 3.7% of the respondents never used wood. Along with firewood, most respondents used dung cakes for cooking. According to the respondents, firewood and dung cakes combined made a good fuel. More than half, (57.8%), of the respondents mostly used dung cakes for cooking, 17.4% used them occasionally for daily cooking while the remaining 24.8% respondents did not use this kind of fuel for cooking at all. In the case of use of coal (charcoal) for cooking, the majority of the respondents (95.4%) did not use it, while only 0.9% mostly used it and 3.7% occasionally used coal for cooking. As for crop wastes, the majority of the respondents (71.6%)

occasionally used it because crop wastes like cotton sticks, cobs, khori etc. were available only seasonally and can be easily burnt under a tavi (a large iron plate for cooking chapaties) and tandoori etc. The majority of the respondents (94.5%) did not use kerosene oil for cooking. Only 4.6% mostly used it and 5.5% occasionally used it for cooking. Electricity was considered a very costly source of energy for cooking, so only 0.9% respondents mostly used an electric heater for cooking and 4.5% occasionally used it while the majority of the respondents (94.5%) could not afford electricity for cooking. Under the category of "others" (Sui gas, cylinder etc.) the majority of the respondents occasionally used them for cooking while only 0.9% used them most of the time. These findings are similar to those of Mohiuddin (1988), Caceres (1989), and Sandhu (1993) who reported that the majority of the rural households used firewood for cooking purposes. However, Mwanza (1988) suggested alternative sources of energy for rural areas of Africa.

Table 2: Percentage Distribution of The Respondents According to Type of Energy Used for Heating

Source of Energy	Response							
	Not at all		Mostly		Occasionally		Total	
	f	%	f	%	f	%	f	%
Dung cake	107	98.2	1	0.9	1	0.9	109	100
Coal	105	96.3	3	2.8	1	0.9	109	100
Firewood	80	73.4	3	2.8	26	23.9	109	100
Crop waste	106	97.2	1	0.9	2	1.8	109	100
Kerosene oil	108	99.1	1	0.9	0	0.0	109	100
Electricity	9	86.2	3	2.8	12	11.0	109	100

Table 2 indicates that, on the whole, the majority of the respondents did not use any type of energy for the purpose of room heating; actually the majority of the rural people did not feel any need to heat their rooms in winter, so 98.2% of respondents did not use dung cakes, only 0.9% respondents mostly used and 0.9% occasionally used dung cakes for heating. Similarly, 96.3% did not use coal (charcoal). The remaining 2.8% respondents used it most of the time and 0.9% respondents used coal occasionally for heating on winter days. Firewood was used mostly by only 2.8% of the respondents and occasionally by 23.9% respondents, while the majority of the respondents (73.4%) did not use wood. Regarding crop wastes for heating, only 0.9% used wastes most of the time and 1.8% used them occasionally, while crop wastes were not used by the majority of the respondents (97.2%). Use of kerosene oil for heating was very rare and only one respondent (0.9%) mostly used kerosene oil while the majority (99.1%) did not use it. Small families comprising 2.8% of respondents used mostly electric heaters and 11% of respondents used electricity occasionally to warm rooms, and the majority did not use electric power for heating.

Table 3: Percentage Distribution of the Respondents According to Satisfaction with the Efficiency of the Fuel Consumed

Source of Energy	Satisfaction											
	Fully		**Partially**		**Not**		**No response**		**NA**		**Total**	
	f	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**
Dung cake	28	25.7	45	41.3	4	3.7	5	4.6	27	24.8	109	100
Firewood	79	72.5	25	22.9	4	3.7	0	0.0	1	0.9	109	100
Coal	0	0.0	1	0.9	1	0.9	3	2.8	104	95.4	109	100
Crop waste	54	49.5	36	33.0	0	0.0	2	1.8	17	15.6	109	100
Kerosene oil	7	6.4	19	17.4	11	10.1	8	7.3	64	58.7	109	100
Electricity	6	5.5	0	0.0	1	0.9	0	0.0	102	93.6	109	100
Others		9	8.3	1	0.9	0	0.0	0.0	99	90.8	109	100

Table 3 shows that the majority of the respondents (41.3%) were partially satisfied with the efficiency of dung cakes as a burning material, while 25.7% were fully satisfied and 3.7% were not satisfied. A further 4.6% did not give any response and 24.7% did not use dung cakes. As for fuel wood, the majority of the (72.5%) were fully satisfied, 22.9% were partially satisfied and 3.7% were not satisfied. The remaining 0.9% respondents did not use firewood. Regarding coal (charcoal), only 0.9% respondents were partially satisfied and 0.9% were not satisfied while 2.8% did not give any response. The majority (95.4%) did not use coal at all. More than half, 58.7%, of the respondents did not use kerosene oil. A further 6.4% were fully satisfied, 17.4% were partially satisfied and 10.1% were not satisfied. The remaining 7.3% did not give any response. Only 5.5% were fully satisfied with the efficiency of electricity and 0.9 % were not satisfied, while the majority of the respondents (93.6%) did not us electricity as fuel at all for this purpose. In the category of "others", i.e. gas cylinder, 8.3% respondents were fully satisfied and 0.9% were partially satisfied, while the majority of the respondents (90.8%) did not use such sources of energy.

Table 4: Percentage Distribution of Respondents According to Use of Wasteland Trees as Fuel Wood

Use of trees	Frequency	Percentage
No	22	20.2
Yes	35	32.1
NA	52	47.7
Total	109	100.0

N.A.= (No salt-affected land (38) +No trees (14)= 52)

Table 4 shows that the majority of the respondents (32.1%) who were owners of waste land trees used those trees as fuelwood while 20.2% did not use wasteland trees.

Table 5: Percentage Distribution of Respondents According to Reason for not Using Wasteland Trees as Fuel

Reasons	Frequency	Percentage
Poor energy source	1	0.9
Difficult to collect	13	11.9
Trees too young	2	1.8
No prunings	1	0.9
No permission from land owner	1	0.9
Difficult to collect and poor energy source	2	1.8
Difficult to collect and distant	2	1.8
NA	87	79.8
Total	109	100

N.A.=(No salt-affected land (38) + No trees (14) + Users of trees (35) =87)

According to Table 5, 0.9% of respondents replied that wasteland trees are a poor energy source, 11.9% respondents said that in the case of pahari kikar it was extremely difficult to collect prunings and 1.8% respondents argued that their wasteland trees were too young and 0.9% said that their (date) trees had no prunings. One respondent (0.9%) had no permission from the land owner to collect prunings and twigs, 1.8% respondents gave two reasons for not using them, i.e. difficulty in collection and poor energy source and a similar percentage of the respondents (1.8%) said it was unsuitable because of sharp thorns (pahari kikar) and also they were very far from their houses.

Table 6: Percentage Distribution of Respondents According to their Willingness to Grow Eucalyptus and Artiplex for Fuel Wood

Willingness	Eucalyptus		Atriplex	
	f	%	f	%
No	15	13.8	48	44.0
Yes	56	51.4	23	21.1
NA	38	34.9	38	34.9
Total	109	100.0	109	100.0

N.A =(No salt-affected land)

According to Table 6, the majority of the respondents (51.4%) wanted to grow Eucalyptus in their salt-affected land and 13.8% female respondents did not want to grow it. On the other hand 44% (majority of the total respondents) did not want to grow Atriplex in waste salt-affected lands, and only 21.1% answered in the affirmative.

Table 7: Percentage Distribution of Respondents According to Reasons for Not Wanting to Grow Eucalyptus and Atriplex

Reasons for no wanting to grow	Eucalyptus		Atriplex	
	f	%	f	%
Lack of knowledge	5	4.6	42	38.5
Want to reclaim land	6	5.5	4	3.7
Lease condition doesn't allow it	3	2.8	2	1.8
No interest	1	0.9	0	0.0
NA	94	86.2	61	56.0
Total	109	100.0	109	100.0

N.A. = No salt-affected land (38) + in favour of growing (56) = 94)
N.A. = No salt-affected land (38) + in favour of growing (23) = 61)

Table 7 shows that 4.6% of the total respondents did not want to grow Eucalyptus because of lack of knowledge and 5.5% respondents did not want to grow Eucalyptus because they wanted to reclaim their land, 2.8% of the respondents were bound by lease conditions and 0.9% had no interest in growing Eucalyptus in salt-affected land. In the case of Atriplex, 3.7% wanted to reclaim their wastelands. According to 1.8% respondents, the lease conditions did not allow them to grow Atriplex. This table reveals that, as compared to Atriplex, more people had knowledge about Eucalyptus. The overall picture that emerges from the foregoing tables is that most of the people were interested in the utilization of their wastelands for fuel wood production, which was generally under the natural vegetation of lana and pahari kikar at the time of the survey (see Kielen, 1996). The latter was not liked by the users because it is difficult to collect and use due to its long thorns. However, the majority of people would like to grow Eucalyptus. Again, the majority of the people who did not grow Eucalyptus or Atriplex, did not have proper knowledge about the prospects of their success in the wastelands; knowledge about Atriplex cultivation was particularly poor. This suggests a need to further strengthen the programme to transfer saline agri-technology to the area. This study also shows the prospects for revegatating a large proportion of the salt-affected waste land of Pakistan (see Qureshi,1994, Qureshi et al., 1996) by growing salt tolerant species like Eucalyptus and Atriplex.

6.4 CONCLUSION AND RECOMMENDATIONS

Fuelwood is used for cooking by a huge majority of the people in the saline areas of Faisalabad. Most of the respondents of this study used wasteland trees as fuelwood and were satisfied with their burning efficiency. The majority of respondents expressed a willingness to grow Eucalyptus but not Atriplex as fuelwood.

The inhabitants of the area should be encouraged to plant Eucalyptus, Atriplex and other species of trees which can be grown in the salt affected lands and can be used as fuel wood. This is crucial to fulfill the present and future fuel wood needs of the area. However, the strategy should be to take the socio-cultural values of the people into account. Awareness about the use of these species, proper selection of the farmer, proper distribution of plants and proper guidance for a plantation programme and some others steps need to be taken to ensure the success of the plantation programme. Farmers should participate in the decision making process from the production to the marketing of fuel wood.

A training programme for better management of fuel wood production and marketing should be available for farmers and other related persons.

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7. WOOD FUEL TRENDS AND PROSPECTS IN PAKISTAN

by

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7.1 INTRODUCTION

It has been estimated that in developing countries, more than half the people meet their energy requirements from wood and charcoal. It has also been estimated that at least half the timber cut in the world still serves its original role for cooking and heating. The essential resource, however, is seriously threatened. The developing world is facing a critical shortage of woodfuel, as serious as the petroleum crisis. The growth in human population is far outpacing the growth of new trees - not surprising when the average user burns as much as a tonne of firewood a year. The results are soaring prices of wood, a growing drain on incomes and physical energy expended to satisfy basic fuel needs, the wasteful burning of animal manure to cook food rather than produce it, and an ecologically disastrous and potentially irreversible spread of treeless landscapes.

If the pace of tree planting around the world is not greatly accelerated at least a further 250 million people will be without wood fuel for their minimum cooking and heating needs and will be forced to burn dried animal dung and agricultural crop residues, thereby further decreasing food crop yields. To meet the challenges of the next century, the growing of suitable species for firewood needs to be emphasised. These species may be little known in traditional forest production. They may be woody shrubs rather than forest trees, they may be branched, crooked, and sometimes short-lived, but nevertheless can meet the requirements for small-scale village use.

Diplomats, economists and the media have given little attention to the scarcity of firewood, but the problem is enormous. Moreover, even if we somehow manage to grow enough food for the people in the year 2010, how in the world they will cook it?

A firewood scarcity is probably most acute today in the countries of the Indian sub-continent and the semi-arid stretches of Africa below the Sahara, although it effects many other areas as well. The price of fuel wood in Pakistan has also risen to Rs.120 per maund and seems to be rising beyond the reach of many city dwellers. Those who can not pay may send their children to collect free fuel if there are enough trees within a reasonable walking distance. Otherwise, they may scrounge about the town for twigs, garbage or anything else that burns, including bark from the ornamental and shade trees that line the streets.

In the past, most firewood was burned in villages. But as wood prices in the town went up, landowners naturally found an advantage in carting their available timber to the nearest town to sell instead of giving it to the rural labourers.

The scarcity of firewood has created a further problem, i.e. the people have started cutting the trees from state forests illegally for fuel wood.

The firewood scarcity has not invited much world attention because the shortage appears essentially local and seems limited in its consequences to the actual user of the wood. But the problem is spreading into larger areas, increasing its severity and exacerbating other problems. In that sense, it is like the oil crisis. In the absence of suitable alternative energy sources and increased efforts to disseminate more efficient cooking stoves, the firewood demand in developing countries will be determined largely by population growth.

The scarcity of firewood is also damaging in other ways apart from resulting in deforestation. Throughout Pakistan, one can often see pyramids of hand moulded dung patties drying in the sun. In many areas these dung cakes have been the only source of fuel for generations but as population increases and supplies of firewood decreases, farmers who once returned all or part of the available dung to the soil have been forced to use it for cooking, thus robbing farmlands of nutrients and organic matter. Hence the use of cow dung as a source of non-commercial fuel is seriously affecting agricultural productivity. Some ecologists in poor countries have been warning their governments for years about the dangers of deforestation and fuel shortages to little avail.

Fortunately, trees when properly managed are a renewable source. The immediate logical response to the firewood shortage, one that will have many incidental ecological benefits, is to plant more trees in plantations, on farms, along the roads, in shelter-belts and on unused lands throughout the rural areas of Pakistan. For many regions, fast growing varieties of trees are available. These can be culled for firewood in less than 10 years and some spring back without replanting. Although the concept is simple, its implementation is not.

There is no single magic solution to the firewood scarcity, but some blend of fuel conservation, tree planting and new technologies could certainly relax its grip on any country. The failure of many affected countries to meet the firewood challenge does not in the final analysis reflect an absence of suitable technologies but rather a failure of the political system, of social organization. Should firewood shortages continue to worsen no dramatic event like an Arab oil embargo will flash crisis signals to the world. For the world's poor, the energy "emergency" is a constant reality. A deepening firewood crisis and the environmental degradation it entails means a steady deterioration in their prospects for a better life.

As fossil fuels become more scarce and expensive the importance of wood is increasing dramatically. Trees, if better managed and utilised, could rapidly increase the energy available, and this could be done fairly inexpensively, without massive inputs of foreign exchange or technology and in many cases by using unskilled workers who are already available and are underemployed. The additional benefits in terms of environmental improvement are hard to quantify but are likely to be substantial.

Since energy for rural development has become a crucial issue firewood should become a focus of national and international priorities and policies. Isn't it pointless to worry about producing more food if there is no fuel to cook it, and foolish to invest in expensive engineering projects if continued deforestation by firewood collection will silt up the dams and irrigation canals and make mountains and roads impassable because of soil slippage?

Firewood far from becoming outmoded, has become a recognised source of energy and demand will increase enormously in the coming decades. Indeed, wood products are likely to continue as the most important universal fuel for rural areas of developing countries like Pakistan. Wood can be a 'self reliant" fuel that:

i. Requires little foreign exchange;
ii. is independent of the vagaries of international commerce;
iii. does not demand a sophisticated marketing network;
iv. is the cheapest source of energy;
v. is one of the fuels that an individual can produce;
vi. can provide export income.

Fuel wood is not limited to household use. Large energy plantations may be planed to fuel machines such as:

- electric generators;
- railroad locomotives;
- dryers for fish, tobacco, lumber grain, copra and other agricultural products;
- brick, charcoal and limestone kilns;
- ovens for smelting metals.

Fuel production has long been considered the lowest use of wood and foresters have traditionally cultivated trees primarily for other purposes such as for timber and pulpwood. For these products, the species they choose to grow are not those that would be grown purely for fuel. Firewood plantings can use species with short boles, crooked trunks or wood that wraps or splits as it dries. These features are not as detrimental to fuel wood use as to timber production.

7.2 ADDITIONAL USES/BENEFITS OF FUEL WOOD PLANTATIONS

In addition to fuel, woodlots can provide stable and pleasant surroundings. They also:

- Provide shade, shelter and beautification;
- provide habitats for wildlife which in many areas are a valued food source;
- reduce wind erosion;
- beneficially influence local temperature and humidity;
- replenish and redistribute essential soil nutrients;
- slow rainfall runoff which generally allows for greater ground water recharge
- and so helps to maintain year round stream flow;
- decrease the likelihood of floods and the build up of silt in reservoir;
- provide vegetable oils and fruits and nuts for food for humans, edible leaves and shoots for animals and forage for silkworms;
- provide green manure for fertilizing soil and tanbark for tannin used in leather marketing;
- provide medicines and pharmaceuticals and extractives such as resins, rubber gums and dyes.

7.3 WOOD FUEL CONSUMPTION OF URBAN HOUSEHOLDS IN PAKISTAN

The 'gap theory' often quoted in the past and used to justify action in the field of enhancing forest resources as well as wood energy conservation programmes, was based on the belief that many, if not all, wood fuel originated from forests. The gap between demand and supply was then used to calculate how long it would take before all the forests would disappear due to wood fuel use. However, 10-15 years of in-depth studies have shown that non-forest areas supply considerable amounts of fuel wood. In fact evidence shows that more than 80% of wood fuel is derived from non forest areas. The latter include village lands, agricultural lands, trees along roads etc.

According to the Pakistan Household Energy Strategy Study (HESS 1991), 87.4% of fuel wood used for household use was derived from the private sector, whereas 12.6% was obtained from forestland against a total consumption of 29.4 million tonnes.

In the urban areas of Pakistan, the size of a city is strongly correlated with the proportion of fuel wood users and their level of consumption. Only 28.5% of the households residing in the larger cities (population one million and above) which house about half the urban population use firewood and their consumption is 30% lower than the consumption of households living in the smaller cities. Large cities generally enjoy a better supply of modern fuels and have larger populations with higher incomes. The level of average expenditure in large cities is about 43% higher than the smaller ones. In urban areas fuel wood is generally purchased but less than 15% is accounted for by medium and low-income households with an average expenditure of Rs.2000 per month.

7.4 WOOD FUEL SOURCES AND THE POOR IN PAKISTAN

In Pakistan wood fuel is the primary source of fuel for domestic cooling. In Pakistan 80% of the total domestic fuel consumed in rural areas is made up of fuel wood, agricultural wastes and animal dung. The use of dung and agricultural wastes as fuel is widespread in agriculturally prosperous regions with fertile soils and controlled irrigation. However, wood continues to be the main domestic fuel in less endowed and poor regions. In addition to cooking, wood fuels are used for heating water in hotels and small eating-places.

7.5 WOOD ENERGY SUPPLY

Biomass of different kinds, both woody and non-woody types, derived from plants and animals is the most commonly used and the most reliable source of energy among a majority of the rural population in the developing counties. Firewood derived from the stems, branches and stumps is the commonly preferred traditional fuel among the different types of biomass that can be used for fuel. Most better-off households and those who have access to production sources prefer wood fuel for domestic uses such as cooking and space heating. Studies conducted so far indicate that the users either purchase fuel wood from the market or harvest at the source or collect fuel wood from free collection sources for their own use.The sources are mostly natural forests or trees grown in public communities or private lands. For the poor people in Pakistan, biomass residues of different kinds, mostly crop and animal residues are the main sources of energy. Of particular importance are additional supply sources such as fallen leaves, needles, twigs and branches of standing trees, leftover wood and branches after commercial harvesting of forests, crop residues of different kinds including stalks, straw, husk, grasses, animal dung, discarded waste wood from different sources, e.g. old furniture, recovered wood from old construction sites etc.

Users' preferences among various biomass fuels, including woody and non-woody types, depend largely on the economic status of the household as well as the availability of, and the accessibility to the supply sources. Given a choice, wood fuel (firewood and charcoal) seems to dominate other non-woody biomass. Wood fuel is placed higher up in the energy economy ladder than other biomass substitutes. Therefore, most households would not like to use other biomass for fuel as long as wood fuel is easily available and affordable.

Despite the fact that the share of traditional fuels in energy consumption is declining in most developing countries over the years in absolute terms, the amount of fuel wood used is not and will not be decreasing in rural areas due to population growth and lack of alternatives. Furthermore, the declining share of traditional sources in total energy consumption needs to be interpreted carefully. It is primarily due to a rapid growth in energy use associated with the import of commercial energy intensive modern technologies and partly due to improvement in living conditions of the urban population associated with the continuing uplifting of the national economy. Whatever the reason, total energy consumption is increasing and is met mostly through commercial fuels. But this process will not replace the use of traditional energy completely within the foreseeable future, as population growth, limited income opportunity, underemployment, and the non-availability of cash to purchase commercial substitutes which are typical constraints of the subsistence economy, compel the rural majority to use biomass for fuel. Thus, wood fuel will remain important even if most energy planners of today do not contemplate the long-term use of the traditional energy.

7.6 WOOD ENERGY SUPPLY SOURCES

Public forests of different kinds have traditionally been the main source of wood fuel supply. With the rapid growth in population lands under the public forests have been and still are illegally encroached or properly cleared for agriculture purposes. Many existing natural forests have been over exploited without adequate consideration of their sustained yield potential, not to mention sustainable utilization and management of the ecosystem. This common scenario of an open access management regime of public forests in the name of allowing free collection of basic needs to the people, without allowing their active participation in planning, management and benefit sharing in the past has virtually depleted the forests within accessible distance of major population centers. As a result, shortages in fuel wood supply are increasingly felt.

People are forced to create or to use alternate supply sources through reforestation/afforestation of private degraded lands. In the process of energy transformation, the economy of a country and the socio-economic status of its population both play a critical role in dictating which alternative will be the most feasible option for the short-term. No single and easy solution applicable to all situations can be found.

In localities where fuel wood is a traded item, where people are willing to pay the price by grade/quality of fuel wood, where the market price is always higher than the cost of its production, new supply sources can be developed over and above the traditional supply sources. Private sector participation in wood fuel production could then complement the supply from the government sector. The success of agro and farm forestry in private lands, and the block plantations in community/lands under different labels of social or community forestry schemes is a clear manifestation of this new possibility.

To the poor and marginal farmers, it is the non woody biomass which is becoming a more important source of fuel to overcome the problems of wood fuel supply shortages due to forest depletion and deforestation. But to others who can still afford it, wood fuel is the preferred fuel for domestic use. They can obtain it from owned forests or trees grown on private lands or trees along roads and canals. In most cases the rich people living in medium sized towns seem to be the ones paying higher prices for wood fuels in terms of money spent for household energy compared to their counterparts in big cities and large urban centres where other commercial fuels are easily available.

In contrast, most people in rural areas seem to collect wood fuel at the source, mostly for free. But where wood fuel is already scarce, they seem to be the most affected and satisfy their fuel requirements by using whatever substitutes are easily available and the quality is immaterial to them. When this is the case, it will not be easy to clearly identify the supply sources for household level wood fuel supply.

7.7 ISSUE OF SUPPLY ENHANCEMENT

To protect the fragile ecosystem and to meet the basic needs of the local people, there should be an enormous expansion in the rate of tree plantation in which the participation of local forest user groups or communities or the private sector is considered a prerequisite. To overcome the wood fuel shortages a three pronged approach is recommended:

- Demand management through the introduction of technology to increase wood fuel use efficiency e.g. improved stoves.
- Supply enhancement through improved distribution system and increased production (e.g. management of natural forests, new afforestation, private planting etc).
- Development of alternatives (e.g commercial utilisation of wood wastes for energy).

But cost considerations appear not to have been adequately addressed. Will it be economic to raise large-scale fast growing plantations purely from the point of view of wood fuel production? If feasible, under what conditions? These are the basic issues which are to be considered carefully while identifying the potential sources for wood fuel production and for a wood fuel supply enhancement strategy. All these issues could be influenced by various factors, including:

- land ownership and tree tenure;
- legislation, rules and regulations governing the movement transportation and trade of wood fuel (produced by local communities or the private sector);
- credit and support services for wood energy development and tree planting;
- marketing and market related information;
- incentives and subsidies.

7.8 STRATEGY FOR SUPPLY ENHANCEMENT

In today's competitive world, whatever cannot be sold can not be raised and whatever has the potential to attract a high price will be raised/grown/produced mostly by farmers and investors from the private sector, even if there is a risk of over supply.

As long as energy planners and policy makers favour commercial energy development, guided by a misperception about woodfuel as a 'dirty energy", commercial production of wood fuel in large scale plantations will remain underdeveloped. This is so despite the fact that wood fuel can be converted into commercial forms of "modern" energy through gasification or electricity generation.

Enhancement of supply in rural areas where wood is not a traded item yet will be more difficult if it is not integrated with other land based production systems (e.g high value tree based cash cops, fruit orchards etc.) in which wood fuel is only a by-product of the multipurpose production objectives of the particular farming system. In areas where the commercial trade of wood fuel is possible, private sector investment in wood fuel production should be promoted by clearing obstacles created by policy, legislation, institutions etc.

Where wood fuel is mostly collected for subsistence, and no prospects exist for commercialization yet, collaborative approaches in the form of social/community forestry and joint forest management should be the strategy. In this way, local participants can satisfy their basic needs while the government can ensure the protection of forests and ecosystems.

7.9 MANAGEMENT OF FUEL WOOD

Nowadays, foresters in Pakistan are receptive to new notions about the purpose and practices of forestry and they recognise the modern necessity of taking forestry outside the forests and involving people throughout the countryside in growing trees to meet their own requirements as well as to protect the land on which they and their livestock live. Firewood production is particularly appropriate to this philosophy. It is less dependent on silvicultural expertise than saw timber and therefore can be done by non professionals who learn the basic techniques for their own use. Firewood best can be produced like a farm crop without government interventions.

However, although the cultivation of firewood species does not demand continuous professional supervision, a forest service may be needed to provide seed or planting stock and advice for getting the trees established. Transferring silvicultural practices can also greatly increase yields. What is sorely needed is the greater involvement of trained forestry experts in firewood production at all levels from village woodlots to the national forests.

Trees for firewood can be planted in non forest areas such as along roadsides in shelter-belts, on farms, on unused lands, school yards etc and home gardens. These may be cultivated in small woodlots. Rural areas can probably supply their own fuel wood from small, local plantings but urban areas can best be supplied from strategically located concentrated large plantations.

Firewood plantations, if carefully managed and protected from fire, animals and poachers can be self-renewing. They are usually managed on a rotation of 5-10 years and even a rotation of less than 5 years seems feasible in many areas, especially for those species that regenerate by sprouting, i.e. by coppicing. The ability to coppice and grow rapidly from root suckers is exceptionally important in a firewood species. The stumps of coppicing plants do not die, instead dormant, adventitious buds generate new shoots. This allows repeated harvest without the cost and efforts of replanting seedlings each time. Moreover, the living shoots bind soil and a canopy of new foliage quickly develops to shield the soil surface from rain and wind and help to suppress weeds. Coppice sprouts, usually grow vigorously because they are served by roots big enough to feed the former tree.

7.10 IMPLEMENTATION

Planting firewood on a large scale demands social and political commitments. Decision-makers should encourage the farmers through funding. The neglect is likely to disrupt energy supplies and lead to some hardship in the rural areas. As the pressure for fuel wood increases it may lead to civil unrest and the development of new plantations. Research on appropriate species and management methods should be started before a crisis is reached.

What is needed is a change in the priorities in the use of trained foresters. Forests for fuel can be treated as just one more farm crop. This makes firewood production implementation a suitable activity for foresters. Agronomists may also be involved in much of the small-scale firewood production.

To be successful, fuel wood programmes should fit into the social, cultural economic, religious, political and legal framework of the local area where plantations are to be established. Without the commitment of local residents to manage and protect the fuel wood plantations they are likely to fail.

Furthermore, as a practical matter, fuel wood plantations are more likely to succeed if they are considered in the context of local land use planning and local development objectives. The integration of fuelwood production with other agricultural activities can help ensure and sustain local interest. It can also cut costs and balance the development of local communities by providing them with a sustainable energy supply.

Local communities must be motivated to assume the responsibility for the management of all vegetation including trees in their areas. To alleviate the growing shortage of wood fuel is one of mankind's major challenges. To this end, firewood research is vital, requiring the combined efforts of government, industry, landowners, villagers, researchers and development assistance agencies.

Some of the activities to be undertaken include:

i. searching out and reducing the wasteful use of available fuel;
ii. testing and developing fuel efficient stoves;
iii. instituting policies and programmes that encourage the use of alternate energy sources such as biogas and solar heat;
iv. conserving existing fuelwood sources by controlling harvesting intensity;
v. identifying available production areas such as those in existing forests, wastelands and farmlands;
vi. inventorying the tree species found locally, noting especially the species traditionally preferred for fuel;
vii. testing tree growth in all the available production areas, and
viii. giving preference to local species over exotic species.

7.11 CONCLUSION

A thorough understanding of the issue discussed above plus the elimination of misconceptions about wood energy among energy planners is a must for the comprehensive and integrated development of the energy sector, without which the energy needs of the households (both rural and urban households), rural, industrial and commercial sectors will be difficult to meet. Such an integrated strategy may also partly reduce the imbalance in foreign trade and payments due to a reduced reliance on imported commercial fuels. The other benefits of renewable wood fuel use would be to help preserve the environment and reduce gaseous emission into the atmosphere and to generate income and employment to the poor and landless.

The issue of a reliable estimation of the ratio of traditional versus commercial fuel in total energy consumption still remains. Though most of the studies show a declining share of traditional energy due to rapid expansion in commercial energy demand from the transport and industry sectors, no standard system exists yet for collection, retrieval and analysis of wood energy related data. The estimates presented so far in terms of demand/supply of wood energy at the national level are gross estimates only. In no case do these represent the true picture of any local situation either in terms of demand or in terms of supply sources because these factors vary significantly from one area to another area for a variety of reasons. Without any provision for periodic collection and updating of data, related to both supply and demand aspects of wood energy, it will be difficult, if not impossible, to show changing patterns in energy consumption and mix or to design the type of supply enhancement strategy and programme that may have to be implemented to meet the rural energy supply gap - a key element of energy sector planning.

7.12 RECOMMENDATIONS

Based on the constraints identified, the following measures seem appropriate to stimulate wood fuel development in Pakistan:

i. Supplies of wood fuels should be increased by intensive management of all accessible natural and man-made forests.
ii. Trees should be planted on open and uncultivated lands.
iii. Existing natural forests should be fully supported with adequate scientific measures and management practices.
iv. Strong political commitment should be given to forest based energy programmes and careful evaluation of energy policies.
v. Co-operation between relevant institutions involved in wood based energy development should be strengthened.
vi. Community forestry and agroforestry programmes should be intensively taken up for the production of sustained fuel wood.
vii. More attention should be given to conservation programmes to slow down forest depletion possibly through establishment of rural community and farm wood lots and the introduction of efficient combustion technology. Use of other viable energy resources should be promoted, especially for urban households.
viii. Adequate funds should be injected into wood based energy development programmes.
ix. Awareness of people regarding the need to conserve forest resources should be increased by means of the mass media.

A wide range of plants should be promoted, especially:

- multipurpose plants that have uses in addition to providing fuel
- plants that adapt well to different sites, establish easily and require little care
- plants not consumed by goats and wildlife
- plants having nitrogen fixing ability
- plants having rapid growth rate
- plants having the ability to coppice
- plants having the ability to produce wood of high calorific value that burns without spark or toxic smoke
- plants having the ability to grow successfully in a wide range of environments including different altitudes, soil types, rainfall regimes, amounts of sunlight and terrain.

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8. FUELWOOD DISTRIBUTION SYSTEM IN SINDH

by

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8.1 INTRODUCTION

Although natural gas has been provided to major cities and towns of the province and a small percentage of the population uses other fuels for their domestic purposes, fuelwood is still the prime source of energy for cooking and heating in rural Sindh. Fuelwood is mainly produced in the canal irrigated central plain of the province and after meeting the local demand the remainder is supplied to the province of Baluchistan. In spite of the increase in the production and consumption of the fuelwood on account of the increasing population, the distribution system has remained the same. This paper describes the fuelwood distribution system, the problems associated with it and recommends suggestions for improvement.

8.2 CLIMATE, GEOGRAPHY AND LAND USE SYSTEM

The climate of the region is sub-tropical where erratic rainfall of 125 to 250 mm is mostly received in the months of June to September. Temperatures fall to 7^0C in winter and rise to 45^oC in the summer season. The total land area of the province is 14.09 million ha. Geographically, the province of Sind is divided into three distinct regions: the central alluvial plain bisected by the Indus River (8.5 million ha); Thar/Nara desert in the east (3.4 million ha), and the Kohistan hilly tract in the west (2.2 million ha). Agriculture and forestry are the main land uses of the central plain and grazing is the main land use in the other two regions. The present population of the province is estimated to be more than 30 million, of which about 43% resides in the urban areas. Since the central plain is the grain bowl of the province, the majority of the population resides in this region.

8.3 FUELS USED FOR DOMESTIC PURPOSES

Natural gas is supplied to 94 major cities/towns and 345 villages of the province. Liquefied gas, kerosene oil, electricity, and agricultural wastes are also used by some people for cooking and heating. However, fuel wood is still a major source of domestic energy for the remaining 68,000 villages and poor city dwellers.

8.4 FUELWOOD PRODUCTION AREAS

State lands

Due to the arid climate there is no natural forest in the province except for some mangroves along the coastline, which are seldom cut for any use. Fuelwood is mainly produced in the government controlled riverine forests situated all along the banks of the Indus River, irrigated plantations, canal/road side tree strips, and wastelands in the central alluvial plain. Acacia nilotica, prosopis cineraria, Eucalyptus camaldulensis, Azadrirachta indica, Albizzia lebbek, etc. are planted and prosopis juliflora, prosopis glandulosa, Tamarix aphyla, Tamarix dioca are naturally grown in the state lands. The sparse population living in the rangelands of Thar, Nara, and Kohistan meet their demand locally. In these regions, the main species naturally grown and used for fuelwood are *Acacia senegal, Acacia nilotica, prosopis cineraria, Acacia jacqumontii, Calligonum polygonoides, Capparis aphyla, Ziziphus numularia, Salvadora oleoides, and Tecoma undulata*. Government controlled riverine forests and irrigated plantations with dense to sparse tree cover of 46% and 61% respectively produce 10% of the total fuelwood requirement of the province.

Forests and rangelands occupy 8% of the total land area in the province. Their distribution is shown in Table 1.

Table 1: Distribution of Forests in Sindh

Type	Area (million ha)	% of total land area
Productive Forests		
Riverine	0.241	1.72
Irrigated	0.082	0.58
Total	0.323	2.30
Protective Forest		
Mangroves	0.345	2.45
Rangelands	0.458	3.25
Total	0.803	5.70
Grand Total	1.126	8.00

Private lands

Private farmlands are the major source of fuelwood production in the province. They are mainly located in the central alluvial plain and are irrigated from the Indus River canal network. Trees are planted or naturally grown in different forms and configurations such as scattered individual trees, trees along boundaries and water channels, windbreaks and shelterbelts, and block plantations. It is estimated that 32 million trees are growing on private farmlands with an average density of 8.7 trees/ha (Pakistan Forestry Sector Master Plan, 1991). The main tree species planted are Acacia nilotica, prosopis cineraria, Eucalyptus camaldulensis, and Azadirachta indica and naturally grown wood species in uncultivated lands such as Prosopis juliflora, Prosopis glandulosa, and Tamarix aphyla are protected for fuelwood production. Acacia and Prosopis species are the preferred fuelwood species due to their high caloric value and odorless smoke.

8.5 FUELWOOD DISTRIBUTION

According to the 1991-92 Household Energy Strategy Study (HESS), 40% of fuelwood is purchased in the cities/towns and the remainder is collected in the villages. With the increase in population, the fuelwood consumption is increasing at the rate of 2% per annum. In spite of this increase in fuelwood production and consumption the distribution system has not changed substantially. The present system of fuelwood distribution system in rural and urban areas is described in the following sections.

Villages

In rural areas, fuelwood is generally collected from the forests and wastelands by the consumers themselves or through wood collectors. In places where wastelands and state forests are not in the vicinity wood is collected from the farm trees or agriculture waste is used for cooking and heating. In these places the distance is generally short and fuelwood is collected by women and children. In the case of longer distances, donkeys and camels and bullock - and donkey - carts are used. Currently, tractor trolleys are commonly used for this purpose.

Towns

Fuelwood is transported in towns by pick-ups, and donkey/camel carts. This wood is either collected by wood collectors directly from nearby forests, farmlands, and wastelands or purchased from farmers and contractors and sold to the retailers, who sell it to the end users.

Cities

Fuelwood is brought to the cities by trucks, pick-ups, and some times by bullock carts and men generally do this work. These middlemen purchase the individual trees and wood lots from forests and private lands and sell to the retailers through commission agents. In this case, three middlemen, viz. a contractor/purchaser, commission agent, and a retailer are involved before the fuelwood reaches the end user. Due to cutting, conversion and transportation charges, highway tolls/taxes, profit of the purchaser, commission of the agent, and profit of toll owner, the end user pays about five times more than the grower gets from the contractor.

It is estimated that 16,000 truck loads (0.192 million tonnes) of fuelwood of various species are supplied annually to Karachi, in spite of the fact that since 1954, gas has been provided to more than 90,000 houses in the metropolis. Since 43% of the population lives in the cities, the same proportion of fuelwood consumption is estimated for the rest of the towns and cities in the province.

Distribution from forest sites to the user

Forest wood lots are sold through open auction on a stumpage basis. The highest bidder converts the wood on the site in such a way that he extracts maximum timber and pit props from it. Only left-over wood is sorted out and sold as firewood. Most of the timber goes to the sawmills where waste wood is sent to the market and used as fuelwood. In this case either the sawmill owner markets himself or a second purchaser comes in and sells this fuelwood through a commission agent or directly to the retailers.

Distribution from farmlands to the user

Unlike forests, trees or woodlots on farmlands are not sold through open auction, but individual purchasers approach the farm owners to purchase the standing trees. Once a settlement is made the rest of the distribution procedure is almost the same.

Fuelwood and its conversion

Generally, round billets 0.6-1 m long and less than 10 cm in diameter are directly used as fuelwood. The wood above this size is generally cut longitudinally for household use. The stumps of the trees, leftover ends of sawn timber, uneconomic timber, etc. are sawn and converted into small pieces locally known as "gutkas". This form of fuelwood is mainly used for BBQ and tandoor-bread baking. It is also marketed to Baluchistan where tandoor bread is preferred. It is estimated that 1,000 truck loads (12,000 tonnes of fuelwood) is annually exported to Quetta from Sindh province. The roots, stumps and small wood is also converted into charcoal by local people and sold through the same methods.

8.6 PROBLEMS

In the marketing of the wood, the grower hardly gets 1/4th of the cost paid by the end user due to the involvement of 2-3 middle men, transportation cost, toll taxes, and other expenses. Due to the increase in population, the fuelwood demand is constantly increasing. Moreover, additional marginal lands are being brought under agriculture and existing fertile lands are losing their productive potential because of waterlogging and salinity. Transportation cost of fuelwood has also increased due to the devaluation of Pakistan's currency, and the increased cost of machinery, petroleum, oil, lubricant and labour.

8.7 RECOMMENDATIONS

i. Involvement of middlemen in fuelwood distribution system should be reduced.
ii. Fuelwood should be relieved of land revenue, toll and municipal taxes.
iii. To make fuelwood cost-effective, felling, conversion and transportation should be mechanized.
iv. Planting of trees on degraded lands should be encouraged so that as well as rejuvenating such lands fuelwood is also produced.

9. NGOS AND FUELWOOD PRODUCTION DEVELOPMENT PROJECTS

by

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9.1 INTRODUCTION

Charitable self-help groups, small and large, inspired by religious faith, or humanitarian concern, have been in existence for a long time in the Indo-Pak subcontinent. Housing societies, cooperatives and other kinds of membership organizations have also been proliferating. The last few years have seen a rapid increase in the number of NGOs. They are distinguishable by the factors that led to their genesis, their objectives, organisational cultures, and linkages with civil society. Most importantly, their relationship with the process of democratisation and socio-economic transformation is prominent. However, Non-Government Development Organisations (NGDOs) involved in development and advocacy activities are a more recent phenomenon. Their genesis in Pakistan can be traced to the latter half of the 1980s. In fact it was widening socio-economic disparities, the inability of the state to meet the basic needs of the people, the breakdown of institutions responsible for service delivery and the protection of basic human rights that combined together to lead many people to form groups or associations to protect the interests of vulnerable sections of society.

Definition

The World Bank defines NGOs as "private organisations that pursue activities to relieve suffering, promote the interests of the poor, protect the environment, provide basic social services, or undertake community development". In wider usage, the term NGO is applied to any nonprofit organisation that is independent from the government. NGOs are typically value-based organisations.

NGOs are beginning to play an increasingly important role in the socio-economic development of Pakistan. Thus, the operational collaboration with NGOs has become an important feature in the implementation of many development projects, particularly projects for rural development, poverty alleviation, social forestry, natural resource management and environmental rehabilitation. Growing collaboration with NGOs can be attributed to the expanding role and influence of the NGO sector generally and due to the specific benefits that NGO involvement can bring to the community. This also holds true for fuelwood production projects.

In the recent past a number of wood fuel production projects of varying scales were implemented and have included some form of NGO involvement. But in quite a few cases, the role played by NGOs was quite minor and frequently limited to project implementation. Achieving the full potential benefits of NGO collaboration implies enhanced roles for NGOs at the earlier stages of the project cycle.

There are two main categories of NGOs:

i) Development NGOs - whose primary purpose is the design and implementation of development related projects, (also called operational NGOs) and,
ii) Advocacy NGOs - whose primary purpose is to defend or promote a specific cause and who seeks to influence the policies and practices of the government.

Operational NGOs are classified into three main groups:

i) Community based organisations (CBOs) - which serve a specific population in a narrow geographic area;
ii) national organisations - which operate in individual developing countries; and
iii) international organisations - which are typically headquartered in developed countries and carry out operations in more than one developing country.

There may also be some NGOs doing both development and advocacy work. NGOs are normally contracted to deliver services, design projects or conduct research. CBOs are more likely to be the recipients of goods and services. In projects that promote participatory development grassroots organisations CBOs play the key function of providing an institutional framework for beneficiaries participation.

Hundreds of development NGOs are involved in social forestry, although, the extent of their activities is not well known. NGOs are involved in many aspects of social forestry, such as developing agro-forestry systems, organising villagers to participate in programmes, educating influential local people about the importance of helping rural populations to protect forest resources, and introducing improved technologies.

The social forestry activities of development NGOs cover a broad spectrum. For example, the CHIPKO movement in Utter Pradesh, India, has been very successful in promoting the preservation of natural forests and improving their management; the development arm of the council of Evangelical Churches in Haiti is instrumental in promoting tree growing by local farmers and is helping to market wood at a fair price. CARE is working with government agencies and local development NGOs in many countries to promote wood fuel production programmes. Save the Children is another programme working in many countries to promote tree growing in the private sector, and the United States Peace Corps has expanded its social forestry programmes in recent years.

9.2 STATUS OF FUELWOOD IN PAKISTAN

Present estimates for the total area of forests and rangelands under the control of forest departments is 10.7 million hectares. Of this, over half (6.45 million hectares) are rangelands. Of the 4.26 million hectares of forests, 1.12 million ha (26.4%) are classed as 'productive' and 3.14 million hectares (73.6%) classed as 'protection forests' that are generally poorly stocked. In addition, it has been estimated that there are another 1.6 million hectares of private or communally owned forest areas giving a grand total of approximately 5.9 million hectares of private and state forests.

The main role of fuelwood is to meet energy requirements of households for cooking and heating. Only a small quantity of wood is used in industry mainly in brick kilns and tobacco curing. The dependence of households on wood is paramount especially in rural areas. The housing census of 1980 revealed that 70% of all households used wood as the principal fuel for domestic cooking. In rural areas the proportion was as high as 79% and in the urban areas it was 48%.

Forests and trees are not only a valuable or renewable resource but are also a vital natural resource for a county like Pakistan. Therefore, it is essential that the decline should be reversed. Trees are necessary not only for timber and fuel wood but also for maintaining micro-climates and soil stability for agricultural purposes, for protecting ground water supplies and streams and for a myriad of environmental and other reasons.

The national wood resource must be preserved by ensuring that the cutting and extraction of wood does not exceed the resource's ability to renew itself by regeneration and growth increment. Thus, extractions should not exceed the resource's sustainable level of production or supply.

Now there is little information available concerning the exact standing wood volume of Pakistan, or its sustainable production or supply potential. The production data presently available refers to what has been harvested from the forests rather than the increment or sustainable production levels. However, the available estimates of present annual national fuel wood consumption and sustainable supply are 31.45 million m^3 and 11.90 million m^3 respectively. This shows a shortfall of 19.55 million m^3 per annum in the sustainable supply. To meet the required demand, government forests supply about 17% of the timber volume and an estimated 10% of fuelwood. Thus, private farms and other sources are supplying 50% of the timber and 90% of the fuel wood demand. And 33% of the timber volume is imported.

The annual shortfall of 19.55 million m^3 in sustainable fuelwood supply is equivalent to the production of an extra one million hectares of fast growing tree species grown on good sites, or approximately 2500 million additional fast growing trees scattered throughout the country. This shortfall of 19.55 million m^3 in the sustainable yield or supply in relation to actual fuelwood consumption is filled by over-cutting. The practice has existed for decades and has resulted in the reduction of Pakistan's forest cover. According to the National Commission on Agriculture (1988), the existing forest cover is less than one fifth of what it should be. Only 30% of existing forests are economically productive, and the "situation" is generally "dismal". Thus according to Sheikh (1972), "The only way out is to propagate the idea of raising trees on farm lands".

9.3 ESSENTIALS FOR PLANNING AND IMPLEMENTING FUELWOOD PRODUCTION PROGRAMMES IN THE PRIVATE SECTOR

The following are essential to carry out fuelwood production programmmes successfully:

- knowledge of local communities;
- credibility/relationship of trust with local people;
- flexible operations;
- autonomy;
- effective extension;
- linkages with other organisations;
- effective technical assistance and access to up-to -date knowledge and experience;
- networking; and
- efficient use of fuel wood.

9.4 STRENGTHS OF DEVELOPMENT NGOS

Knowledge of local communities

Development NGOs have acquired detailed knowledge of local organisations, economic structures, local funding systems, indigenous practices, social norms and political forces that are essential to launch successful fuelwood production programmes. NGOs can help to identify local needs and preferences for wood products and species. They can locate local seed sources and sites for trials, demonstrations, potential planting and nursery sites and they can identify local people who could manage them. A development NGO with local ties might also be in a position to know about and help resolve tenure problems which are a hindrance in the introduction of trees.

Relationship of trust with local people

Many development NGOs have established relations of trust with local people and can work with people who are wary of public functionaries such as the Forest Department. This kind of relationship is a prerequisite for gaining local support for fuelwood production activities. A development NGO can act as an intermediary between the community and the government and can act to bring their interests together to achieve practical solutions to fuelwood production problems.

Flexible operations

Development NGOs generally enjoy a great deal of flexibility, because they do not have the heavy administrative overlay of many development bureaucracies, are free to act quickly, to experiment and to change the directions of projects in mid-course as opportunities arise.

Autonomy

An important factor in the success of development NGOs is the degree of autonomy they have over their activities. By having a degree of autonomy, development NGOs substitute the service of overburdened government agencies and explore new approaches to solving problems that government agencies, by their very nature, cannot deal with.

Extension experience

One of the major limiting factors in social forestry is the lack of effective technical assistance or extension capacity. Development NGOs can help fill this gap. Many have long-term experience in agricultural extension with small farmers. They often have resources to train their personnel in agro-forestry systems and the flexibility to experiment with new systems through demonstrations and pilot programs.

Co-ordination

Fuelwood production programmes cannot produce the desired results while working in isolation. The development NGOs have the experience to co-ordinate and develop linkages with other organizations working in the project areas. This helps in pooling resources and avoids contradictory messages to the communities. The development of linkages and co-ordinated efforts can help to bridge the gaps and avoid the conflicts that can at times arise with sister organisations.

Networking

NGOs working in social forestry can receive technical assistance through a number of channels, especially at the junior technical level, which is sometimes not easy to obtain through domestic bilateral and international assistance programmes. For example, the International Technology Development Group (ITDG), Voluntary Service Overseas (VSO), and US Peace Corps can provide assistance to development NGOs. In addition, links amongst development NGOs can be strengthened through regional workshops.

Efficient Use of Fuelwood

The use of wood is no less important an issue than its production. It, however, involves technical and socio-economic problems that many forestry agencies are ill-equipped to handle. Development NGOs have been involved in the design, production, and dissemination of technologies like efficient wood-stoves. These NGOs have been useful in linking technical design to the qualities that consumers value in stoves as in the fuel efficient cooking technologies (FECT) programme in Pakistan.

9.5 DEVELOPMENT NGOS' EXPERIENCE IN PAKISTAN

In Pakistan most projects aiming to promote fuelwood plantations have been launched successfully with the active participation of NGOs and grassroot organisations. Examples of these include:

- Agha Khan Rural Support Programme(AKRSP);
- Malakand Social Forestry Programme;
- Kalam Integrated Development Project(KIDP);
- Mansehra Village Support Programme(MVSP);
- Sarhad Rural Support Corporation(SRSC);
- Joint Forest Management(JFM) in NWFP;
- Forestry Planning & Development Project, Pakistan(FPDP);
- Second Barani Area Development Project, ABAD Rawalpindi;
- Korangi Eco-System Project, Karachi of IUCN;
- National Rural Support Programme (NRSP);

9.6 ENVIRONMENTAL REHABILITATION IN NWFP AND PUNJAB (ERNP)

Various projects are being funded by the Commission of European Communities (E.C.). They aims at halting and reversing the ongoing process of environmental degradation in the three upland regions of Pakistan (two in NWFP and one in Punjab) through integrated measures of rehabilitation/conservation of natural resources and sustainable socio-economic development. The fundamental approach is the full involvement of the local population in the management of resources on which they depend. The projects started in January 1997 and are 7 years duration. The projects are described in the following sections.

9.6.1 Upland Rehabilitation & Development Project-Murree, Kahuta And Kotli Sattian Tehsil (Punjab)

This project is based on a community participatory approach, being executed by the Murree Kahuta Development Authority (MKDA) which aims to design and implement a sustainable programme of natural resource management and socio-economic development. The immediate objectives are to:

- improve range and forest management;
- increase agricultural commodity production;
- improve the capacity of government and NGOs to support rural development and natural resource management; and
- establish self-sustained village organizations for the common benefit.

To achieve these objectives, the implementation arrangements include an international NGO (IUCN) to seek involvement of local communities. The project envisages planting an area of 16,500 ha with fast growing species on private, communal and state lands to resolve the fuel wood problem of the people of the project area.

9.6.2 Natural Resource Conservation In Galiat (NWFP)

Being part of environmental rehabilitation activities in NWFP and Punjab, the project is being executed by the Forestry Department of NWFP. It aims at interrupting and eventually reversing the process of degradation of natural resources in the Galiat area of Abbottabad District. The goal of the project is to conserve and increase forests for enhancing the supply of timber, fuel, fodder, watershed values and other forest products on a sustainable basis. The project is based on the involvement of local communities through a participatory approach.

To achieve these goals, the project aims to plant fast growing species over an area of 7,000 hectares to meet the timber, fuelwood and fodder demands of the local inhabitants. The IUCN-Pakistan has been involved in the community organisation process to ensure the successful implementation of the project.

9.6.3 Dir-Kohistan Upland Rehabilitation and Development Project (NWFP)

This project is also the part of the environmental rehabilitation activities in NWFP and Punjab and is spread over the Upper Dir District. The project approach is participatory, seeking to actively involve local people as far as possible in the rehabilitation of degraded natural resources through afforestation, range improvement and agricultural commodity production. For fuelwood, fodder and timber production, the activities will be carried out over an area of 7,500 ha.

To achieve the project goals, an International NGO (IUCN) has been engaged to organize and mobilize the local population to ensure their full involvement in the programme.

9.7 RECOMMENDATIONS

In view of the critical importance of widespread local participation in social forestry, it is recommended that development NGOs be involved in all future social forestry projects to achieve successful results.

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10. PRODUCTION, UTILIZATION AND DISTRIBUTION OF FUELWOOD IN THE DESERTS OF PUNJAB

by

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10.1 INTRODUCTION

Energy for cooking food is as essential as food itself for the survival of mankind (Singh 1978). In Pakistan fuelwood constitutes the main source of energy. According to estimates, fuelwood alone constitutes 54 percent of the total energy requirements of the rural households in Pakistan while the remainder is met by animal dung (16 %), bagasse (16 %), cotton sticks (6 %) and other miscellaneous sources (8 %) (IUCN 1993).

Over the last 50 years, the national forest area has not increased beyond 5.2 percent of the total landmass. The state forests are providing only 10 percent (about 2.28 million m3) of the national total production of fuelwood while 90 percent (about 20.54 million m3) is met from farmlands (Pakistan Forest Institute, 1992). The country's forests are thus mercilessly hacked to meet the insatiable demand for fuel.

The burning of animal dung is another disastrous result of the fuelwood shortage in rural areas. As mentioned earlier, about 16 percent of rural household energy requirements are met by animal dung. According to estimates, domestic livestock produce 315 million tonnes of fresh dung (with 78.1 % moisture content) and 69.1 million tonnes of dry animal dung annually. It contains 1.44, 1.10 and 0.34 million tonnes of N, P and K, respectively (Sandhu 1988). The practice of using animal dung as fuel results in the loss of most of the valuable plant nutrients and organic matter contained in it. It is claimed that if animal dung being burnt as fuel is spared and applied to agricultural fields, the resultant increase in grain production will be sufficient to meet the national food deficit and the cost of crop production will also drop due to reduction in the use of chemical fertilizers. The supply of sufficient fuelwood can thus help to solve food problems and the energy crisis.

Desert areas pose special problems with regard to the production of plant biomass. Due to low precipitation, relatively poor soil fertility, uncontrolled grazing and unchecked removal of woody vegetation, the plant cover is always sparse in these areas. Desert dwellers rely heavily on natural vegetation for the survival of both animal and human life. This paper will discuss the issues of fuelwood distribution, utilization and production in desert areas of the Punjab province. The paper will also highlight the ways and means by which the fuelwood shortage can be overcome through the wise use of the limited water resources available.

The Deserts of Punjab

The arid areas of Punjab comprise 11.9 million hectares (57.8 % of the total area of 20.6 million ha of the province) (Bokhari, A. S., 1991). These arid areas include two major sandy deserts viz., the Thal and the Cholistan (Figure 1). Both of these sandy deserts have almost equal area, similar vegetation and socio-economic conditions. The Thal desert has been converted to irrigated areas except for a few pockets. The lifestyle of the people occupying these deserts is predominantly nomadic pastoralism with subsistence farming. The climate of these deserts is harsh with pronounced droughts, low rainfall and extreme summer temperatures (Figure 2). The annual rainfall seldom exceeds 250 mm. Whatever rain is received is highly erratic, variable and uncertain both temporally and spatially. Droughts are more common and take a heavy toll on livestock in terms of mortality. Major economic activities in sandy deserts include livestock rearing with subsistence dryland farming. The nomads of these areas keep on moving in search of water and forage (Akbar et al, 1996).

Figure 1: Map showing the deserts of the Punjab Province (Pakistan)

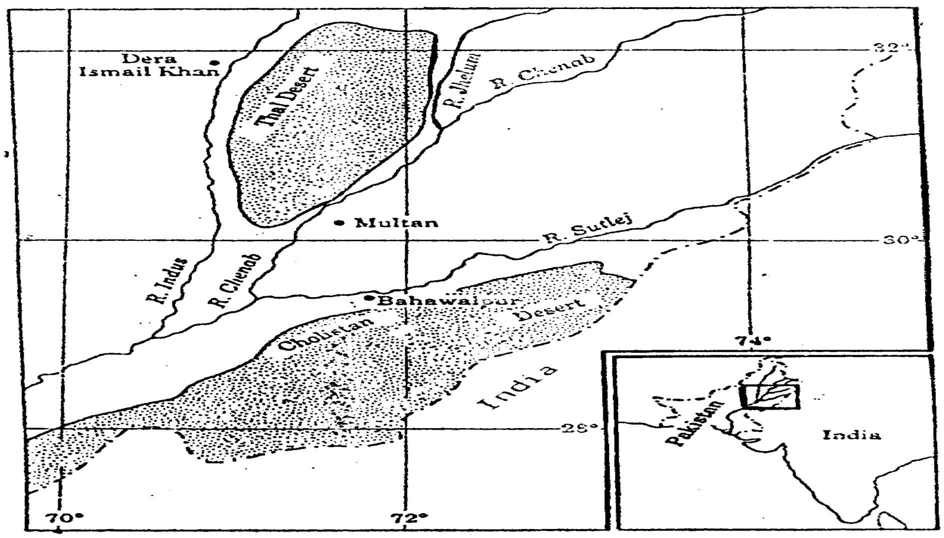
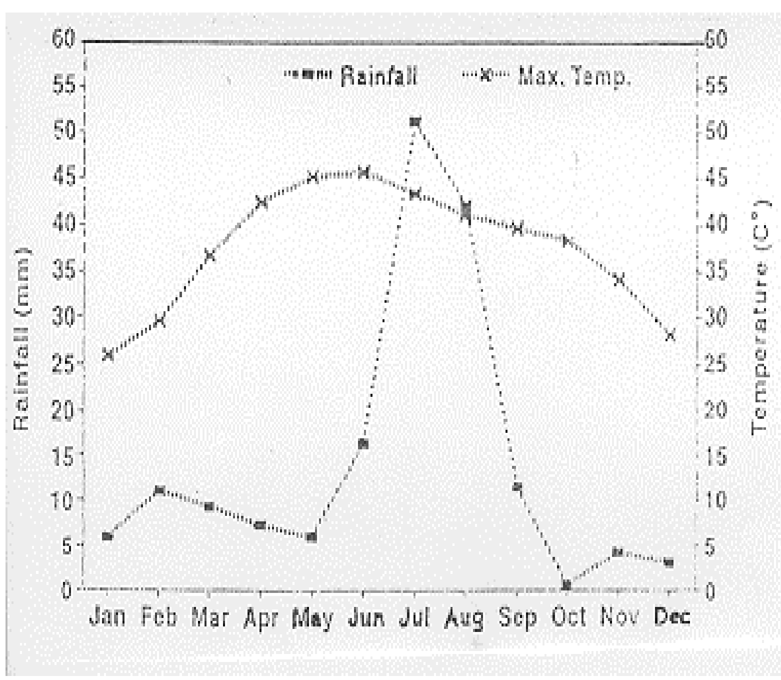


Figure 2: Ombrothermic diagram for the Cholistan Desert



(a) The Thal Tract

The Thal desert is situated between 30^o and 33^o north latitudes and 71^o and 72^o east longitudes extending over an area of 2.6 Mha out of which nearly one Mha sand dunes have been converted to productive croplands. The desert is bounded by the piedmont of the salt range in the north, the Indus river flood plains to the west and the Jhelum and Chenab river flood plains to the east (Dasti and Angrew, 1994; Khan, 1971; Mohammad et al, 1985). About 50 percent of the entire tract is covered with sand dunes while the rest of the area comprises abandoned channels with flood plains having silty clay loam soils. The pH of the entire tract ranges from 8.3 to 9. The mean maximum and minimum temperatures in the tract are in the order of 44^{o}C and 0^{o}C, respectively with occasional frost in the winter. Annual rainfall varies from 133 mm to 300 mm, the bulk of which is received during the monsoon season. Sub-soil water is generally sweet and found at the depth of 15 to 18m (Baluch, 1983). The sandy soils peculiar to the tract are subjected to severe wind erosion. The Thal tract supports populations of 2.5 and 3.92 million humans and livestocks, respectively (Joyia and Noor, 1994). The natural vegetation of the area consists of Acacia jacquemontii, Acacia nilotica, Euphorbia cauducifolia, Leptadenia pyrotechnica, Haloxylon recurvum, Haloxylon salicornicum, Kochia indica, Prosopis cineraria, Rhazya stricta, Salvadora oleoides, Salsola foetida, Salsola fruiticosa, Tamarix aphylla, Zizyphus mauritiana and Z. nummularia among trees and shrubs.

(b) Cholistan Desert

The Cholistan desert, an extension of the Great Indian Desert, is located between latitudes 27^o 42' and 29^0 45' north and longitudes 69^o 52' and 75^o 24' east (Baig et al. 1980). This desert comprises an area of about 2.6 million hectares (FAO 1993; Akbar et al, 1996; Khan, 1987). In spite of its low productivity, this desert sustains relatively high human and livestock populations (0.10 million and 2.0 million, respectively). Based on the topography, parent material, soil and vegetation the whole Cholistan Desert can be divided into two geomorphic regions. The northern region or Lesser Cholistan borders canal irrigated areas and covers about 7770 km2 and the southern region or Greater Cholistan Desert comprises 18,130 km2 (Baig et al, 1980; Khan, 1987). The Lesser Cholistan Desert consists of saline alluvial flats (locally called `dahars') alternating with low sandy ridges. The clayey flats of Lesser Cholistan Desert are generally homogenous to a depth ranging from 30 to 90 cm. These soils are classified either as saline or saline-sodic, with pH ranging from 8.2 to 8.4 and from 8.8 to 9.6, respectively. The Greater Cholistan Desert is a wind swept sandy desert and is comprised of river terraces, large sand dunes, ridges and depressions (Baig et al, 1980; Khan, 1987).

The Cholistan is a hot arid sandy desert. The mean annual rainfall varies from less than 100 mm in the west to 200 mm in the east. Monsoon rains occur mostly in heavy showers. Mean minimum and maximum temperatures are 20^{o}C and 40^{o}C, respectively. The mean summer temperature (May-June) is 34^{o}C with highs reaching nearly 50^{o}C. Aridity is the most striking feature of the Cholistan with wet and dry years occurring in clusters. The dunes reach an average height of about 100m.

There are no permanent, natural bodies of surface water in the Cholistan Desert. Factors like low rainfall, high rate of water infiltration into the sands, and a high evaporation rate prevent the natural accumulation of surface water (FAO 1993). Fresh (rain) water is collected in locally made water ponds called tobas. Underground water is at a depth of 30-40m which, with a few exceptions, is brackish containing salts 9000-24000 ppm (Baig et el, 1980).

The vegetation in the Cholistan Desert is typical of arid regions and consists of xerophytic species which are adapted to extreme seasonal temperatures, moisture fluctuations and a wide variety of edaphic conditions. Compared to the hyper arid southern region vegetation cover is comparatively better in the eastern Cholistan Desert (200mm rainfall zone). Here plant species, though slow growing, respond very well to the favorable climatic conditions and provide ample biomass. Important tree species include Prosopis cineraria, Zizyphus mauritiana, Acacia jacquemontii, Acacia nilotica, Salvadora oleoides, and Tamarix aphylla. Among shrubs Calligonum polygonoides, Haloxylon recurvum, Haloxylon salicornicum, Leptadenia pyrotechnica, Capparis decidua and Salsola baryosma are included (Akbar et al, 1996).

10.2 DISTRIBUTION AND UTILIZATION OF FUELWOOD

There are no reliable statistics on the amount of fuelwood produced from the natural vegetation of desert areas. In the Cholistan Desert each tree and shrub species is preferred for a specific use by the desert folks. For instance, the most preferred species for fuelwood are Haloxylon salicornicum (Lana) and Sasola baryosma (Lani). These species are mostly preferred by the women because the fuelwood of these species burns instantaneously and produces little smoke. These species are then followed by Calligonum polygonoides (Phog). Tree species like Acacia nilotica (Kikar), Acacia jacquemontii (Banwali), Prosopis cineraria (Jand), Tamarix aphylla are generally used for fodder, timber and small agricultural implements. The species like Capparis decidua (Karir) are also used for its fruit and small implements. Crotolaria burhia (Chag) and Leptadenia pyrotechnica (Khip), along with some grasses, are frequently used for making thatched housing locally called Gopas (Table 1).

Table 1: Characteristics of Prominent Trees and Shrubs of the Sandy Deserts of the Punjab

Species	Description	Utilization	Distribution in Deserts of Punjab
Acacia jacquemontii (Banwali)	A spiny bush or shrub, 1.5 – 2.5 m height	Firewood, sand binder, fodder, tanning	Cholistan
Acacia nilotica (Kikar)	Almost evergreen tree, 6-10 m height	Timber, firewood (4950 kcal/kg) tanning, fodder gum	Cholistan & Thai
Calligonum polygonoides (Phog)	A slow growing branchy shrub, 1-2 height; few or no leaves	Fuelwood, hut making, soil binding, fodder (leaf crude protein 10-15$)	Cholistan & Thai
Capparis decidua (Karir)	Densely branching shrub or small tree	Timber for small implements, fuelwood, medicinal	Cholistan & Thai
Haloxylon salicornicum (Lana)	Low, erect, almost leafless shrub	Halophyte, fuelwood	Cholistan
Leptadenia pyrotechnica (Khip)	Much branched often leafless, 1-2 m height	Fodder, thatching, soil binder, fibre used in ropes	Cholistan
Prosopis cineraria (Jand)	Almost evergreen tree, 8-10 m height	Timber, firewood (5003 kcal/kg) tanning, fodder (10-15)	Cholistan & Thai
Sasola baryosma (Lani)	Excessively branched shrub, 0.9-1.2 height	Halophyte, fuelwood	Cholistan
Salvadora oleoides (Pilu)	A small tree, 8-10 m height, evergreen	Timber, fruit, fodder (leaf crude protein 13.6%) medicinal value	Mostly in Thai but found in Cholistan also
Tamarix aphylla (Frash)	An evergreen tree, up to 15 m height	Halophyte, fuelwood (4835 kcal/kg) timber, basket making and mats	Cholistan & Thai
Zizyphus mauritiana (Ber)	Medium sized, evergreen tree	Timber, Fuelwood (4878 kcal/kg) charcoal, fodder (C.P. 13-17%), medicinal, fruit (protein 0.8%)	Cholistan & Thai

A similar pattern is observed in the Thal desert. The only difference is that in the Thal, especially in areas adjoining irrigated belts, Acacia nilotica wood is commercially used for making charcoal. Charcoal kilns are a common scene along road sides in irrigated belts of the entire Thal tract.

In both the deserts people normally do not sell fuelwood; rather it is mainly used for domestic purposes. Animal dung is frequently used along with local shrubs to meet the household energy requirements. In the Cholistan Desert, each desert pastoralist family owns a piece of land measuring 12.5 acres in newly converted irrigated areas. On irrigated farms, species like Acacia nilotica, Dalbergia sissoo and Tamarix aphylla are grown frequently either around homesteads or along farm boundaries. These trees are generally sold to the wood cutters of surrounding towns at a lump sum rate. Wood cutters in turn fell these trees and convert into timber and firewood. Farm plantations serve as a source of reserve capital for the farmers. Fresh fuelwood in surrounding towns is sold at the rate of Rs.35/- per 40 kgs. While the dry wood is sold at the rate of Rs. 65/- to 70/- per 40 kgs.

Desert areas face great pressures on their already depleted natural vegetation. An increasing livestock population accompanied by the cutting of vegetation by desert pastoralists to meet their domestic requirements for construction of thatched houses and fuelwood has seriously deteriorated the plant cover (FAO 1993). This situation has resulted in the extinction of some of the valuable plant species of these regions. There is also a great tendency in desert areas to increase the livestock population since it is the only means of livelihood of pastoralists. This increase in the livestock population is at the expense of the fragile ecosystem. Erratic, uncertain and unpredictable rainfall, low humidity and extremes in diurnal temperatures are compounded by increasing livestock numbers and the consequent decrease in vegetation cover triggers the process of desertification.

Trees, shrubs and even roots of the plants are indiscriminately cut for fuel, feed, fencing and the construction of gopas. Moreover, a variety of desert plants serve as valuable source of food, medicine and for other domestic uses by the desert inhabitants. The over-exploitation of the natural vegetation to meet these requirements is adversely affecting the natural process of regeneration of these species thus severely crippling the life pattern and reversing the natural successional trends, ultimately degrading the environment.

10.3 MEASURES TO ENHANCE FUELWOOD PRODUCTION

The natural vegetation of sandy deserts is slow growing and yet vulnerable to severe destruction brought about by man and his beasts. A desert that loses its natural vegetation becomes extremely hostile to its inhabitants, whether human or animal. Due to extreme and inhospitable climatic and edaphic conditions, its ecosystem once disturbed, responds very slowly to human interventions. Under this scenario, it is our obligation to maintain a healthy ecosystem in the desert areas and to try to keep the vegetation cover in balance with the needs of the people and their livestock. Moreover, a healthy ecosystem must guarantee the survival of its precious wild fauna that is affected most seriously once the conditions become more unhealthy. To meet the ever increasing demand of fuelwood in such areas, the following measures are required.

I. Efficient use of water

The importance of water to sustain life in desert areas cannot be over-emphasized. Successful establishment of trees and shrubs depends entirely on the availability of soil moisture, particularly in the initial years of their establishment. The Arid Zone Research Institute, Bahawalpur, through its years of research efforts and comparing various methods of consumptive use of water has come up with various techniques to establish trees and shrubs in the Cholistan Desert.

Six watering techniques were studied to establish Jojoba (Simmondsia chinensis) in the Cholistan Desert. These included pitcher irrigation, PVC pipe irrigation, traditional pits, furrows, drip irrigation and laundry bags (Figure 3). Among these, the plastic laundry bag technique has been found most reliable, ecologically viable, economically effective and easy to use. The details of these techniques can be obtained from the institute (Arid Zone Research Institute,1997).

II. Introduction of suitable tree/shrub species

There are millions of plants on the earth and none is considered useless. Every individual is important in an ecosystem (Anon 1991). The selection of species for fuel purposes is based on the urgency of needs, priorities, edapho-climatic conditions and acceptability among social groups. Considering these factors, Arid Zone Research Institute, Bahawalpur is in the process of establishing a desert botanical garden at its Cholistan farm. In this garden, a wide variety of species of local and exotic origin is being introduced. Some of the species raised successfully so far include Acacia nilotica, Acacia cupressiformis, Acacia farnesiana, Acacia victoria, Acacia ampliceps, Acacia colei, Acacia adsrugens, Acacia oligophleba, Acacia tumida, Acacia holosericea, Acacia jacquemontii, Balanites aegyptiaca, Zizyphus mauritiana, Zizyphus spina-christi, Zizyphus nummularia, Tamarix aphylla, Prosopis cineraria, Parkinsonia aculeata, Atriplex canescens, Atriplex nummularia, Atriplex halimus, Atriplex lentiformis, Casia augustifolia, Leptadenia pyrotechnica, Capparis decidua, Tecoma undulata, Sesbania grandiflora, Sesbania sesban var. nubica and Sesbania formosa. This garden will be expanded in the future as new suitable tree/shrub species are established. All these tree species are raised for demonstration, education and research purposes.

III. Village energy plantations

The fuelwood lots or energy plantations are attracting much attention mainly because of: (i) the dwindling non-renewable natural resources; (ii) the sharp increase in the demand for fuelwood; (iii) the increased rate of deforestation; and (iv) the depletion of the ozone layer and the greenhouse effect. To overcome these difficulties, it is suggested that each village should own its own woodlot and no village member should be allowed to cut trees from elsewhere. Government departments should impart technical training regarding nursery and planting techniques, after care, and moisture conservation methods to harvest wood on a sustainable basis. Such plantations could successfully be established around tobas in the deserts. One must also explore the possibility of introducing dryland horticultural plants like Zizyphus mauritiana grafted with suitable edible varieties. Pomegranate is another suitable choice. These measures will certainly increase the interest of desert people in tree planting.

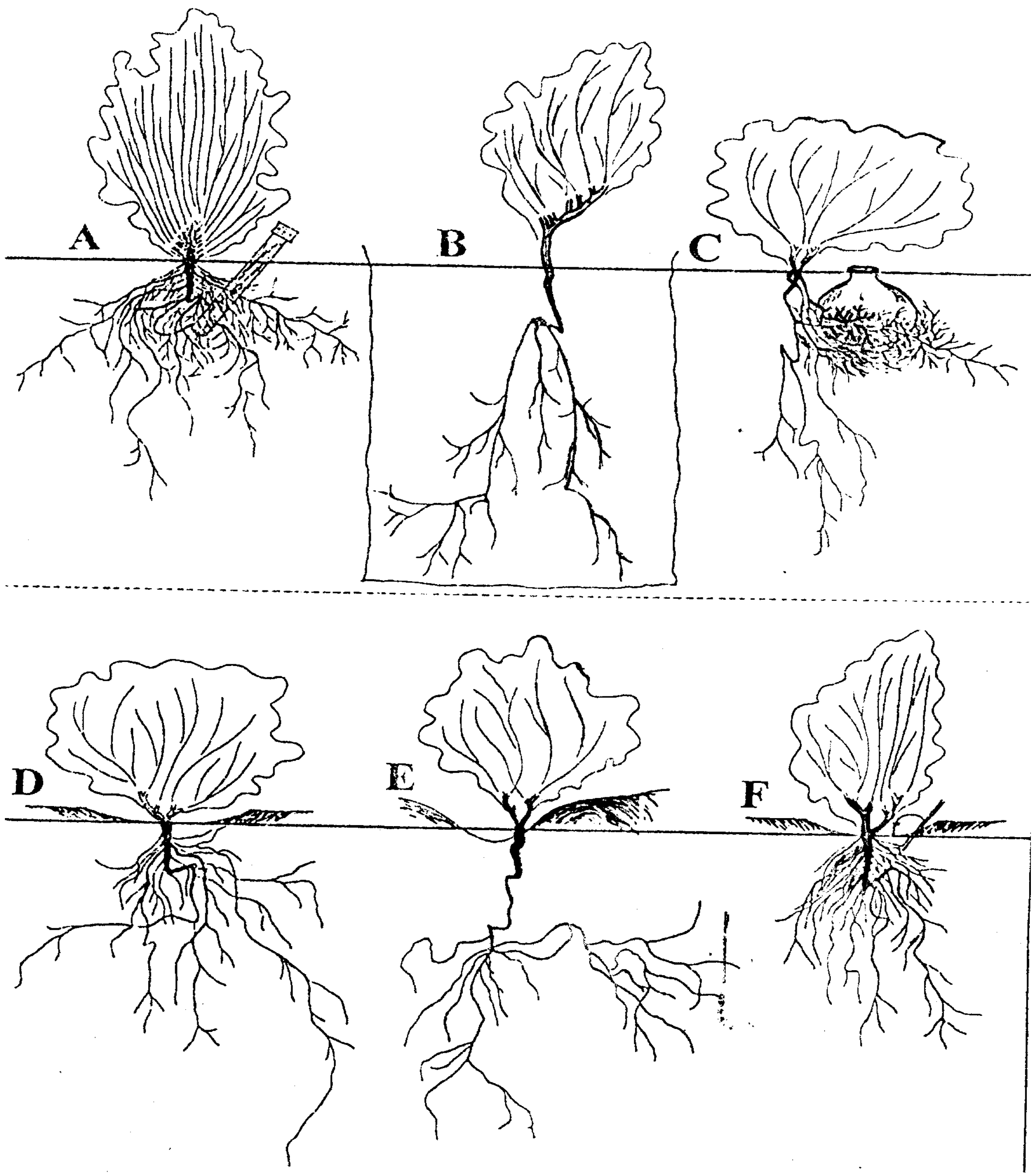
IV. Community mobilization

Our experience over the past 50 years clearly reveals that the sustainability of natural resources is directly related to the prevailing socio-economic conditions of the communities inhabiting such areas. Under a tribal system where land is a common property, fences serve as signs of hatred. People lose their trust in government agencies and consciously or unconsciously do not cooperate and hence cause interventions and management efforts to fail. Under such situations fences should be built in the minds of people and they should be persuaded to give importance to trees and shrubs on a par with their livestock and crops. Huge number of NGOs has mushroomed in the country. In Bahawalpur alone more than 400 NGOs/VOs are registered. These NGOs/VOs must be provided with the necessary skills and motivation to mobilize the desert communities and establish energy plantations.

<u>Acknowledgement</u>

The author gratefully appreciates the assistance of Mr. Mohammed Arshad, Cholistan Institute of Desert Studies, Islamia University, Bahawalpur for the drawings presented in Figure 3 of this manuscript.

Figure 3: Impact of different watering techniques on root behaviour of 18 months old Jojoba (Smimondsia chinensis) plants in sandy soils of the Cholistan Desert (A) PVC Pipe, (B) Plastic Bag, (C) Pitcher, (D) Dimple Pits, (E) Furrow and (F) Drip.



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11. MANGROVE FORESTS - AN IMPORTANT WOODFUEL RESOURCE OF THE COASTAL BELT

by
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11.1 INTRODUCTION

Mangroves are a diverse group of predominantly tropical trees, shrubs, and associated flora growing in the marine intertidel zone where conditions are usually harsh, restrictive and dynamic (Tomilson, 1986). Mangroves are principal coastal features of tropical & sub tropical climatic zones. They cover estuaries in warm climate zones but fresh water is also essential. Mangroves thrive best where the tidal regime is normal, amplitude is significant (2 meters or more), fresh water is mixed with seawater and water temperature does not drop below 200c.

Mangrove forests have developed in a manner reflecting the shifting course of the Indus River. A few centuries ago, the river was flowing near Karachi. Due to geological changes, it shifted its course towards the southeast near Ketibunder town, which is about 120 km from Karachi. As a result 21 big and a number of small creeks and islands were formed. These creeks became the ideal locations for mangrove growth. The size of the islands vary from a few ha to thousands of ha.

The Indus delta mangroves represent the sixth largest mangrove block in the world. The entire coastline of Sindh from Karachi to Indo-Pakistan border, stretching over 240 km, has mangrove forests.

11.2 OWNERSHIP AND LEGAL STATUS

Historically, the Indus delta mangrove forests were never managed scientifically. After partition, they came under the control of the Sindh Board of Revenue. During this period, most of the damage occurred to mangrove forests because there was no forestry expert within the organization. The total area of mangrove forests was 6,17,530 ha. In 1958 the Government transferred the majority of it to the Sindh Forest Department and declared it a "Protected Forest". The remaining 272,600 ha remained with the Board of Revenue. In 1973, the Sindh Forest Department transferred 64,500 ha to the Port Qasim Authority. At present, the Sindh Forest Department manages 280,430 ha (Qureshi, 1985).

11.3 SPECIES COMPOSITION

Mangroves are considered a tidal swamp forest by ecologists (Champion et al, 1965). The research work done so far reveals that the following 8 mangrove species are growing in the Indus delta:

- *Avicennia marina*
- *Rhizophora mucronata*
- *Aegiceras corniculata*
- *Ceriops tagal*
- *Ceriops roxburghiana*
- *Burgularia conjugata*
- *Soneratia caseolaries*
- *Rhizophora apiculata*

The dominant species is *Avicennia marina*. Its share in the mangrove forests is about 95% (Champion et al, 1965).

11.4 LAND USE CATEGORY OF MANGROVE AREA

Dense mangrove forests are found either in narrow stretches or in blocks of more or less rectangular form along creeks with profuse growth of Avicennia marina, which grows abundantly on muddy shores subject to the periodic inundation of seawater.

The satellite imagery produced by SUPARCO shows that about 36,310 ha are covered with dense mangrove growth, 54,410 ha of moderate canopy vegetation, 49,390 ha of sparse or blank area, 11,430 ha are under rivers and creeks and 365,990 ha of sand dunes.

11.5 IMPORTANCE OF INDUS MANGROVE

Mangroves are playing a vital role in the economy of Pakistan. The greatest economic importance of the mangroves comes from the fisheries they harbor. The creeks and mangrove provide excellent nursery areas for young fish especially shrimp. Shrimp are a major export commodity, making up 68% of the US $ 100 million which Pakistan earns in foreign exchange from fish exports (IUCN, 1994). Approximately, 100,000 people are dependent or partially dependent on mangrove fishing. The mangroves forests are an important source of fuelwood for people living along the coastal belt. Approximately, 200,000 people, primarily fisher folk, occupy the land immediately adjacent to the mangrove mud flats. Over 60% of the population, use Avicennia marina as their principal source of fuel and even to construct their huts. They either collect it themselves or purchase it from professional woodcutters. About 100,000 people (10,950 households) use 18,000 tonnes of mangrove wood as a fuel each year. It has been estimated that about 128 kg of mangrove wood are used as fuel per household every month (IUCN, 1995). The market price of Avicennia marina wood at Tall is Rs.1 to 1.5/kg.

Avicennia marina leaves are excellent fodder for animals. The leaves are regularly collected by the villagers for stall feeding of cattle, sheep and goats. Besides, during the rainy season about 16,000 camels are herded into the mangroves (IUCN, 1995). It is estimated that one camel eats 30 kg of mangroves leaves per day. Browsing by camels puts considerable pressure on the existing stands of mangroves nearest the coastal villages, to such an extent that many mature stands are stunted due to over grazing, browsing and lopping. The estimated consumption of mangrove as fodder is 536,650 KGB (IUCN, 1995)

Mangroves provide protection to the coastline from wind and ocean currents. The mangroves actually assist maintenance of Quasi Port by reducing its dredging needs. Besides, mangroves protect and preserve the natural environment and wildlife.

11.6 CAUSES OF DEGRADATION OF MANGROVE FORESTS

There is no doubt that a substantial reduction in mangroves, both in terms of area and density has taken place. The severest environmental stress on mangroves is caused by the reduction of fresh water flow down the Indus, together with a reduced load of silt and nutrients due to the construction of dams. Before 1947, the mangroves were getting 847 MA of fresh water per year. After construction of dams and barrages, the flow has been reduced to 35.2 MA (IUCN, 1994). The quantity of silt deposit has reduced from 400 million tonnes to 30 million tonnes annually.

Reduced fresh water flow results in increased salinity levels. This tends to stunt the growth of mangrove trees and animal life. The other major cause of degradation is human interaction with the system. A tremendous increase in population along the coastal belt has increased the fuelwood and fodder requirements manifold. Large numbers of camels, cows and buffaloes are grazing in the area, causing irreparable damage to the mangroves.

Pollution is another serious threat to mangroves. Apart from untreated domestic sewerage of Karachi city, there are significant untreated discharges from about 10,000 industrial units. Besides, in the Port Qasim area, there is frequent dredging of the shipping channels. The silt is being dumped on the mangrove stands causing mortality.

11.7 REHABILITATION PROGRAM

In the past, mangrove forests were considered wasteland and their management was not given priority. After the discovery of the role of mangroves in the coastal fisheries in the early 1970s, the Government of Pakistan established a National Mangrove Committee and also instructed concerned departments to prepare plans for the scientific management of mangrove forests. Various international and national Organizations started research and replanting programs. The major projects are:

a) UNDO/UNESCO Regional Mangroves Project

The Project was implemented during 1987 to 1989. Under this project experimental plantations were raised throughout the Indus delta. The results of these experiments show that indigenous species. *Avicennia marina* and *Rhizophora mucronata* are the most promising plants for plantation under the existing conditions.

b) IUCN Korangi Phitti Creek Mangrove Project

In 1994, IUCN initiated a mangrove rehabilitation project with the collaboration of the Sindh Forest Department. Under this project 400 ha have been restocked with Avicennia and Rhizophora.

c) Rehabilitation and Replanting of Indus Delta Mangrove Project (World Bank funded)

Sindh Forest Department is implementing a mangrove rehabilitation and replanting project assisted by the World Bank. The project period is from 1993-94 to 1998-99. The salient features of the project are:

- Institutional strengthening of the Coastal Forest Division;
- mangrove regeneration (16,000 ha);
- implementing social forestry in the coastal area to create an alternative resource of fuelwood and fodder to reduce pressure on the mangroves;
- a research programme for sustainable management of mangrove resources with local community participation; and
- training the Sindh Forest Department staff for skill development.

11.8 CONCLUSIONS

The Indus delta mangroves are under stress due to a number of factors, including:

- Reduction in annual flow of fresh water, silt and nutrients down the Indus;
- over-cutting for fuelwood & fodder; over browsing by camels;
- pollution from expanding domestic and industrial areas of Karachi.

To halt the degradation process, it is necessary to initiate coordinated efforts at provincial and federal level with the active participation of communities living along the coastal belt.

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12. RURAL WOMEN AND WOODFUEL ENERGY

by

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12.1 INTRODUCTION

Fuelwood is the dominant source of domestic energy in Pakistan, especially in the rural areas. Estimates of the annual demand are very high and most of it is met from trees grown on farmlands and wastelands, while government forests contribute only a small proportion. The price of fuelwood has risen continuously over the years due to the acute scarcity of the resource. This situation is expected to be more critical in the near future.

The housing census of 1980 showed that 70% of households in Pakistan use wood as the principal fuel for domestic cooking; 55% and 76% in urban and rural areas, respectively.

12.2 WOMEN AND WOOD ENERGY

Women are heavily involved in wood energy. In most countries, at least in rural areas, it is primarily women who are responsible for gathering firewood not only for their domestic consumption but also to obtain additional family income. Generally, trends towards higher woodfuel prices, low woodfuel quality and reduced access to woodfuel increases the burden of women. Interventions in the energy sector such as land use and fuel price reform often have disproportionately negative implications for women, especially those of the lower income groups. They have insufficiently benefited from the potential that wood energy development offers. In many countries of Asia the concerns of women are underrepresented in shaping wood energy polices and strategies. But without the participation of women such activities will fail. In the Northern areas of Pakistan women play an active and direct role in fuelwood collection and use and have also shown a keen interest in establishing and operating forest nurseries to earn some cash income. Similarly in Nepal, rural women are the primary collectors and users of woodfuel products. They are the ones most concerned with woodfuel development and conservation. India also has many examples of commercial fuelwood collection in forest areas by women which provides them employment and income. In most of the rural areas of Asia "micro-enterprises" that use wood as fuel are largely operated by women. Little attention has been paid to technological advancement in these enterprises and this could form the basis of a set of interventions, specifically the development of adequately scaled improved burners which would probably reduce the labour time involved in processing many foods.

In view of the above, the participation of women in rural woodfuel resource management, planning and implementation of development programmes will be of crucial importance. It is widely recognized that wood energy plays a part in the reproductive tasks that most women carryout, that is to say in the maintenance of the household. The development of cheap (or less time consuming) woodfuel efficient cooking and heating devices and sustainable access to sources of wood energy will be of direct benefit to women in this role. But women increasingly also have energy needs in their productive, breadwinning tasks. Many women today depend on wood or other biomass energy for independent commercial activities such as food preparation for sale or are employed in establishments which operate on a woodfuel base. Others are economically dependent on trading in fuelwood and charcoal. Moreover, where firewood is being sustainably produced either in woodlots or by planned offtake, and the management of natural forests is in the hands of local communities, women are certainly involved.

The truth is that the majority of wood energy planners (and the overwhelming majority of them are men) rarely really sit down with the women for whom they are planning and discuss the problems from their perspective. Too often the assumption is made that, for example, a new type of stove that has been shown to use less firewood will be readily adopted by women because it saves their time in woodfuel gathering. In reality women have many criteria in assessing the utility of stoves, of which fuel economy may be only one. These criteria are not universal and may need to be carefully investigated in the early stages of planning if the stove project is to be a success. And an even more common assumption is that women will be pleased to plant some trees because this will provide them with a ready supply of firewood. Whether this is the case or not may depend on a number of factors: whether there is any land available where the women feel confident that their trees will be saved; whether tree growing is culturally considered to be a suitable activity for women; what type of trees are being offered; and of course on whether they have any time during the planting season to take on this extra work.

Less obvious but even more common, are cases where wood energy related projects which by their nature are not intended to specifically benefit women, turn out to have inadvertent negative effects on women. Usually the problem is simply that no thought was ever given in the planning to the fact that the project might have an impact on women, which is different from the impact that it has on men. A little forethought might have prevented some serious problems. The main reason for the neglect of women is the weak position of women in a male dominated society.

It is now well understood that, in much of the developing world, wood energy is set to remain one of the prime energy sources, especially in poor rural communities. It is also well known that there are several problems, associated with its collection and use as a household fuel. A number of options exist for interventions aimed at offsetting these problems, and as women are most often at risk from the adverse effects of woodfuel use, it makes sense that considerations of gender should be a major factor in the design of these interventions.

Economizing on woodfuel, which is largely a collected fuel, is a question of reducing the labour-time required for its collection. This collection is largely done by women and children, particularly girls. A gender-disaggregated analysis of household labour-time leads to the conclusion that it is the availability or otherwise of women's unpaid labour-time that is the crucial factor determining the extent to which a household economizes on woodfuel use.

Obviously women who do the cooking are exposed to woodfuel smoke. But so also are children, particularly infant and young children, who spend most of their time around their mothers. The main health effects of domestic smoke pollution are:

- Respiratory diseases and corpulmonale;
- Adverse pregnancy outcome (still birth, neonatal death, low birth weight);
- Cancer;
- Eye problems.

Studies reveal that the root cause of the problem lies in the exposure of the women and the children to smoke pollution from the use of woodfuel/biomass fuels in cooking and heating. Chronic lung disease and the resultant heart damage hit women after a period of exposure, affecting them between the age of 30 and 50, which should be the most productive period of their lives. Domestic smoke pollution is an important contributing factor for three major classes of respiratory diseases: acute respiratory infection among infants and children; chronic obstructive lung disease (COLD) in adults; and interstitial lung disease.

Taking all the above factors together we can grasp the truth of the Latin proverb:

"THE KITCHEN KILLS MORE THAN THE SWORD."

It is well known that fuel-efficient stoves can reduce indoor air pollution, which would improve the health of women and children.

12.3 SUGGESTIONS

- Implement programmes that specially address women's issues in wood fuel production. The use of improved stoves is one example of economizing on the labour of fuelwood collection, since less fuel is needed for their operation.

- Make sure stove size, height and capacity are appropriate to women's cooking patterns and other activities that are carried out at the same time.

- Carry out research on better kitchen management techniques. Combustion of woodfuel produces harmful emissions (smoke contains respirable particulates, CO NO, Formaldehyde and hundreds of other simple and complex organic compounds) thus research should be conducted on indoor air pollution to identify such species which are most likely to result in health problems.

- Encourage women's participation in social forestry, as it is very important for their development. Otherwise women will have to spend more time and walk longer distances to collect wood fuel as the forests recede from the settlements.

- Provide effective government support and intensify extension services.

- Promote the active participation of women in woodfuel energy planning at all levels both by imparting training and training materials which demonstrate in a highly practical manner how women at village level can be approached and encouraged.

- Stimulate the appreciation of gender issues in wood energy planning among all energy planners.

- Recognize and secure property rights particularly for those who experience the worst problems regarding access to woodfuel resources.

- Improve access to and management of local land resources.

- Introduce species which have a high calorific value.

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APPENDIX I: WOMEN, WOOD ENERGY AND HEALTH

Fuel Cycle	Activity	Possible Health Effects.
Collection	Gathering fuel Trauma	Reduced infant/child care Bites from snakes etc. Allergic reactions. Fungus infections.
Transportation	Transportation of biomass fuel	Backache Severe fatigue Damaged reproductive organs over time (pro-lapsed uterus)
Processing	Cutting up fuel	Trauma Cuts Abrasions
Combustion	Smoke	Conjunctivitis Acute respiratory infection (AIR) including pneumonia Cor pulmonale Adverse reproductive outcomes Lung cancer Higher rate of infant morbidity/mortality Depressed immune response Chronic obstructive lung diseases (COLD) Chronic bronchitis Emphysema Asthma
	Toxic gases (CO)	Acute poisoning Low birth weight Higher rate of stillbirths
	Heat	Burns and scalds Cataracts
	Cooking position	Arthritis and related bone disease Back pain.

13. ROLE OF IRRIGATED PLANTATIONS IN THE PRODUCTION OF WOODFUEL IN THE PUNJAB

by

Mian Riaz-Ul-Haq, Divisional Forest Officer
Chichawatni of Wood and Population, Growth in the Punjab

Throughout the world, increasing attention is being given to the material resources required to maintain and improve the present standard of living and to the energy needed to sustain community and other activities. The use made of a particular resource will depend on several factors, including its availability and renewability, the disturbance to the environment entailed in its extraction or harvesting and the amount and type of energy required in its production and subsequent processing, application and disposal. Wood-based materials are more attractive in these respects than most alternative materials. The amount of raw materials required and the costs of protecting the environment at all stages up to the preparation of products such as building materials are much less for wood than for aluminum, steel or concrete. The energy required for the conversion of raw materials into products of comparable use, such as sawn wood, reinforced concrete, cast iron and aluminium alloys, is in the ratio of 1:8:16:39. Thus because of rising energy costs, it seems safe to predict that the world's already high dependence on forest products will increase. The utilization of more land for wood production would increase supply, but land is also increasingly required for food, water and living space, which reduces the availability of land for afforestation. Consequently larger and larger proportions of the forested areas are required to be devoted to intensively managed valuable species, to meet the need for wood for a widening range of purposes.

13.1 FUELWOOD SITUATION IN PUNJAB

According to the Forestry Sector Master Plan (FSMP) Punjab, domestic fuelwood overshadows the demand for industrial wood. Domestic fuelwood consumption is being estimated by the Household Energy Strategy Study (HESS) by rural and urban areas for each province of Pakistan. The FSMP is able to use the preliminary results from the HESS survey, which shows that the urban population uses 3.883 million m3 and the rural population uses 19.043 million m3. The FSMP calculates population growth at 4.8% for urban areas and 3.1% for rural and urban areas combined (Economic Survey, 1991-92). But the urban per capita fuelwood consumption is expected to decrease because of gradual substitution with other energy sources, while rural consumption is likely to stay relatively steady. Taking into account all relevant factors an overall 2% annual increase in total consumption is therefore assumed. Table 1, shows that fuelwood consumption will increase from 22.9 million m3 in 1993 to 37.6 million m3 in 2018.

Table 1: Projected Consumption Of Wood And Population Growth in the Punjab

	Units	1993	1998	2003	2008	2013	2018
POPULATION							
i Rural	Million	46.6	51.9	57.8	63.9	70.2	76.4
ii. Urban	Million	23.0	28.9	36.4	45.8	57.6	72.5
TOTAL	Million	69.6	80.8	94.2	109.7	127.8	148.9
FUEL WOOD CONSUMPTION.							
i. Rural	000 m3	19048	21025	23213	25629	28297	31242
ii. Urban	000 m3	3883	4287	4733	5226	5769	6370
TOTAL	000 m3	22926	25312	27946	30855	34066	37612

When firewood is unavailable, rural people do not switch to fossil fuels, which are often not available locally and are always expensive, but to crop residues and dried cow dung. The resulting diversion of organic matter and nutrients from field to fireplace carries its own negative economic effects. According to the FAO, some 400 million tonnes of cow dung are annually burned in Asia, the Near East, and Africa. Each tonne burned means a loss of about fifty kilograms of potential grain output.

13.2 THE IRRIGATED PLANTATIONS OF THE PUNJAB

Khattak (1976) with reference to the history of forest management in Pakistan, mentions that Changa Manga was the country's first irrigated plantation, established in 1866. It was followed by Chichawatni (1913), Khanewal (1917), Daphar (1919), Kamalia (1946) and Wanbachran (1948). Although intermittent and largely unsuccessful attempts had been made to raise irrigated plantations in the former Bahawalpur State since 1870, systematic work was started in 1955, after Bahawalpur Forest Division was created. With the exception of Changa Manga all the plantations of the Punjab were raised by leasing out land for temporary cultivation. Here the lessees themselves cleared the existing tropical thorn forest, uprooted the stumps and levelled the area after paying lease money to the Forest Department. The technique for raising irrigated plantations has developed by trial and error. Originally plantations were started by flood irrigation on the analogy of agriculture. Later the practice was changed to trench-cum-flood for conserving irrigation water. The choice of species in all the Punjab plantations mainly has been confined to shisham and mulberry. Various other fast growing species were tried like poplar and eucalyptus, but in the earlier stages these met efforts with failure mostly due to a lack of technical knowledge. Shisham still remains the principal species of irrigated plantations of the Punjab, though mesquite (Prosopis glandulosa and P. juliflora) have invaded some plantations, especially Chichawatni, Khanewal and Piplipahar plantations.

Olander (1984) has listed the 76 plantations in Punjab (Appendix II), these are distributed in six administrative units as follows:

Table 2: Area Under Irrigated Plantations in the Punjab

Name of unit	Total area (Hectares)	Planted area (Hectares)	%
Multan Forest Circle	16,193	13,553	84
Lahore Forest Circle	8,994	7,558	84
Bahawalpur Forest Circle	27,499	7,859	29
Sargodha Forest Circle	34,416	20,551	60
D.G. Khan Forest Circle	38,423	15,368	40
Lal Suhanra National Park	4,047	1,619	40
Total	129,572	66,478	51.31

Ever since the creation of Pakistan, the Punjab Forest Department has been making strenuous efforts to overcome the shortfall of forest products by intensifying management of government forests and motivating the rural communities to undertake tree plantation.

The following tabulation of figures depicts the major achievements in respect of the area brought under trees and wood production during 1990-91 to 1994-95:

Table 3: Achievement In Terms Of Wood Harvested From State Forests and Land Area Brought Under Trees Cover State Forest Land

Fiscal year	Quantity of wood harvested			
	Timber (m3)	F/Wood (m3)	Area afforested (ha)	Area harvested (ha)
1990-91	54116	250664	7230	2346
1991-92	56308	226775	13899	1554
1992-92	82032	163975	12653	3404
1993-94	43549	144921	11066	1441
1994-95	44396	127959	7899	1633

Wood consumed in the Punjab comes mainly from farmlands, irrigated plantations, and riverine forests. Even taking all these sources together, the planned production is inadequate to cope with the requirement. That in turn results in the over-exploitation of the existing forests or the import of wood products from other provinces and abroad.

13.3 Factors Affecting the Productivity of Irrigated Plantations

Financial Aspect

The Forest, Department, Punjab earns a revenue of Rs.150 to 200 million every year. The afforestation/regeneration strategy adopted so far is a continuation of the region's age-old practices. With the passage of time the strategy has become incompatible with the changing social and economic pattern of life. The land - the basic resource - cannot be put to full use due to various constraints; most important is financial constraints. As a matter of fact, the main reason for a decline in the productivity of the state forests over the years is the inadequacy of the inputs required to maintain the trees. Whereas the budget allocation available a couple of decades ago was sufficient for 17 man-days per acre, the corresponding figure at present is only two man-days per acre. Due to paucity of funds, long term management plans (working plan) which are essential tools to scientifically manage forests over a period of one or two decades, remain unoperational. Funds are not available even to cut the mature harvestable trees and regenerate the cleared area. This in turn causes revenue losses to the provincial exchequer. In 1993-94, the government suffered a loss of Rs.3.00 crore per month and felling could not be undertaken as per schedule. Non-development budget allocation during the last 7 years is shown in Table 4.

Table 4: Non-development Budget Allocation

Year	Amount allocated (million Rs.)
1988-89	206.56
1989-90	201.08
1990-91	307.59
1991-92	234.59
1992-93	284.43
1993-94	225.25
1994-95	308.30
1995-96	415.40

Despite the undeniable contribution of forests in material and environmental terms, the Forest Department is treated as a low priority sector in the Annual Development Plan. The shares of the Forest Department in the provincial ADP budget for the last seven years show the alarming state of affairs (Table 5).

Table 5. Share of Forest Department in Provincial ADP budget, 1988-95

Year	Provincial ADP Budget	Share of Forest Department	%
1988-89	2773.40	75.90	2.70
1989-90	7169.00	86.50	1.20
1990-91	7660.00	67.70	0.88
1991-92	12002.00	110.00	0.92
1992-93	12002.00	79.80	0.66
1993-94	9000.00	52.97	0.59
1994-95	12000.00	58.33	0.49

With this meager allocation i.e. hardly 1% of the total amount available to the provincial functionaries, it is not possible to undertake effective development programmes and make a real leap forward to increase the forest revenue and cope with public requirements. It is worth mentioning that the entire developmental/non-developmental funds are not spent only for growing trees. Rather the allocation covers fields like parks and recreations services, development of rangelands for livestock, soil conservation etc., and only a fraction of the entire financial resources trickles down for silviculture.

For optimum development in the forestry sector, a minimum of Rs.300 million are required to be budgeted through ADP allocation to meet the present day demands, viz. mechanization of forestry operations, computerization, planting for environmental rehabilitation and, above-all, establishment of tree plantations in private farm-lands, border areas, railway/roadsides, thus ultimately bridging the gap between demand and supply.

Supply Of Irrigation Water

The stocking and yield in the irrigated plantations have significantly declined firstly because of delivery of less than the sanctioned amount of water by the Irrigation Department and, secondly, due to the very poor condition of the irrigation system. The water seepage through unlined channels causes further losses. The net result is at least 40% water shortage.

Protection

Most of the forest areas are highly prone to grazing/browsing pressure prevailing in the Province. Even the land allocated to forestry is under strong pressure for alternate use.

Labour Problems

Labour problems are typical in the irrigated plantations. Taking Changa Manga as an example, 50 ex-prisoners brought into the plantation in 1864 for physical work were given concessions such as free grazing of two cows and 2 kanals of land. The number of the descendants of these original labourers has now shot up to 50 times the original figure with a huge number of cattle and heavy encroachment on state land. Yet none of them is willing to work for the Forest Department. This is causing an indirect loss of Rs.3 crores to the government. The only remedy is to shift these people elsewhere as part of a rehabilitation plan.

13.4 FUTURE STRATEGY

In order to overcome the shortage of wood, a multi-pronged attack is required along the following lines:

- Planting additional trees on private lands through agro-forestry/social forestry project;
- increasing productivity of existing public forests by planting bare areas and intensification of forest management;
- wasting less wood in harvesting, storage and utilization;
- reducing wood consumption by using it more efficiently.

APPENDIX II: DETAILS OF PLANTATIONS AND AREAS PLANTED

by

Punjab Forest Department

Name of plantation	Total area Hectares	Acres	Planted area Hectares	Acres	%
Depalpur	2928	7235	245	6045	84
Arifwala	614	1518	564	1393	92
Chichawatni	4668	11530	3721	9196	80
Khanewal	7211	17818	6292	15549	87
Mirpur	775	1914	529	1306	68
Daphar	3416	8441	2771	6848	81
Changa Manga	5063	12511	4547	11237	90
Rakh Docile (R.F)	475	1173	208	514	44
Rakh Teb She (R.F)	40	99	31	77	78
Lal Suhanra	8489	20974	3241	8008	38
Bahawalpur	524	1296	457	1130	87
Chak Katora	536	1324	470	1162	88
Mianwali Toba	130	320	115	283	88
Bahawalnagar	342	845	321	792	94
Dunga Bunga	6	15	6	15	100
Abbasia	2855	7079	1490	3682	52
Abbasia Ext. Area	7335	18125	294	726	40
Walhar	1875	4632	654	1616	35
Qasim Wala	2084	5150	812	2006	39
IL/IL/Gulmerg	2109	5212		-	
Sahiwal	1206	2979	-		-
Lal Sohanra Nal. Park	4047	10000	1619	4000	40
Kamalia	4397	10864	3621	8947	82
Chak No. 199 R.B.	66	163	54	134	83
Chak No. 193 R.B.	13	33	11	28	85
Chak No. 200/R.F.	22	54	19	46	85
Chak No. 25/R.F.	217	536	23	57	11
Chak No. 46/G.B.	19	47	19	46	98
Chak No. 15/G.B.	31	76	25	61	80
Chak No. 160/G.B.	76	187	62	152	84
Chak No. 300/G.B.	603	1491	202	500	35
Bhagat Reservoir	282	697	236	582	84
Chak No. 536/G.B.					
Chaku Rakh	158	390	131	323	83
Chak No. 534/G.B.					
Chaku Reservoir	380	940	246	609	65
Chak No. 534/G.B.					
Chak No. 367/G.B.	124	306	34	84	68
Chak No. 367/G.B.	241	595-	-		-

(Kupi plantation)					
Baghat plantation					
Chak No. 359/G.B)	251	620	205	506	82
Chak No. 361/G.B)					
Chak No. 324/G.B.	142	351	125	310	88
Shorkot_Plantation	4079	10079	123	3035	30
Chak No. 700/G.B.	11	27-	-		-
Chak No. 703/G.B.	10	25	6	16	64
Chak Bahadar Plantation	462	1141	452	1116	98
Chak 178/G.B.	815	2015	769	1900	94
Chak Jalal Din	284	702	262	648	92
Kundian Plantation	7800	19275	3679	9091	47
Chak No. 155/R.F.	188	462	48	118	26
Hornoli Plantation	889	2196	423	1328	71
Shelter Belt	233	575	233	575	100
Fateh Major Plantation	1255	3101	541	1337	43
Chak Plantation	2210	5462	1638	4048	74
Rodi Shelter Belt	301	743	217	537	72
M.M. Road Shelter Belt	73	180	36	90	50
Bakhar Plantation	2214	5249	1093	2700	51
Shelter Belt	104	258	101	250	97
Bela	198	489	195	483	89
Mitha Tiwana Plantation	1116	2758	519	1282	46
Jauharabad Forest Plantation	399	985	182	450	46
Chak Planting	2045	5054	1236	3054	60
Shelter Belt	1875	4632	1619	4000	86
Daman	2270	5610	1299	3209	57
Kot Mithan	422	1042	326	806	
Kotla Issan	2178	5381	548	1353	25
Khikapur	371	917	257	634	69
Machu, Inayat Nat. Park	8349	20632	4249	10500	51
Chak Plantation	1595	3942	737	1821	46
F/Pur Chak Plantation	2017	4983	1093	2700	54
Rajan Shah Plantation	2110	5214	1298	3207	62
China Malana Forest	1692	4180	838	2070	50
Belawala	340	840	192	475	57
Bet Mir Hazar Khan	1457	3600	1268	3134	87
Bakaini	809	1998	435	1074	54
Bamberwala	1057	2613	414	1023	39
Mudwala	171	423	163	402	95
Sarian	766	1893	173	427	23
Dandewala	452	1118	355	877	78
Ranuja	535	1322	432	1067	81
Khan Pur Plantation	11912	29436	1295	3200	11
TOTAL	129572	320179	66478	164271	51.31

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14. SOCIAL FORESTRY AND THE WOODFUEL CRISIS

by

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14.1 SOCIAL FORESTRY

Social forestry is a term that refers to any situation that intimately involves local people in forestry activities. The main role of social forestry programmes is to help farm families, particularly poor ones, become self-sufficient and improve their living conditions by raising trees.

The term social forestry was apparently first used in 1968 by J.L Westoby who explained that social forestry aims at producing a flow of production and recreation benefits for the community. Later, in 1983 it was emphasized that Social Forestry was actually an instrument for rural development where the large landless population would be the major beneficiary.

"A village group in the Republic of Korea plants a small community woodfuel plantation. A Costa Rican landowner plants trees along her field as a living fence and a source of woodfuel. Philippine farmers plant trees that they will later sell to the Paper Industries Corporation of the Philippines for pulpwood. Rural, landless people in West Bengal, India, plant trees along fields for wind breaks and woodfuel. A women's group in Kenya tends its small tree nursery. A farmer in Nepal plants trees for fodder and other uses, while his landless neighbors tend a village woodlot. A Guatemalan farmer plants trees among his coffee bushes for shade and for fuel. Villagers in Thailand and Nigeria intercrop trees with food crops. All of these are examples of social forestry." (Gregerson et al, 1989)

Beside the examples quoted above social forestry also includes government or other groups planting trees on public lands to meet local village needs. The traditional production of wood from state lands, is also used to meet people's needs, but it is differentiated by the fact that in the case of social forestry the primary focus is on the local population, their involvement, and on the trees that offer them direct and indirect benefits. This distinction is important due to lack of success in trying to achieve social forestry objectives with traditional production forestry approaches.

14.2 PRESENT WOODFUEL SCENARIO

Woodfuel production is a main objective of most social forestry projects which are critical in efforts to resolve the energy crisis, since wood is the major source of energy in rural areas of the developing world, both for domestic uses and traditional industries.
isalabad

Almost 70% of the people in developing countries, most of whom live in rural areas, depend mainly on wood to meet their household energy needs. Over 80% of the wood harvested in developing countries is used as fuel wood. In rural areas gathering and transportation of woodfuel increasingly dominates the daily lives of millions of people. In the mid-1980s an FAO analysis indicated that 1.5 billion people are cutting wood faster than it can grow back.

Some 125 million people in 23 countries cannot find enough wood to meet their needs, even by over-cutting the forests.

Without major policy changes to ensure better woodfuel conservation and increasing supplies, by the year 2000 some 2.4 billion people will face woodfuels shortage and will be caught in a destructive cycle of deforestation, woodfuel scarcity, poverty and malnutrition. At the present rate of consumption, by 2000 the annual woodfuel deficit in developing countries will be 925 million cubic meters. This short-fall, which is now met by over-cutting forests, is equivalent to the annual output of wood from 80 million hectares of woodfuel plantations.

14.3 RURAL POPULATION AND WOODFUEL

Most of the woodfuel used by the rural families is collected by the users and does not enter the cash economy. The small portion that enters the cash economy enters through the informal marketing arrangements of very low-income rural people whose objective is to earn cash. It is a business conducted by small farmers and head loaders around the state forests. Whether or not the removals are illegal or unauthorized, these marketing activities have proceeded with little official attention.

The major reason for the neglect of woodfuel in energy development programmes has been a strong presumption on the part of planners that family income would increase as a result of national development programme and ultimately the people would switch to other fuels. But in developing countries it is very difficult to supply alternatives to the rural population and to make the people switch from a fuel, which they collect free of cost. Thus, woodfuel provides the most realistic option for meeting a considerable portion of the energy demand, both globally and regionally. By far the greater part of the woodfuel demand will come from rural households and promoting social forestry to increase woodfuel production has an important, even dominant role in ensuring a sustainable output of woodfuel.

Effective social forestry strategies to increase the production of woodfuel are complex. The adoption of tree planting for woodfuel production is not very easy. Many efforts have failed to secure local support because project planners and implementers did not take the time to understand the local situation. Government agencies must evaluate the relative importance of woodfuel in the total energy use and then decide what programmes are needed to ensure an adequate future supply. There is simply no place for a derogatory attitude towards woodfuel.

The success of social forestry projects depends on the socio-economic conditions of the people. The rural population understand only the knowledge of their own socio-economic environment. Unless we look at social forestry in the light of these socio-economic factors, success will be elusive. For example, agriculture is a way of life of the rural people and not a profession. It is very rare to change their cropping pattern in their fields for food requirements. Hence, the adoption of tree planting needs strong and individual motivation. Similarly, the elimination of their prejudices about the adverse affect of trees on crops is very essential. It is usually assumed that the increase in the price of woodfuel is a sufficient incentive for promoting tree planting. But it is more likely to encourage the use of other alternatives such as crop residues and cow dung etc. Sometimes, although the immediate need may be for woodfuel, people prefer to plant commercial trees and continue to collect free woodfuel from any source available.

Despite all these factors social forestry programmes can only meet success when people's participation is ensured in planning, execution, selection of area, choice of species, management, harvesting and distribution of produce and benefits.

14.4 OPTION OF USING DEGRADED LANDS FOR WOODFUEL PRODUCTION

In Pakistan there are huge wastelands and degraded areas that for several reasons are not being effectively utilized under agriculture. However, these lands can be gainfully utilized for woodfuel production. Once the area is regenerated it ultimately starts improving the soil conditions. In a number of social forestry projects in India, degraded lands are leased for cultivation of trees and also planted on a cost-sharing basis. Such areas can be identified within state lands, coastal lands, and desert fringes. On the basis of long term planning, every year a portion of these lands can be taken up for planting with the involvement of local people. It has been reported that the total production and value of fuel, fodder and small timber from degraded lands are much greater than the total production and value of the coarse grains usually produced on them.

Degraded government areas can be managed under suitable micro-level organizations on a cost-sharing basis to achieve the desired results. While formulating the long term planning of such areas the classification of lands can be made on the basis of their edaphic and climatic conditions. This information, along with the assessment of local needs, will facilitate in formulating a management plan and identifying the nature of planting and the choice of species. There are various species, already identified, which are capable of growing on wastelands and degraded areas, therefore study of site conditions for the selection of species may not be required. In the absence of public resources for rehabilitation and production of woodfuel, these areas can be taken up on a cost-sharing basis with the private sector.

14.5 CONSTRAINTS ON WOODFUEL PRODUCTION

Raising trees for woodfuel production is a complex process which involves social, cultural, and psychological dimensions. Social forestry is a new idea. The newness of the idea leads to some degree of uncertainty about the expected consequences. There are numerous constraints which need to be rectified at the time of planning social forestry projects or should be addressed at the time of implementation. Some of these are discussed below.

In such projects the needs of the poor or the less vociferous are seldom taken into consideration and very little is offered to the landless and similar groups. Unless all sections of society have an interest in social forestry, its success cannot be ensured. In such cases it is observed that the resource rich farmers are the beneficiaries. These projects despite impressive achievements in area coverage, increase in number of trees and other targets, these have been subjected to deviations and distortions.

Sometimes lack of effective organizations at local level to look after the interest of all sections ultimately causes poor results. Such micro-organizations are necessary, since the government departments are considered to be more bureaucratic and lack extension acumen.

Inadequate information available to farmers regarding marketing and the demand for their produce. The farmers do not have access to a competitive marketing system and instead they resort to local village buyers and receive the minimum return for their produce.

The high transportation cost and imposition of various taxes on the movement of wood from one place to another.

At the planning stage no sociological survey is carried out in order to assess the immediate local needs and their priorities. It has to be figured out whether there is any positive correlation between tree production and the anticipated rise in the incomes of local people.

The people are sometimes unaware of the public projects being implemented in their areas and therefore cannot get benefits from them. For example, sometimes they are unaware of the existence of a subsidy on planting stock, and often there is no printed information available for them.

Competition for land and labour is another constraint on social forestry. There are a lot of areas where the farmers are not land owners but only tenants and are not in a position to make decisions. Sometimes there is some ambiguity regarding the ownership of produce in the form of timber and woodfuel. Similarly, the small size of land holdings is a limiting factor for woodfuel production, even to meet domestic needs.

Though, the project may focus on the immediate need of woodfuel production, people are more likely to opt for commercial species to obtain greater economic return.

The most important factor of market demand can result in increased production of woodfuel, but generally the farmers either do not have access to the market or lack the knowledge of the market for their produce. This results in the farmers being exploited by the middleman and they receive low prices for their produce and hence do not plant trees on a sustainable basis.

Forestry activities associated with social forestry projects are generally carried out in areas where big landowners prefer to plant for commercial purposes. This preference may be because the landowners are absentee landowners or because of the unavailability of labour for agricultural activities. Such planting of trees has little effect on local woodfuel consumption and production.

14.6 RECOMMENDATIONS

- People's participation at all stages of social forestry project has to be ensured.
- Prior to the formulation of a social forestry project, the study of socio-economic and demographic conditions should be carried out.
- The existing trends of woodfuel production and utilization, including the alternatives being used, have to be considered.
- Information regarding marketing should be gathered and very clearly communicated to the farmers. The fear of suffering from a market surplus of woodfuel has to to remove from their minds.

- Research on raising woodfuel plantations should be carried out since the cultivation of woodfuel as an energy plantation is a sophisticated undertaking.
- The corporate sector should be involved.
- A credit facility over the gestation period of the energy plantation should be available.
- Available railside and roadside public areas in addition to other degraded lands for woodfuel production should be utilised.
- Considering the immediate needs, short rotation, fast growing, and coppice character species should be propagated.
- Identification and breeding of suitable fast growing, coppicing tree species of high calorific value for different agro-climatic zones should be carried out.
- Education through extension services should be supported by research.

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15. STRATEGY FOR ENHANCING FUTURE WOODFUEL PRODUCTION

by

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15.1 INTRODUCTION

The impact of humanity on the earth and its resources has increased at an unprecedented rate during the last couple of centuries and it is still increasing today. Human activities are now affecting some of the basic climatic and biological cycles of the planet (PNCS, 1991). Such activities include the cutting of forests for cultivation to feed the increasing population, the transformation of the wilderness areas, encroaching upon marginal and sub-marginal lands for food crops, slashing trees for fuelwood and construction timber.

These activities are neither compatible with land and resource management principles nor with wise use. The major pressure is for fuelwood and food crop cultivation. These imperatives are depleting natural forest resources all over the world. More than 70% of the world population lives in rural areas and are dependent partially or completely on woodfuel for domestic energy.

Pakistan is a forest poor country with only 0.03 ha of forest per capita compared to a world average of 1 ha. Even this figure is declining with the population growing at 3% annually (FSMP,1992). The forestry sector contributes only 0.3% to GNP, but the intangible benefits are numerous, with watershed value, environmental and biodiversity concerns on top of the list. The entire requirement of wood based industries, (employing more than 500,000 workers), amounting to 3.5 million m3, is met by this forest resource. Forests also contribute 32% of the energy needs as fuelwood. Ninety percent of rural and 60% of urban households use fuelwood and other forms of biomass as the primary source of energy. The meager forest resource also meets the forage needs of 28.7 million heads of livestock out of more than 86 million in the country. Approximately 70% of the area of Pakistan is arid or semi-arid supporting only scrub or thorn vegetation, which can produce only woodfuel (FSMP,1992).

The public forests, including coniferous and scrub forests as well as farmland trees, cover an area of 4.2 million ha and constitute 4.8% of the area of the country. These forests are the main source of construction timber, they protect upland watersheds for sustained supply of water for multipurpose hydropower dams and irrigation, and they provide the major share of the country's requirement of wood for fuel. They are also a source of important non-wood products and a habitat for a rich variety of faunas. Rangelands of Pakistan, extending over 29 million ha are another source of some woodfuel for domestic use. The areas under trees with a potential to produce woodfuel in the country are presented in Table 1.

Table 1: Woodfuel Potential of Selected Tree Area (000 ha)

Forests	AJK	Balochistan	NA	NWFP	Punjab	Sind	Total
Conifers	241	42	660	940	30	-	1913
Scrub	16	504	-	539	132	-	1191
Riverine	1	20	-	13	27	112	173
Mangrove	-	2	-	-	-	205	207
I. Plantation	1	-			79	23	103
Farmland	7	23	6	70	306	54	466
Linear plant	-	-	-	2	14	-	16
Misc.	10	-	-	120	20	5	155
Total	275	592	666	1684	608	399	4224

Source: FSMP Satellite Imagery database

According to the Pakistan Census, 1980, there were about 330 million trees on 19.3 million ha of farmlands throughout the country. This works out to about 20.5 trees per ha with an estimated standing volume of 70.3 million m3. These farmlands have received much emphasis for tree plantation since the eighties. The number of trees has increased since then and there is ample scope to further increase tree plantation on the farmlands. This is equivalent to 0.466 million ha of compact plantation (equal to 40 Changa Manga plantations) assuming a density of 710 trees per ha.

15.2 DEMAND AND SUPPLY OF WOODFUEL

The Household Energy Strategy Study (HESS) carried out a nationwide estimation of biomass productivity during 1990-1992, for various agro-ecological zones with the help of satellite imagery and estimated a total standing biomass of 209.856 million m3 with 122.430 million m3 of timber and 87.426 million m3 of fuelwood over 85.221 million ha. The details for various zones established by HESS are listed in Table 2.

Table 2: Biomass Productivity per Zones (1990-1992)

Zone	Timber	Fuelwood	Total	Area
Desert	286	1,857	2,143	25,234
Semi-Arid	6,000	7,857	13,857	25,383
Natural Forests	61,143	12,997	74,140	-
Barani	429	4,429	4,858	2,788
Irrigated low Punjab/Balochistan	3,286	4,429	7,715	4,461
Irrigated low Punjab/NWFP	14,286	14,286	28,572	3,186
Irrigated High Sind/Balochistan	4,143	4,714	8,857	1,987
Irrigated High Punjab/NWFP	32,857	36,857	69,714	9,185
TOTAL	122,430	87,426	209,856	85,221

The total annual energy requirement of the country was estimated as 36 million tonnes of oil equivalent (Mtoe) in 1988, and exceeded 50 million Mtoe by the year 1993 due to fast population growth and increased per capita consumption. Of this, 68% was contributed by commercial energy sources such as fossil fuels and electricity and 32% by the non-commercial sources such as fuelwood and agricultural residues. Woodfuel is predominant in household use and in the rural areas, for the obvious reasons of availability and traditional use. The other sources of non-wood energy include electricity, oil, natural gas, liquefied petroleum gas (LPG), coal, biomass fuels including cowdung and crop residues etc. HESS estimated that 43.495 million m3 of woodfuel was consumed annually (constituting 50% of the total production) distributed among urban areas (6.917 million m3) and rural areas (36.578 million m3) with an average of 3.42 m3 per household per annum.

With the population of 140 million expected to double by the year 2010, the projected demand is likely to more than double. Woodfuel will remain the major source of energy for households. Woodfuel is environment friendly because the production of wood is directly proportional to the amelioration of the environment. It is also a renewable source of energy and can be produced using indigenous technology and knowledge. It can be grown locally and is available near the houses in the rural farmlands. Woodfuel is a conventional source of domestic energy very well known to the local people. It is cost effective and has been in use for centuries.

15.3 STRATEGY FOR ENHANCING WOODFUEL PRODUCTION

It was explained earlier that land cannot be diverted from agriculture to forestry to increase the forest area for fuelwood, timber and various intangible benefits. The sole reason for this is that more food is required to be produced for the fast growing population. Even if we have additional area available for growing more forests, the inputs required in the form of funds, water, machinery and manpower are not available. Just to add one percent area to the existing 4.8% (4.224 m ha) forest area of Pakistan, an additional 0.88 m ha, more than 35,000 cu secs of water, 8950 million rupees and 10 years of time is required. When we think of increasing the forests to 10% or 20-25% the inputs and resources required will be many times greater. Presently, 90% of fuelwood comes from farmlands, which have much more potential. Farmlands are clearly the best candidate to be managed on a scientific basis to produce to their maximum potential and meet the projected demand in 2018. Agroforestry, farm forestry, social forestry and participatory management are the key elements in the country's future forest management efforts. Based on these guiding principles, the following strategies for enhancing woodfuel production is proposed:

(a) Woodlots: All the vacant, or currently idle marginal, sub-marginal lands, including saline, waterlogged, unleveled areas in the private sector, shall be developed into woodlots, to enhance production of environment-friendly woodfuel to meet the country's energy requirements on a sustainable basis.

(b) Agroforest farms: Farmlands have the highest potential for enhancing the production of wood, especially from woodlots and various agroforestry practices. The cultivated area constitutes more than 20% of the land area of Pakistan. If 20 trees per ha can be added through a suitable AF system or woodlots on marginal and sub-marginal lands, 52 million trees will be raised on a short rotation of 5-10 years. This will mean an additional estimated production of 26 million m3 of woodfuel every year. It will improve the farm economy and help maintain soil fertility as well as fight back the twin menace of salinity and water logging. Cow dung will be saved for manuring agricultural crops.

(c) Integrated farming: The concept of integrated land and resource management refers to a system where farmers grow crops, maintain trees, raise fruit trees, rear livestock, practice fish farming, produce honey and silk through sericultural practices in accordance with land capability classification for maximum farm production and income.

(d) Integrated participatory natural resource management in watersheds: Growing of trees in the public forests, village common lands, guzara forests and private lands through a participatory approach will ensure their protection. This is essential in watersheds to produce a good quality sustainable supply of water for irrigation, hydropower production and drinking purposes. Growing of trees in the watershed areas for their watershed value will also enhance the production of woodfuel, urgently required for the domestic energy requirements of the hill people.

(e) Development of wood based industries: The development of wood based industries will provide incentives to the farmers to grow more trees for financial benefits and will add to the woodfuel production and help create a better environment.

(f) Improved marketing and utilization: Similarly, better marketing and utilization will result in more financial returns to the growers, resulting in enhanced tree plantation and increased woodfuel production to meet the increased demands.

(g) Firm government policy and commitment: Government policies regarding restrictions on movement and cutting of trees and taxes affect the tree plantation efforts in the private sector. Similarly, tax holidays from agricultural taxes on trees and soft loans for afforestation will encourage people's efforts to grow more trees. Import policy and sufficient funds for the forestry sector also effect afforestation efforts in the private and public sector. Incentives and motivation through extension services will help enhance tree plantation and hence woodfuel production in the country.

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16. MARKETING OF WOODFUEL IN PAKISTAN

by

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16.1 INTRODUCTION

Forests are one of the most valuable possessions of a nation because the sustained benefits they yield are tremendous.

In their protective role the forests protect the soil from wind and water erosion, regulate the flow of water, balance the extremes of temperature, and cut down ferocious wind velocities. In their productive role they produce major forest products like timber and fire wood and minor products like fibers, leaves for sericulture, bark for tanning, grass for grazing and scores of other things. They also offer substantial opportunities for recreation. Forests are thus a valuable environmental and economic resource for supporting natural systems and for improving human welfare.

The term woodfuel implies the utilization of wood for the purpose of obtaining energy. Fuelwood is often seen as a waste product of timber processing and tree utilization, a minor use of "the leftovers" and its ranking is often lowest.

Fuelwood is one of the main energy resources in Pakistan. Wood constitutes nearly one-half of the total fuel used for cooking and heating and over 80 percent in rural areas. Animal dung and agricultural residues are used to supplement the wood. It is estimated that about 50 percent of domestic energy requirements are met by wood fuel, 34 percent by animal dung and agricultural residues and the remaining 16 percent by other fuels. Per capita consumption of fuelwood is estimated as 0.2 cubic meter.

On the supply side, less than 5 percent of the country's land area is covered with natural forests and tree plantations. Their share in the total woodfuel supply is only 10 percent. The major share of woodfuel (or 90%) is supplied from non-forest lands (i.e. private and community lands). Only about 41 percent of the woodfuel used by the households is purchased in markets, and the rest is obtained free from the source by self-collection.

Helping the rural and urban poor is a moral obligation for everybody. An affordable energy supply is a basic need like food and shelter. A majority of the poor

are like other segments of society, dependent on fuelwood for their daily needs - the preparation of meals and the heating of homes. Marketing, a tool for directing the flow of goods and services from producers to consumers, has also a social dimension and can be used to meet the above-mentioned moral obligation. This can be done by improving the efficiency of the market for fuelwood and by removing distortions. More efficient marketing can lower consumer prices and increase the quantities of fuelwood supplied.

16.2 FUELWOOD MARKETING AND TRADE SYSTEM IN PAKISTAN

There is a comprehensive woodfuel distribution system in operation in Pakistan which is based on free enterprise and is generally serving the country well.

The actors in the marketing system consist of the producers, the traders and the consumers of fuelwood.

Producers	Farmlands; Government Forests	
Traders	1) Rural Assembler/Wholesaler/Retailer	52%
	2) Road Side Assembler/Wholesaler/Retailer	16%
	3) Urban Wholesaler/Retailer	32%
Consumers	1) Households	
	2) Commercial (bakeries, ovens, hotels, etc.)	
	3) Industrial (charcoal kilns, tobacco kilns, bricks, kilns, etc)	

16.2.1 Fuelwood suppliers

The HESS study estimated that there were some 1,435 million standing trees with a total wood weight (air dry) of 210 million tonnes, or an average of 2.4 tonnes per hectare. Very close to half the trees were on farmlands, where the average stocking density was 4.9 per hectare, or just over twice the all-country average.

The total growth of wood per year was estimated to be 22.7 million tonnes or 10.9 percent of the standing stock. Just over a third of all trees in Pakistan are of only three species. Shisham at 16.6 percent, Ailanthus species at 9.5 percent and Babul 9.4 percent. A further three species or groups - Citrus trees at 7.0 percent, Acacia modesta at 6.7 percent and Populus spp. at 6.0 percent, bring the share of the leading six species up to over 55 percent of all trees.

Producers

State-controlled forests and the trees grown on private lands are the main sources of fuelwood production in Pakistan.

a) State Controlled Forests. Natural forests, Irrigated plantations, riverine forests, mangrove forests, rangelands, cultivated and fallow government lands, and road/canal side strips under the jurisdiction of the government constitute the production area for fuelwood. In state controlled forests, two methods are used for the disposal of fuelwood. In the first method which is followed in the northern regions of the county, the trees are felled and cross-cut into billets of suitable size and transported to depots where they are classified and stacked and from where these are sold by periodic public auctions. The low value fuelwood produced, as logging residue (branches, tops, chops, broken pieces and bark etc) during regular tree felling, is left at the stump to be collected by the local people. The purchasers transport the billets to wholesale firewood markets in cities, usually by trucks. At these markets the produce is sold to retailers through commission agents. In the second method, followed in the central and southern regions of Pakistan, the contractors are awarded wood contracts on a stumpage basis through an open auction, where cutting and conversion operations are done by the contractor and the wood is transported to consumption centers.

b) Agro-Forests. Private lands that include farm and fallow lands are the major sources of fuelwood production. Hilly areas of Pakistan are mostly rural and fuelwood is collected freely rather than purchased and is almost all forest based. Proximity to the forest, the right to collect fuelwood for domestic use and the poor economic conditions of rural people, which make purchasing fuelwood and substitute commercial fuels more or less impossible, reinforce this tendency toward free collection.

Trees in the plains are planted in the form of scattered, individual trees, tree lines along field boundaries and water courses, windbreaks/shelterbelts, *HURRY* plantations, and woodlots of other species. In the rural areas, generally fuelwood is almost a free commodity. The main reason for planting trees is to produce timber with fuelwood as a by-product.

Traders

Fuelwood trading businesses are generally small-scale operations that remain open year-round. About 40,412 businesses operate in fuelwood markets throughout Pakistan. Roughly 32 percent are found in urban centers, 52 percent in villages, and the remaining 16 percent are located along metalled roads. Retailers dominate the firewood market and constitute about 91 percent of the total. Almost 94 percent of traders in urban areas are retailers, whereas 28 percent of roadside traders are wholesalers.

a) Assemblers (Beopari)/Contractors. The assembler purchases the standing trees from the farms. The Pathan community (or local Chohan community in Sindh) is generally involved in this business throughout the country. The assembler fells, cuts, converts and transports the trees. Some assemblers have their own sale depots in the city or on roadsides where they stock the timber as well as fuelwood. Some of them also make charcoal from the wood. The assembler has to bear the expenses for cutting, loading, unloading and transportation of wood which he purchases from the farms. About 30-40 percent of the expenses are incurred on transportation (the major cost item). The assembler's profit range from 17 to 20 percent of the sale price. The profit ranges from 35 to 50 percent of sale price in the case of charcoal making. The *HURRY* plantations (Sind) are generally sold to the contractors on a stumpage basis.

In government forests, the contractors are awarded wood contracts on a stumpage basis through an open auction. Cutting and conversion operations are done by the contractors and the wood is directly transported to consumption centers.

b) Wholesalers. A trader who sells 50 percent or more of his sales to other traders is defined as a wholesaler. If 50 percent or more of his sales are made directly to consumers then the trader is classified as a retailer.

The wholesaler stores the products for some time and generally sells to the retailers. Sometimes he simultaneously acts as a retailer. The profit margin of the wholesaler is estimated as 8 to 18 percent of the sale price, depending on the area in which he is conducting his business.

c) Retailers. Retailers are situated close to their clients (consumers), indicating the overriding importance of proximity to the end-use market. In Pakistan the average retail establishment is comprised of 1.7 workers, including the owner.

The profit of the retailer is estimated as 13 to 20 percent of the sale price in various regions of the country. Seasonal variations in the supply and demand structure of the fuelwood trade are more pronounced for retailers whose summer trading activity drops to approximately 38 percent of winter sales.

The Punjab and NWFP account for about 65 percent of all retailers. This heavy concentration can partly be attributed to the availability and proximity of wood supplies from private farms. Thus most of the wood trade is taking place in the northern part of the country. Of particular note is the situation in rural areas of the NWFP where retailers account for 56 percent of the total sales to rural consumers.

Fuelwood Consumers

Consumers are the last link in the marketing chain. Their power is determined by the availability of fuelwood substitutes to which they can switch. People with low incomes and no access to fuelwood resources are especially vulnerable to high market prices.

It is estimated that as much as 60 percent of the household consumption of fuelwood is collected free of cost and the traded fuelwood represents only 40 percent of the total fuelwood consumed in Pakistan.

Fuelwood is consumed by households, commercial enterprises (bakeries, ovens, hotels etc) and industrial concerns (brick kilns, tobacco kilns, lime and charcoal kilns). Preferred species in order of priority are Babul, Mesquite, Shisham and other species. The size and shape of fuelwood are dependent upon the type of use. Fuelwood is sold in the markets in the forms of 0.8 to 1.0 meter long billets, wood pieces converted into wood stems and stumps in saw mills (gutkas), timber residues, and agriculture crop sticks (particularly cotton sticks) etc. Most of the wood consumed in a specific province originates in the same province, except for Balochistan which imports most of its supplies from neighboring Sindh and Punjab.

16.3 MAJOR MARKETING FUNCTIONS

a) Grading of Fuelwood. The fuelwood is sorted according to species and size. Billets having a diameter of 4-8 cm are treated as thin firewood billets while billets having diameter above 8 cm are sorted as thick fuelwood. The bulk of the thick fuelwood is transported over long distances to Quetta, NWFP and various big cities for use in soap factories, tobacco kilns, brick kilns, charcoal kilns, date processing units and in ovens (nan tandoors) etc. The thin firewood is sold locally for household use and firing lime kilns.

b) Storage of Fuelwood. The fuelwood is stored by the traders for assembling and distribution. Although termites attack the wood particularly that which is lying on the ground, the loss is not enormous as the wood is stored for a short period only. Attack by termites is more serious in the monsoon months when there is high humidity.

c) Transportation of Fuelwood. Transport plays a fundamental role in the trade and marketing of fuelwood and its nature depends on several factors like infrastructure, wages and fuelwood prices. Mechanization of loading and unloading is not widely used and most handling is done manually. This is very time consuming and adds to the transportation costs.

Off-road transport of fuelwood is practiced mostly by the fuelwood and biomass collectors living at the fringes of the forest. This system of transport works well for short distances (a maximum of 10 km). The means of transport are head loads or pack animals. A part of the fuelwood extracted and transported by pack animals is used for commercial purposes and is directly sold to the consumers in the towns on the basis of animal loads through mutual bargaining.

On-road transport takes place on the forest roads as well as the public roads. The means of transport may be mechanical, manual r by animals. On-road transport by mechanical means is the quickest way to transport fuelwood.

Water transport is practiced in the hilly areas and between Guddu and Sukkur Barrages at the Indus River. In the hilly areas the collectors of fuelwood (mostly split billets) throw it into the stream and float it in batches. In Sindh the fuelwood is transported by boats. Water transport is cheaper than other transport modes in these areas.

Taxes on the transportation of fuelwood are charged by the forest departments (royalties and transit permits) and local bodies like district councils, municipalities and town committees (zila taxes and octroi duties). Transit taxes show wide variation from place to place. Zila and octroi taxes vary from 9 percent in Sindh to 34 percent in Punjab.

16.4 FUELWOOD PRICES

Fuelwood prices are governed by many factors such as type of species, form/shape of fuelwood, distance from production to consumption areas and octroi and other taxes etc. In Pakistan the price differences at different market localities are small (6 percent of the national average) because fuelwood from lower-priced markets is brought to the higher priced markets where the additional fuelwood, in turn, increases the supply and decreases the price. Another reason could be that fuelwood is not considered to be scarce. Real firewood prices in Pakistan have remained relatively stable in recent years. The price for all sales ranges from 200 to 1500 rupees/tonne with an average price of about Rs. 850/tonne. Babul prices are the lowest, fetching about Rs. 50/tonne, while assorted other species fetch roughly 50 percent higher prices (Rs. 750 /tonne). Shisham wood is valued at Rs. 850 /tonne.

16.5 RECOMMENDATIONS

i) In order to secure needed improvements in fuelwood marketing, fuelwood markets deserve to be a more prominent focus of research.

ii) The information sector has a very important role to play in developing and marketing fuelwood. Meaningful linkages need to be created between the informal and formal sectors. The existing mass media channels (radio,T.V. and newspapers) should be used to disseminate marketing information on prices, buyers in the marketing chain and post harvest technology etc.

iii) A review of country wide zila (District), octroi and forest department taxes structures should be undertaken with a view towards transparency, simplification and standardization.

iv) Holding auction is the best way to settle the price. But presently, these are so manipulated by the market functionaries that the producer does not receive a fair price for his produce. No regulation or organization exists for checking unfair practices and excessive charges in marketing services and for removal of operational defects of the system. The following measures are suggested to improve the situation.

- Government functionaries should be associated with the regulation and supervision of markets. For this purpose, Market Committees should be entrusted to perform the functions like granting of licenses to commission agents, formulation and enforcement of rules for auction etc.

- The bulk purchasers earn abnormal profits due to the producers' ignorance of the prevailing retail prices. Growers should, therefore, be kept informed of the day-to-day retail prices of the fuelwood by displaying these on notice boards installed in the timber markets and other prominent places like agricultural produce markets, bus stands and railway stations etc.

v) Forest production and management on private lands should be declared an industry and loans should be advanced by the institutional sources for increasing production and purchasing improved means of transportation and handling.

vi) Improved methods of harvesting forests, conservation, transportation, loading and unloading of forest products, to save time and losses, should be adopted.

vii) The subject of wood energy and fuelwood trade should be included in the training courses at Forestry and Agricultural Training Institutes. Refresher courses in woodfuel production and marketing should be arranged for field staff of government forestry and agriculture departments.

viii) Fast-growing fuelwood trees should be grown on village common lands (shamlat Deh).

ix) Policies to motivate growers and promote reforestation/activities and to reform the taxation system etc. need to be addressed on a sustainable basis. There needs to be more public participation in policy formulation.

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17. ENVIRONMENTAL IMPACTS OF ENERGY PRODUCTION FROM BIOMASS

by

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Almost all methods of producing energy have environmental impacts. Energy related activities not only disturb ecosystems but also affect human health. The combustion of fossil and biomass fuels causes the emission of CO_2, SO_2, NO_2, NOx etc. which contribute strongly to the greenhouse effect. The generation of hydro-electricity through the construction of big dams results in the inundation of fertile land, dislocation of thousands of people, loss of biodiversity and pollution of soil through waterlogging and salinity. The production of nuclear energy may cause radiation with disastrous consequences for human health. Some of the renewable sources of energy like solar, wind and geothermal energy are environmentally friendly but are not yet popular.

Biomass, when burnt directly, has impacts on the atmosphere through the release of carbon dioxide if the amount does not match with the carbon dioxide needs of the plants in photosynthesis and this contributes to the greenhouse effect. However, the negative impact of biomass energy on the environment is less than that of fossil fuels. On the positive side biomass acts as a sink for atmospheric CO_2 and helps to conserve soil and water.

17.1 BIOMASS ENERGY SOURCES OF PAKISTAN

There are three major sources of biomass energy in Pakistan. These are fuel wood, agricultural residues and livestock manure. It has been estimated that the share of biomass energy sources in overall energy use is around 30%. The actual and estimated consumption of biomass fuels over a period of 10 years are given in Table 1.

Table 1: Consumption of Biomass Energy Fuels

Fuels	**Consumption (thousand tonnes)**	
	Actual (1983-84)	**Estimated (1993-94)**
Dung cakes	7,219.20	9,702.00
Firewood	14,183.79	19,061.82
Charcoal	53.39	71.75
Bagasses	3,811.22	5,121.96
Cotton sticks	2,060.98	2,769.78
Saw dust	190.90	256.55
Shrubs	2,059.85	2,768.55
Weeds	79.58	106.95
Tobacco sticks	12.27	12.27
Total	29,671.18	39,871.35

Biomass meets about 86% of the total domestic energy requirements (Table 2). About 90% of the rural population and 50% of the urban population depend on biomass fuels. It has been estimated that about 80% of these fuels is used in rural areas. In fact anything that can be burnt is used for cooking and heating in rural and semi-urban areas.

Table 2: Biomass Energy Consumption in the Domestic Sector(1991-92)

Fuel	Energy consumption (Mtoe)
Charcoal	0.119
Firewood	10.640
Dung cakes	30613
Crop residues	2.816
Total Biomass	17.188
Total energy consumption	19.988

Fuelwood accounts for 50% of the total biomass fuel supply. Its production during 1995-96 was about 357 thousand m^3. Presently, about 10% of the firewood requirements are met from state forests while 90 percent come from the farmlands. Of the total fuelwood used more than 75% is consumed in rural areas mainly for cooking, heating and processing of agricultural products. It is also used for brick burning and tobacco curing.

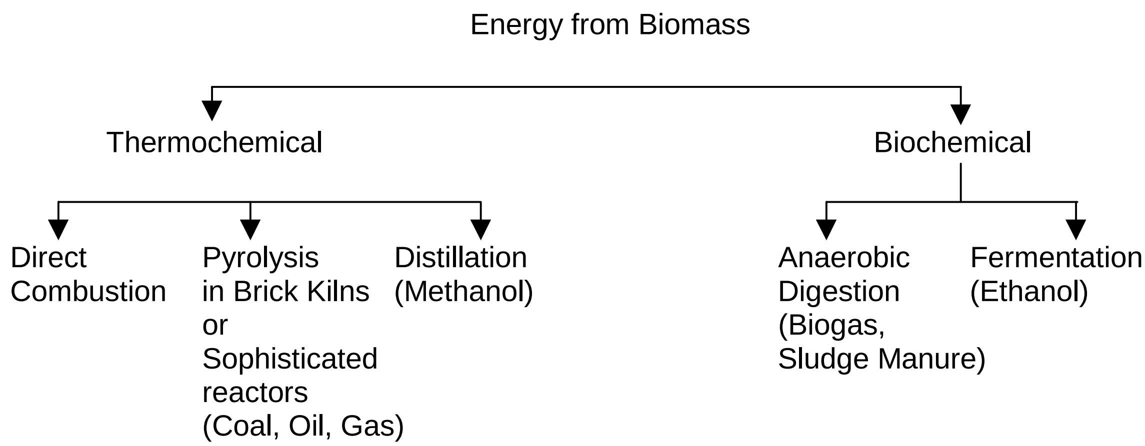
The agricultural residues in Pakistan mainly consist of the straws of wheat, rice, barley, sticks of cotton and tobacco and the stubbles of sorghum, maize and millet. The total production of crop residues during 1995-96 was estimated as 49 million tonnes. The major portion came from wheat straw, rice straw, cotton sticks and tobacco sticks. Among these, rice straw, cotton and tobacco sticks and sugarcane bagasse are widely used for energy production. Maize, sorghum and millet stubbles are also used as domestic fuel by poor farmers.

Animal manure production was estimated to be 260 million tonnes during 1995-96. About 50% of animal dung collected is burnt in the form of dug cakes. Animals manure can be easily converted into biogas but the technology is still not popular among the farmers.

17.2 BIOMASS CONVERSION PROCESSES

Biomass is converted into various energy forms by different processes ranging from simple burning to extremely complex methods. As shown in figure 1 biomass can be transformed into energy sources through the thermochemical process of pyrolysis and distillation whereby products such as charcoal, oil, gases and methanol are produced. Through the bio-chemical process of anaerobic digestion biomass and crop residues are converted into biogas and by fermentation into ethanol.

Figure 1: Biomass Conversion Process for Energy Production



The biomass conversion processes and technologies commonly practiced in Pakistan are discussed below.

Direct Combustion

Direct combustion is the most common method of energy production from biomass in Pakistan. Clay stoves with a thermal efficiency as low as 5 percent are generally used for cooking in rural areas. Some energy efficient cooking stoves have been developed which are able to achieve a fuel saving of 30-40 percent over the traditional ones. However, these stoves have not been adopted on a large scale by the rural population.

Pyrolysis

Pyrolysis of biomass can provide liquids(oils), low calorific value gases and charcoal. In Pakistan this technology is used for charcoal production. The coal produced is of low quality due to its charring in excess air and the use of a poor quality wood mixture during the process. Other products like gas and liquid which are not collected result in loss of energy and environmental pollution.

Bio-methanation

Bio-methantion (anaerobic digestion) is a microbial process which converts biomass into methane gas for use as fuel. The technology was introduced into Pakistan in the Seventies. More than five thousand biogas plants of 5-7 m3 capacity have been installed. However, most of the these are not now operating, only 20 percent are in working condition. There is a general belief that biogas programs have failed in Pakistan.

17.3 ENVIRONMENTAL IMPACTS OF BIOMASS ENERGY PRODUCTION

The biomass energy production and consumption systems strongly effect the environment. The production and conservation of biomass, especially forests, improve the environment as it absorbs the CO_2 from the atmosphere, arrests soil erosion and reduces run-off. On the other hand its over exploitation may result in enhanced soil and water erosion, loss of organic matter and biodiversity. It may contribute to greenhouse gas emissions if burnt in large quantities or allowed to decay. The environmental impacts associated with various biomass energy sources are outlined in Table 3.

Table 3: Environmental Impacts of Biomass Fuels

Kind of Fuel	Activity	Associated Impacts
Fuelwood and charcoal	Production	Deforestation; ecological impacts including loss of bio-diversity, erosion and watershed disturbance leading to increased flooding and inadequate flow in the dry season
	Combustion	Air pollution and health effects
Plant and animal residues	Burning as fuel	Loss of organic matter needed by soil, local air pollution
Biogas	Production	Land, water and air pollution
	Combustion/ Electricity Generation	Benign as compared to fossil fuels
Ethanol	Production	Large amounts of toxic effluents and stillage generated
	Burning/use in internal combustion engines	Relatively safe as compared to fossil fuels

The greenhouse gas emissions from different sources have been estimated in a study on "greenhouse Gas Emissions" recently conducted under the Ministry of Environment, Local government, Forestry and Wildlife. The GHG emissions due to energy related activities are given in Table 4. Environmental impacts of biomass fuels and related activities practiced in Pakistan are briefly discussed as follows:

Fuelwood

Burning of firewood, forest clearing together with unsustainable land use practices add significantly to the total atmospheric carbon dioxide budget. It has now become evident that an additional impact of non-fossil CO_2 into the atmosphere due to reduction in forests and other biomass stocks, conversion of forest and rangelands and abandonment of rangelands at global level is of the same order of magnitude as the impact of fossil fuel CO_2.

As the CO_2 emissions due to the burning of biomass are completely offset by the annual uptake of CO_2 from regrowing biomass, the net CO_2 emissions are accounted for by the reduction of total biomass. Thus the CO_2 emissions in Table 4, besides wood burning, also include CO_2 releases due to wood decay and land use changes. However, the major contribution comes from fuelwood.

The over-exploitation of forest resources for fuelwood production may also result in the deterioration of the environment through desertification, enhanced soil erosion, flooding, land slide, sedimentation, habitat destruction, species extinction and soil degradation etc. Due to fuelwood shortage the pressure on the natural forests, especially in the hilly areas, has tremendously increased in the recent past. Wood is the only available energy source in most of the remote areas.

In contrast to other energy sources, biomass, especially wood biomass, greatly helps to improve the environment if properly managed. Forests play a critical role in the global environment and are an important component of many terrestrial ecosystems. They not only combat air pollution but also check soil erosion, conserve water, regulate stream flow, ameliorate climate and determine the distribution of flora and fauna.

Charcoal

Since charcoal is produced from wood, the impacts of its production are essentially the same as those described under firewood. However, the use of charcoal itself is less polluting than firewood. It is smokeless, with much fewer emissions of particulates and hydrocarbons. Therefore, it is more suitable for cooking and heating in closed places. However, carbon monoxide poisoning may occur if adequate ventilation is not provided. Moreover, during the production of charcoal in brick and mud kilns, effluent gases including CO_2 are released in large amounts into the ambient environment. GHG emissions due to charcoal burning are given in Table 4.

As compared to fuelwood and crop residues, which are utilized in a most inefficient way, charcoal is a clean and easily transportable fuel. The negative environmental impact of charcoal production could be further reduced if the gases and liquids produced during the process were also collected and properly utilized.

Crop Residues

Burning of crop residues for energy production contributes significantly to greenhouse gas emissions as the bulk of these are used through direct combustion (Table 4). The atmospheric pollution due to the burning of crop residues could be greatly reduced if transformed into other useful energy forms. The crop residues may also lead to environmental pollution and loss of soil fertility if not handled properly.

Animal Dung

Direct combustion of animal dung not only deprives the soil of valuable organic matter but also adds substantially to GHG emissions (Table 4). Efficient utilization of this biomass sources will not only reduce environmental pollution but also help in the generation of clean energy.

Biogas produced from animal dung through anaerobic fermentation is almost environmentally benign compared to fossil fuels. However, the environmental impacts of production and use of biogas vary in the context of the technology package. Environmental problems with regard to land and water pollution may arise if the slurry is not handled properly. Besides, methane may escape from the slurry if not completely digested.

Table 4: GHG Emissions from Biomass Fuels (1994-95)

(Gg)

Activity	**CO_2**	**CH_4**	**N_2O**	**NOx**	**CO**
Changes in forests & other woody biomass	39256	-	-	-	-
Wood burning	-	211.20	1.45	52.48	1847.99
Agricultural wastes	-	23.04	0.57	24.05	483.92
Animal dung	-	107.56	0.79	33.01	664.36
Charcoal	-	3.16	0.15	0.65	19.50
Total biomass sources	39256	344.96	2.96	110.19	3015.77
All energy sources	84159	616.00	3.00	110.00	3016.00
Total national emissions	127359	4655.0	3.00	112.00	3066.00

17.4 ENVIRONMENTAL IMPACT ASSESSMENT

Environmental Impact Assessment (EIA) is a primary tool for enforcement of interventions related to the environment. It helps to identify the negative environmental consequences of various developmental activities and to suggest means for their mitigation. Different techniques are used to examine problems, conflicts or natural resource limitations that may affect project viability and potentially harmful effects to people, fauna, flora, soil, water, atmosphere, landscape cultural sites etc., adjoining land uses that are in the project area or affected by it.

In considering the possible environmental impacts of the proposal the following aspects should be fully assessed:

(i) Adverse and/or beneficial effects;

(ii) Primary and secondary effects;

(iii) Unavoidable effects;

(iv) Immediate short-term effects;

(v) The probability of an effect occurring; and

(vi) Whether or not any changes are irreversible or will offer or consume irreplaceable resources.

17.5 CONCLUSIONS AND RECOMMENDATIONS

Continuous use of non-renewable sources of energy, especially fossil fuels, has caused environmental pollution both locally and globally. The renewable sources of energy are comparatively benign. Biomass may be a suitable alternative as it is renewable and available in abundance. However, its use could be more beneficial if, instead of burning, it is converted into other useful forms of energy and produced on a sustainable basis. What is immediately required in Pakistan is to popularize fuel-efficient stoves and utensils among the rural masses. Awareness should be raised so that energy sources can be used more judicious and cause less damage to the environment. To promote biomass production and its utilization in an efficient manner the following suggestions are made:

- Produce biomass, especially wood on a sustainable basis;
- introduce/popularize fuel-efficient devices in the domestic sector;
- transform of biomass to clean energy forms like charcoal, biogas, producer gas, ethanol, methanol etc; and
- create awareness among people regarding the negative environmental impacts of energy use.

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18. BIOENERGY FOR MEETING GROWING ENERGY NEEDS

by

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18.1 INTRODUCTION

An adequate supply of energy at reasonable cost is a key factor in the economic development of a country. The choice of the predominant form of energy to be used during a particular period in history has been governed mainly by the competitive cost, dependable availability, end-use suitability and environmental compatibility. The oil crisis during 1973 proved a blessing in disguise. We then realized that too much dependence on only one source of energy was not only risky but could even be suicidal. Serious thought was then given to the search for alternative renewable and non-polluting sources of energy. Fossil fuels generally have fallen out of favour. They are non-renewable and thus the supply of many such fuels is approaching the stage of exhaustion. It is becoming increasingly difficult to procure some of them due to transport bottlenecks and steep hikes in their prices. Their continued and increasing use also creates environmental problems. Biomass has been in use since time immemorial, but it is only recently that its potential for meeting our growing energy needs have been given serious consideration.

18.2 THE WOODFUEL PROBLEM

In 1980 nearly half the world population depended for its energy needs on fuelwood. Wood is thus the most commonly used source of energy in the world. For the inhabitants of the developing countries, it is much more than that: it was and is the staple energy resource of three-quarters of the population. In some of the poorest African nations it still accounts for more than 90% of national energy consumption. Of the 2000 million people in developing countries who depended on wood, 96 million were already in 1980 unable to satisfy their minimum energy needs for cooking and heating. A further 1052 million people were in a " deficit situation" and could meet their needs only by depleting wood reserves. Out of this total of 1148 million people, more than 64% lived in Asia.

These are the essential statistics of the 1980 fuelwood crisis. However, the situation has been worsening rapidly since then.

By the year 2000 the world woodfuel deficit is expected to reach 960 million cubic meters a year - the energy equivalent of 240 million tonnes of oil a year.

Projections for the year 2000 suggest that, without immediate action to improve the situation, 2400 million people will by then either be unable to obtain their minimum energy requirements or will be forced to consume wood faster than it is being grown.

18.3 ROLE OF NON-COMMERCIAL FUELS IN NATIONAL ENERGY CONSUMPTION

The composition of national energy consumption has undergone considerable change during the past 15 years. The share of commercial fuels has gone up to 63.2% (20.3 million toe) whereas the consumption of non-commercial fuels is 36.8 % (11.9 million toe). See Table 1 for a breakdown by fuel type. The household and commercial sector is the largest consumer of energy in Pakistan and its share in overall energy consumption is 49.7%. The industrial sector consumes 25.1% of all energy consumed and the share of the transport sector is 20.9%.

Table 1: Estimated Annual Consumption of Non-Commercial Fuels

Fuel Type	**Oil equivalent (1000 tonnes)**	**Oil equivalent 1996 (Projected @2.9% growth rate) (1000 tonnes)**	**Share in percent**
Firewood	3806	4784	54.16
Dung cake	1091	1371	15.52
Bagasse	1157	1454	16.50
Cotton sticks	448	563	6.36
Shrubs	392	493	5.58
Saw dust	91	114	1.29
Others like tobacco sticks, etc	42	53	0.59
Total	7027	8832	100.00

Source: Ms. Mamoona S. Malik (1996)

18.4 SHARE OF WOOD IN HOUSEHOLD SECTOR

The dependence of households on wood is paramount, especially in rural areas. Of all households, 70% used wood as the principal fuel for domestic cooking, whereas this proportion was 79% in rural areas and 48% in the urban areas in 1980. The relative share of urban areas in total fuelwood consumption is 22%, whereas the share of rural areas has gone up to 78%, indicating an increasing demand for fuelwood in rural areas.

Total energy consumption in the household sector is 14.286 million toe, the share of commercial fuels has increased to 18.3% and that of non-commercial fuels to 81.7%. The relative share of wood is 44.2% among the non-commercial fuels and that of others 37.4%, consisting of dung cakes, bagasse, cotton sticks, shrubs, saw dust, tobacco sticks, etc. Wood accounts for over 20% of national energy consumption and 45 % of total domestic energy consumption.

18.5 BIOMASS AS ENERGY

The relative importance of different energy sources can be assessed by knowing the number of people who depend on a particular source. Biomass may come on top of the list for the simple reason that some 3,800 million people living in developing countries rely more on biomass than on any other individual fuel. Currently, about ten times more energy is stored in the form of biomass than is consumed globally in all energy forms in a year. This means considerable potential for the expansion of the use of biomass energy exists.

One of Pakistan's natural assets is the abundant availability of sunshine. There is thus a vast scope for harvesting solar energy and improving photosynthetic efficiency. Photosynthesis helps to remove carbon dioxide from the atmosphere and generate oxygen, the life sustaining gas. Biomass energy is thus environmentally a very acceptable resource. The World Energy Council quotes a figure of approximately 12% as being the share of biomass in the total amount of primary energy used on a worldwide basis. For South Asia this amount is about 50%. An important property of biomass is its versatility, e.g. it can be burnt directly to provide heat, it can be converted to electricity, to liquid or gaseous fuels, it can be stored.

18.6 THE SOLUTION TO THE PROBLEM OF ENERGY SHORTAGES

It may be said that the solution to the woodfuel problem is to find an alternative energy source for the developing countries including Pakistan. The best alternative to woodfuel is more woodfuel - and the reason is that providing energy in the form of renewable wood solves far more than the problems of a drastic energy shortage. Wood plantations can take many different forms and provide many different benefits. Besides yielding fuel, they can help provide timber for homes and village industries, restore fertility to the land, halt desertification, prevent soil erosion, reduce flooding, provide animal forage and improve the climate. No other alternative form of energy can offer such a broad prospectus.

Most of the literature on energy stresses the magnitude of the woodfuel problem but this is only one aspect of the story. In the long run, the role of forest energy in world development is likely to be far more positive. Even today, there are many countries in which woodfuel supply is much higher than demand. In those countries, this important and renewable energy source will play and already is playing, a key role in national development. Wood, after all, is a cheap and renewable form of solar energy. As one report has put it, "Despite much research, no one has yet invented a cheaper or more adaptable system for capturing and storing solar energy than leaves and wood."

Many countries are already using wood energy not only to meet the demand for domestic cooking and heating but to meet the demand of the industrial sector as well. Woodfuel and charcoal have many positive features as sources of commercial energy. They are ideal, of course, for providing both process heat and shaft power for forest industries like saw milling, chipping, panel production and pulp and papermaking. In most cases these industries can now be run more profitably using wood energy than they can using fossil fuel.

Secondly, there are many small-scale, predominantly rural industries where fuelwood or charcoal can provide a convenient source of heat. These include crop drying, brick making, pottery firing, lime production and even the manufacture of cement. Thirdly, wood energy is also used extensively in heavy industry, notably in mineral smelting where charcoal is in some countries the preferred fuel. Finally, the use of fuelwood and charcoal for electric power production is being intensively investigated and, in fact, a handful of countries are already generating electricity in this way.

It is also significant that the uses of fuelwood are now being intensively investigated in the developed countries. In the long run, restoring and increasing the number of trees in rural areas is likely to provide more advantages for less expenditure than any other comparable technique for dealing with the woodfuel crisis. But solving the woodfuel problem cannot be conceived as an isolated issue, separate from related problems of rural development, agricultural production and environmental stabilization. The effective solutions will be those which include energy forestry as part of a more general development strategy and which reap all the rewards which trees can offer including the supply of fuel.

18.7 STRATEGIES TO OVERCOME THE ENERGY CRISIS

A few ways to overcome the energy crisis are given below:

(a) Increasing the productivity of existing resources

Improving the productivity of existing resources is obviously much cheaper than establishing new plantations. Active management is needed not only of the forests themselves, but also of all other types of tree cover like open scrub, small woodlots and even of trees grown for other purposes such as fruit, fodder or shelter. Even simple protection measures can sometimes increase yield by more than 50% Every attempt must be made to win the support and help of local people. Only if they are actively involved in managing and controlling their fuelwood supplies is there any hope of averting worsening problems in the future.

Some basic preconditions to improving the productivity of existing resources are:

- Production of fuelwood will have to become a major goal of national forestry policy.
- New legislation can be passed to provide local people with access to fuelwood resources and stimulate them to become involved in forest management and control.
- Forestry institutions must be strengthened so that they can help local people manage their own woodfuel resources.
- Sustained yield management practices must be adopted to stimulate forest biomass production.
- The woodfuel potential of existing resources must be surveyed and publicized.

One important reason for the low productivity of today's forests is past unplanned use, resulting in low yields. Introducing scientific forestry practices can ensure high and sustainable yields.

Using simple techniques to improve the woodfuel potential of existing resources, it seems possible that production could be increased by an average of 20 per cent. This figure can be used to check the economics of improving what already exists as against planting new areas for woodfuel. New plantations may well be essential but improving production from existing resources is normally the first thing worth looking at. Though implementation may be difficult, the gains can be particularly rewarding.

Forest, agricultural and urban wastes are generally difficult to handle because of their bulky and scattered nature, low thermal efficiency and copious release of smoke. To ensure maximum and efficient exploitation of bio-resources, it is essential to compress them into manageable units with high thermal value.

Many of these products have a surprisingly high calorific value. For example, a briquette containing 30-45% charcoal dust, 30-45 per cent chopped twigs and 15-20 per cent manure burns comparably to a medium-quality hard coal. However, few of these techniques have yet been tried out in developing counties. They need to be developed in combined programmes aimed at improving the design and distribution of stoves, because fuel which has been compressed in some way cannot usually be burnt satisfactorily in an open fireplace.

(b) Creating new resources

Woodfuel shortfalls can be made good within a reasonable period if several hundred million trees are planted annually and well looked after. This formidable task is made more difficult by the fact that the areas in which new trees are most needed are often those in which population pressure is high and environmental conditions are unfavourable. Indeed, it is often pressure on the land which has led to deforestation, soil erosion and woodfuel shortage in the first place. Encouraging farmers to plant trees on an individual basis is often the most effective method.

The main objective of energy plantations is to produce energy rather than industrial wood; therefore, selection of species assumes greater significance. The specific objective should be to select species with high biomass yield, high calorific value, fast growth, good coppicing, ease of establishment, high adaptability, little after-care, identification of plants for problematic regions and species with nitrogen fixing ability as well as high woodfuel yield.

(c) Improved woodfuel distribution

If woodfuel is to be continuously available within reasonable distances and at reasonable cost, it must be planted, managed, harvested, distributed and sold. Over the next few years the supply of rural woodfuel will become increasingly commercialized and the concept of firewood as a free good will disappear. Not only is this inevitable, it is desirable - in spite of the excessive profits which may be exacted by rapacious middlemen, and of the difficulties which inflexible bureaucrats may introduce. A properly organized system for the distribution and sale of woodfuel will do much to protect the rural poor from exploitation by the urban middle classes. Transport is the most important factor in determining the cost of woodfuel. It rarely pays to use lorries to transport woodfuel over distances of more than 100 kilometers.

Marketing cooperatives and associations need to be organized, a price structure worked out and storage facilities established so that stocks can be accumulated to satisfy demand when supply is low. The production and marketing of charcoal is already a commercial business in most countries and one which is now likely to expand significantly because it is economical to transport charcoal over much greater distances than are viable for wood.

(d) Improving conversion and utilization technologies

There are three important ways of increasing the efficiency with which woodfuel is converted into useful energy: improving the efficiency of charcoal production; persuading consumers to use improved cooking stoves; and making economies during cooking itself.

18.8 IMPROVING THE EFFICIENCY OF CHARCOAL PRODUCTION

Charcoal is an excellent fuel, with a calorific value comparable to that of good quality coal and about twice that of wood. It neither rots when stored nor smokes when burnt, is light and hence cheap to transport and imparts a delicious flavor to food cooked over it. The energy losses incurred during production are no larger than those of a power station. And because charcoal is usually burnt in stoves, and because those stoves are usually more efficient than those which burn wood, it may in fact be nearly as energy efficient to use charcoal as it is to use woodfuel. Production is, therefore, only one aspect of the charcoal industry and overall efficiency depends on a whole chain of operations from wood harvesting to use. Where huge quantities of wood are being carbonized, it is obviously important to produce the charcoal as efficiently as possible.

18.9 IMPROVED COOKING STOVES

The consumer is the one who benefits - or should benefit - when a stove capable of burning either woodfuel or charcoal efficiently is used instead of an open fire. It is often claimed that stoves can reduce the amount of fuel needed for cooking by upto 50%, though 30 per cent might be a more realistic figure. This is because the efficiency of open fires is thought to be only 5-10 per cent. It is clear that a stove can improve the domestic environment quite dramatically. Ridding the atmosphere of smoke and improving ventilation are two major advantages. Another is that there are fewer burns from stoves than from open fires. Where space heating is important, there is no doubt that the improved energy efficiency of a stove can produce major savings in fuel consumption. For all these reasons, where the stove is an appropriate solution there is a need to disseminate knowledge of the technology involved very widely.

18.10 BIOMASS PLANTS

Inadequate supply of energy through conventional sources and the sky-rocketing prices of inorganic fertilizers are posing major constraints in improving the productivity of human, soil and plant resources. On the other hand, disposal of animal dung in an un-hygienic manner spreads a variety of infectious diseases and creates a host of pollution problems. Installation of biogas plants helps to provide not only fuel for homes, fertilizers for the soil but also sanitary conditions for a good 'living'. It is an important innovation to conserve firewood. Unlike the huge thermal power stations, these mini 'power houses' of the rural folk do not involve heavy capital investment or huge transmission and distribution losses.

18.11 POWER GENERATION

Rural electrification is one of the basic infrastructural elements in rural development. The main thrust has been on electrification of villages and energization of pump sites. Under the changing energy scenario, new and renewable sources offer promising scope for rural electrification on account of their low running cost, no adverse environmental impact and decentralized energy production, thus leading to local energy self-reliance. The supply of electricity through these sources can also be expanded for meeting basic needs, such as lighting and drinking water; for irrigation; for existing income generating activities; community services and cultural services. In other words, decentralized energy supply will help to raise income and improve the well-being and quality of life of the people.

18.12 RECOMMENDATIONS

Bioenergy occupies a dominant place as an energy source, particularly in the rural sector. In order to meet the minimum energy needs, a bioenergy programme needs to be given top priority. Its success, however, depends upon the following policy measures:

- Integration of production, conversion, utilization and conservation of bioenergy aspects.
- Integration of R&D, demonstration and extension activities.

To accelerate the development activities relating to bioenergy, stress needs to be laid on the following aspects:

- Conservation of wood through popularization of improved stoves, biogas plants, briquetting of organic residues and technologies based on solar energy.
- Selection of fast-growing, nitrogen-fixing species having good coppicing capacity and high calorific value under sub-standard soil conditions.
- Development of sound management practices in respect of planting techniques, irrigation, protection measures, harvesting techniques, etc.
- Development of producer gas technology based on wood and agricultural residues for electrification, lift irrigation and use in automobiles.
- Collection and dissemination of information on the availability of biomass organic residues, aquatic biomass, forest biomass, energy trees and shrubs in different locations.

The objective should be to set the stage to make biomass programmes a people's movement where all activities relating to production, conversion, utilization and conservation of biomass will be taken up on a decentralized basis to meet local needs to a significant extent.

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19. FUELWOOD PRODUCTION FROM PUBLIC AND NON-FOREST AREAS IN PAKISTAN

by

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19.1 INTRODUCTION

Despite replacement by natural gas and kerosene oil cooking stoves, wood remains the principal source of energy for domestic cooking and heating in Pakistan. For the majority of rural households and many of the poor urban households woodfuel is the most accessible and affordable option for cooking. According to the 1980 census figures, about 70% of households in Pakistan use wood as a fuel. The HESS reports 1991, revealed that 79% of all households use fuelwood. In rural areas, 91% of the households use wood fuel whereas in urban areas 52% of the households are fuelwood users. Fuelwood is also used in brick kiln and tobacco curing industries. A small quantity is converted into charcoal which is used mainly for room heating. Restaurants and laundry shops also use charcoal in small quantities.

The supply of fuelwood is insufficient to meet the demand with the result that cow dung and crop residues are being burnt which otherwise would have been used to restore soil fertility and increase food production.

According to the Forestry Sector Master Plan per capita fuelwood consumption is 0.208 m3 and total fuelwood consumption in 1997 is thus estimated at 28.14 million m3 (industrial and domestic) for the population of 135.28 million. With the tremendous increase in population, the projected consumption of fuelwood in Pakistan will be more than 30 million m3 in 2000 and 43 million m3 in 2018. The share of fuelwood consumption in total use of round wood is 89%. The annual production is estimated at 14.4 million m3. Thus there will be a gap of more than 15 million m3. According to the HESS report of 1993, the annual fuelwood production is 30.25 million m3 and annual consumption of 43.30 million m3. Thus the fuelwood gap for Pakistan is 13.8 million m3. This gap is very close to that stated in the Forestry Sector Master Plan. Other studies have also given somewhat similar results.

According to the Forestry Sector Master Plan, only 2% of the fuelwood supplies come from state forests and the remaining 98% from the trees grown on farmlands within the country.

The existing forests and plantations are under tremendous pressure from cutting trees for fuelwood and this has depleted wood resources.

The Government of Pakistan has prepared a 25 years Forestry Sector Master Plan to increase the forest area from the existing 4.8% to 10% and the main focus is on planting on farmlands, i.e. 3.6 million ha on private land and 0.3 million ha on public land. The new forest areas and the improvement in management of existing forests will raise the sustainable supplies of wood from 14.4 million m3 to 49.5 million m3 by 2018. This will be sufficient to meet 96% of the projected demand and will solve the fuelwood scarcity problem in the future.

19.2 FOREST RESOURCES

Pakistan is a forest deficit country. Forests cover only 4.28 million ha. or 4.9% of the total land area of 87.98 million ha. The production forests cover just 1/3 of the total forests and the rest are "protection forests" whose role is to protect the watersheds and erodible lands. The biggest forest resources are the coniferous forests on an area of 1.94 million ha, and about one half of these are production forests. Other productive forests are the plain irrigated plantations of 0.26 million ha, especially in the Punjab and Sindh and the riverine forests of 0.32 million ha in Sindh and the Punjab. The non-productive forests in the hills and plains are the scrub forests of 1.27 million ha and the coastal forests of 0.28 million ha respectively. Per capita forest area is 0.03 ha as compared to the world average of about 1 ha. Out of the total of 4.28 million ha, only 1.36 million ha or 31.8% produce timber and firewood. The productive forest area by provinces/territory is given in Table 1.

Table 1: Abstract of Area Statistics by Province and Territory, 1992-93

(Million hectares)

Province/ Territory	Total land area	Forest area		Production forest		Per capita forest area
		Area	% of total	Area	% of forest	
NWFP	10.17	1.40	13.8	0.26	18.6	0.077
Punjab	20.63	0.57	2.8	0.28	49.1	0.008
Sindh	14.09	0.65	4.6	0.18	27.1	0.024
Balochistan	34.72	0.29	0.8	-	-	0.115
Northern areas	7.04	0.95	13.5	0.22	23.2	1.187
Azad Kashmir	1.33	0.42	31.6	0.42	100.2	0.147
Total	87.98	4.28	4.9	1.36	31.8	0.034

Source: Forestry Statistics of Pakistan,1996.

19.3 FUELWOOD SUPPLIES AND DEMAND

Wood is the main source of energy for domestic cooking and heating especially in the rural areas of Pakistan. According to the Forestry Sector Master Plan, per capita fuelwood consumption is 0.208 m^3 and total fuelwood consumption for the population of 135.28 million in 1997 is thus estimated at 30.16 million m^3 (industrial and fuelwood) of which 0.2 million m^3 is used in the industrial sector and the rest in the household sector. Of the total, 27.14 million m^3 is contributed by farmlands and waste land and the remaining 3.01 million m3 (10%) is supplied by the state controlled forests, in the form of recorded and unrecorded removals. Growing at 2% per annum, it will increase to 30.2 million m^3 in 2000 and 43.1 million in 2008. The recorded output of firewood from the state controlled forests is nominal i.e. 0.14 million m^3. The annual production from state forests and farmlands is estimated at 14.4 million m^3 (FSMP). Thus there is a gap of about 15 million m^3. According to the HESS report of 1993, the annual fuelwood production is 30.25 million m^3 and annual consumption 43.3 million m^3. Thus the fuelwood gap for Pakistan is estimated at about 13 million m^3. This gap is very close to that estimated by the Forestry Sector Master Plan of 15 million m^3. Other studies have also given somewhat similar results. The gap is being met by overcutting of trees in the state and private forests and on farmlands which is not only depleting the resource but also causing environmental degradation. Table 2 shows biomass resource, sustainable productivity and consumption levels by type of wood.

Table 2: Biomass resources, sustainable productivity and consumption level by type of wood

(000 tonnes)

Type	**Standing Stock**	**Sustainable**	**Consumption productivity**	**Deficit level**
Round wood	169,600	12,590	19,400	6,810
Twigs	31,390	4,360	5,500	1,140
Shrubs	9,780	5,740	7,600	1,860
Total	210,770	22,690	32,500	9,801
Million m3	281.03	30.25	43.3	13.05

19.4 PROBLEMS OF FUELWOOD PRODUCTION

- Fuelwood production is not commercial as compared to agronomic crops on fertile soils.
- Due to the involvement of middlemen in the fuelwood trade, the growers are not getting the expected return.
- The fuelwood price has not increased in proportion to daily use commodities and other fuels.
- Fuelwood production is dwinding with overall degradation of producing areas.
- Primitive, wasteful and inefficient systems of felling and converting of trees are being practiced.

19.5 PREFERRED FUELWOOD SPECIES

The species that farmers prefer for use in cooking are Shisham, Kikar, Phulai, Babul, Kandi, Ber and Mesquite. These species are preferred because their wood has good burning characteristics (they burn easily and with heat) and because they are readily available. In Sindh, in mangroves, the main species is Timer which accounts for 99% of the species composition and people of the area use this species for fuelwood. In the future, Eucalyptus and Poplar will be the main species for fuelwood due to their fast growing nature.

19.6 FUELWOOD AND CHARCOAL PRICES

The fuelwood prices during 1994-95 ranged between Rs.63 and 80 per 40 kg in different retail markets. The retail prices of firewood increased from Rs.52 per 40 kg in 1990-91 to Rs.75 in 1993-94 showing an increase of 44% in prices. Likewise, the prices of charcoal ranged between Rs.115 and 275 per 40 kg.

The retail prices of firewood and charcoal in different markets are given in Table 3.

Table 3: Retail Prices of Firewood and Charcoal In Different Markets

(Rs./40kg)

Market	Firewood 1990-91	Firewood 1994-95	Growth%	Charcoal 1990-91	Charcoal 1994-95	Growth
Quetta	42.73	63.48	48.56	80.42	115.73	43.91
Karachi	44.38	66.65	50.18	112.93	180.01	59.40
Sialkot	53.02	79.58	50.09	149.79	222.56	48.58
Islamabad	55.78	80.00	43.42	137.92	275.73	99.92
Peshawar	55.63	75.57	35.84	136.88	223.68	63.41
Lahore	56.69	82.74	45.95	158.06	205.22	29.84
Rawalpindi	55.83	80.00	43.29	135.83	258.80	90.53
Average.	52.00	75.44	45.08	130.26	211.68	62.51

Source: Pak. Statistical Year Book, 1994

19.7 FUTURE PLAN

Being aware of the acute shortage for timber and fuelwood production in the country, the government of Pakistan has prepared a long-term forestry development programme. This programme primarily aims at increasing sustainable wood supplies in the country by planting trees on farmlands and restocking existing forest areas. The main production programmes and targets of the plan are briefly given below.

Planting on farmlands

Farmlands of the country have great potential for increasing wood production. At present 2% of the farmland areas is covered by trees whereas 90% of fuelwood and 60% of timber comes from farmland. The tree cover of 2% can be increased to 10% without harmful effect on agricultural production. The plan envisages planting farmland equivalent to 1.9 million ha of block plantations during the plan period. Farmers will be motivated to grow trees by the extension wings of Forest Departments and planting material will be supplied at nominal cost. Total cost of this programme will be 11.5 billion rupees, of which 7.5 billion will be borne by the private sector and the remaining 4.0 billion(35.1%) by the public sector. This will supply an additional 25 million m3 of wood per year by 2018.

Management of coniferous forests

The coniferous forests are the main source of wood supplies in the country. However, the productivity is very low. The master plan has provided for intensification of these forests to increase their productivity. About 400,000 ha will be brought under intensive management. In addition, 226,000 ha of poorly stocked areas will be restocked. The total cost of the programme is estimated at 9 billion rupees in which 1.8 billion rupees will be spent on planting poorly stocked areas.

Managing irrigated plantations

The yield from irrigated plantations have gone down over the years due to a variety of factors. The plan aims to rehabilitate 100,000 ha. In addition, 50,000 ha will be replanted. The cost of the programmes will be 1.2 billion rupees.

Managing riverine forests

The plan seeks to rehabilitate 138,000 ha of riverine forests at the cost of 1.3 billion rupees. This will yield additional supplies of wood amounting to 1.1 million m3 per year by 2018.

Amenity plantings

This programme covers the planting of trees along canals, roads, as shelterbelts on farmlands, in urban centers around schools and in other institutions. The programme provides for planting 135,000 ha equivalent area at the cost of 1.4 billion rupees.

Planting non-forest public areas

A large area of public lands which are under the responsibility of the revenue department is lying idle. The plan aims to lease these lands to farmers, forest industrialists and other interested parties for tree growing. The estimated cost will be Rs.1.2 billion which will be borne by the private sector.

The successful implementation of the Forestry Sector Master Plan will increase the forest area from the existing 4.2 million ha to 8.6 million ha(9.1% of total land area). Planting on additional areas will produce additional supplies of 33 million m3. Moreover, restocking of existing public forests will yield supplies of 2 million m3 per annum. Thus the new forest areas and improvement in the management of existing forests will raise the sustainable supply of wood from the existing level of 14.4 million m3 to 49.5 million m3 by the end of the plan period. These supplies will be sufficient to meet about 96% of the projected demand. The contribution of farmlands in the total amount will be 33 million m3(66%). The successful implementation of these production programmes will reduce the fuelwood scarcity problems in the future.

19.8 RECOMMENDATIONS

Wood is the most important fuel for the domestic sector. The supply is unable to meet the demand with the result that cow-dung and crop residues are being burnt which otherwise would have been used to restore soil fertility and increase food production. Regarding production enhancement from government forest and waste lands, increased emphasis should be on the management of existing public forests for fuelwood production and their management by or joint management with local communities. Beneficiaries' planting programmes may be desirable for fuelwood production and fuelwood using industries e.g. brick kiln, tobacco-curing etc. should be encouraged. It is therefore very essential that wood energy development may be given due attention. For sustainable development of wood resources, the fuelwood production system should be made efficient by:

- Increasing planting activities on farmlands and appropriate areas currently lying unutilised;
- improving management of public forests for increased production per unit area;
- encouraging wood based industries to enhance fuelwood availability for the household sector;
- managing wood supplies properly so that producers do not find it difficult to sell their fuelwood;
- developing suitable government institutions to supply necessary information to growers regarding current prices, market trends and needs, new technical development, new species etc;
- implementing a system of information dissemination in the main wood producing areas aimed at instructing farmers on ways to improve the marketing of their firewood products;
- reducing government interference and interference from outside agencies as far as possible. The optimum role of government should be to support forest management, improve infrastructure and remove other obstacles to the free movement of woodfuel from production sources to consumption centers;
- declaring forest production and management on private lands an industry and advancing funds and loans on a priority basis;
- establishing special fuelwood plantations especially in the Punjab and Sindh to meet the increasing demand for fuelwood in the future.

PHOTOGRAPHIES SUPPLEMENT

Formal Opening Session of the Workshop (PFRI)

Group session in progress at PFRI Library (PFRI)

PART III: ANNEXURES

ANNEX 1. COUNTRY AND REGIONAL BACKGROUNDS

by

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Introduction and Objectives

Country Background

The total forest area in Pakistan is about 2.06 million ha only, consisting of natural forests and plantations amounting to 1.86 million ha and 0.2 million ha, respectively. In terms of percentage of the total land area in the country, natural forests represent about 2.4%, and plantations another 0.3%. If one tries to include all types of land that are under the control of Provincial Forest Departments (i.e, other wooded land, permanent meadows and pastures), the share may go up to about 5% (a total area 4.05 million ha). The agriculture policy adopted in 1991 envisages that the present share of the forest covered area will increase from 5% to 10% during the next 15-year period.

Statistics indicate that only about 10% (or 2.2 million) of Pakistan's annual total woodfuel consumption of 22 million m3 is supplied from government controlled managed forests and plantations, and the bulk of 19.8 million m3 (or 90% of the demand) is supplied from non-forest area based trees and shrubs, under public, private and community management or ownership. Although the share of traditional fuel in the total energy consumption of Pakistan is reported to have been about 21% in 1993 (WI 1996), this is a rather low share compared to many other RWEDP member countries in the region.

Reliable statistics on the consumption of traditional fuels in Pakistan are not available as most of these fuels are not traded in the market. Only about 41% of the woodfuel supply passes through the marketing channels and the major share (59%) is supplied free to the users at the source of production(forest and non-forest land). The estimate presented in the Household Energy Strategy Survey (HESS) of 1991 (under the UNDP/World Bank ESMAP Project) shows a total of 38.3 Mtoe energy consumption in Pakistan, of which the share of traditional and commercial fuels are 52% (or 19.9 Mtoe) and 48% (or 18.4 Mtoe) respectively in the domestic sector. As much as 86% of the household energy consumption is reported to be met by biomass fuels(i.e. fuelwood 54%, crop residue 18 % and animal residue 14%). The household sector accounts for about 52% of the total energy consumption.

From the point of view of natural resources endowment and the characteristics of the wood energy systems, Pakistan presents a unique scenario. Though a forest deficit country, its household sector energy demand is primarily met with traditional fuels and fuelwood plays a prominent role. In addition to the people in rural areas, a significant proportion of the population in large cities and towns also consume fuelwood for domestic energy. Out of the total 9,227 toe energy consumption in Peshawar city 1,670 toe (or 17%) was accounted for by woodfuel in 1992, despite the fact that the city was already supplied with natural gas. In fact natural gas accounted for 79% of the energy supply. And out of the total traded fuelwood, the share of household and commercial sectors was 92% and 8% respectively, whereas the government sector was the principal consumer of charcoal, 86%. Despite a large urban population (36% of the total in 1995) and a high (4.4%) urban growth rate in

1990-95, the domestic sector still relies heavily on traditional fuels for the supply of household energy.

On the supply side, two main sources for woodfuel production have been identified: (a) state controlled forests (b) private farm or non-cultivated lands. The HESS report of 1993 presents the contribution of government controlled forests in the total woodfuel supply as only 10% (or 2 million m3). The contribution of non-forest land was as high as 90% (or 20 million m3). Therefore, the importance of non-forest area based woodfuel production in the national energy balance of Pakistan is very significant and should be duly recognized. The irrigated farm lands in NWFP and Punjab are the most important contributors to non-forest wood production in the country. The former hold 51% of the non-forest land raised trees and 52% of the standing stock, and the latter 43% of the trees and 42% of the standing stock, respectively. These non-forest lands are not only producing 90% of the woodfuel consumed in the country, but are also producing 60% of its timber requirements.

RWEDP duly recognizes these important developments that have been taking place in the forestry/ agriculture sector of Pakistan, and their contribution to the energy sector and the national economy. And in order to support further integration of woodfuel production and marketing in forestry, agriculture or rural development programs, a number of training courses at regional and national levels, study and observation tours, expert consultations, etc. have been implemented in different countries, and a few more are planned for the next two years of the project's life. In Pakistan alone, one regional and two national training courses have already been organized, and these dealth with the specific issues and problems of wood energy development. So far, 89 officials from Pakistan have benefited from their participation in these courses which have covered wood energy planning; woodfuel trades; gender in wood energy; integration of woodfuel production and marketing in land-based production systems, etc.

Regional Background

Some important information related to wood energy from RWEDP member countries in Asia includes the following:

1. RWEDP member countries consume about 10,000 PJ of woodfuel each year, which is about 30% of the total energy consumption. It should be noted that large variations exist in the data provided by different sources such as FAO, WRI, UN, IEA, AEEMTRC, HESS.
2. Despite most country level energy balances showing a declining share of biomass in total energy consumption in recent years, woodfuel consumption in Asia is increasing at an annual rate of 1.6% in absolute terms. It is not expected to decrease within the foreseeable future.
3. The economic value of woodfuel consumed in RWEDP member countries(except Combodia) amounts to about US$ 30 billion, assuming average woodfuel prices of $ 40 per tonne.

4. Country specific information related to the socio-economic impacts of wood energy is not yet complete, but studies conducted in a number of RWEDP member countries show that they are significant. It is believed that the woodfuel business in Asia is the main source of income for 10% of the rural population.
5. Traditional woodfuels may comprise woody biomass of different kinds, i.e. stem-and branch-wood, twigs, sawdust, logging and processing residues, charcoal, etc., modern wood energy may include heat and power generated from woodfuel combustion.
6. Woodfuel supply sources may include both forest and non-forest lands, i.e. managed/protected natural forest or scrub land, forest and non-forest tree plantations, homestead/homegarden trees, private/village woodlots, farm-community forests, etc.
7. Logging and milling residues contribute significantly to woodfuel production; only about 20% of the trees harvested may be available as kiln dried sawn wood after the multiple stages of wood processing.
8. The exact ratio of forest and non-forest area supplied woodfuel is not known; it certainly differs significantly from area to area even within a single country depending upon various factors - data from 7 member countries of RWDP show the share of forest and non-forest area based production as 1/3 and 2/3, respectively.
9. Most traded wood fuel originates within 100 km from the market, but the self-collected portion comes from within a 20 km radius of the collector's home; recycled wood (from old construction sites, packing cases), driftwood, etc may contribute as much as 20% of the total supply.
10. The traditional perception that the heavy reliance of people on woodfuel for energy in Asia is the root cause of deforestation is now believed to be incorrect for most cases and forest clearing for agricultural land expansion is now thought to play the dominant role globally.
11. The projected woodfuel supply/demand imbalance for most countries in the region, which was based on the "gap theory" in the mid 1970's, now seems completely outdated. It ignored the potentials of non-forest supply sources as well as interfuel transformation within biomass sources.
12. The share of woodfuel in total round wood production in the region is very high; only one country, Malaysia, has a lower share (about 17%). In the rest of the member counties the share is between 70% and 97%.
13. Energy transformation is taking place both in urban and rural areas in favour of commercial and/or inferior biomass substitutes, depending upon their accessibility, availability and affordability.
14. Sustainable production and use of woodfuel can be socially, economically and environmentally feasible, provided impediments are removed to promote expanded participation of the private sector.
15. Most government and energy sector planners in developing countries seem still unaware or ignorant of the role of wood energy in the national economy; wood energy is not yet a priority sector for development.

RWEDP Objectives

The long-term objective of RWEDP is "to contribute to the sustainable production of wood fuels, their efficient processing and marketing, and their rational use for the benefit of households, industries and other enterprises".

The immediate objectives of RWEDP during its current third phase project(1994-1999) are to:

1. Contribute to an improved database on wood energy at regional and (especially) national level and to improve the capacity of institutions to generate, manage and assess such data at regional, national and sub-national level.
2. Contribute to the development and adoption of improved wood energy policies, plans and strategies in member countries.
3. Improve the capabilities of government, private and community-based organizations to implement wood energy strategies and programs.

The present national training course on "Integration of Woodfuel Production and Marketing in Forest, Agriculture and Tree Production Systems in Pakistan" is one of many activities designed to achieve the third objective.

National Course Objectives

The broad objective of the national training course is to contribute to human resource development for sustainable production and utilization of wood energy in Pakistan. Its specific objectives include to:

1. Network participants from GOs, NGOs and POs who are (or are likely to be) contributors to woodfuel production, distribution and marketing;
2. enhance the understanding of participants about the system of woodfuel production and marketing, and its role in the national economy and energy balance;
3. identify strategies for enhancing the production and sustainable supply of woodfuel in the future; and
4. assist in institutional capacity development to formulate policies, strategies and programs for integration of trees into the farming systems so as to enhance economic benefits through sustainable land use practices.

Expected Output

Considering the important role played by traditional fuels in the national economy (including the rural socio-economy), and the forestry sector priority for social forestry development, RWEDP is assisting the Government of Pakistan in her efforts to promote non-forest area based woodfuel production flows and utilization. The present national training course provides a unique opportunity to bring together the individuals and agencies responsible for forestry, agriculture and energy sector related development, to enter into discussions and to identify a strategy for the further integration of trees into the farming systems so as to enhance and make available a range of socio-economic benefits.

During the three days of deliberations and field observations, participants are expected to make a critical review of the situation related to woodfuel supply/demand; to identify the crucial issues and constrains that may be currently acting as hindrances to development in the sub-sector, particularly to woodfuel production and marketing; and to recommend a pragmatic strategy that promotes the integration of woodfuel production and marketing into the extension programs of forestry, agriculture and related sectors. Therefore, participants are encouraged to identify the issues and constraints of integrated woodfuel production and marketing, particularly from the point of view of non-forest area based production by the private sector or through participation of the local community.

In the group session, participants are expected to review all important on-going extension programs in forestry, agriculture and related sectors that are under implementation at different levels (e.g., provinces districts, etc.,), which are directly relevant to woodfuel production enhancement and marketing, and for environmental preservation.

To make the participants aware of the importance of wood energy, and to increase their understanding of the contribution of wood fuel to the national economy as well as to rural income and employment generation, a number of presentations, including case studies, will be made to cover these specific aspects. The presentations are expected to cite examples from different parts of the country and to deal exclusively with the issues of woodfuel production, flow or utilization. These presentations may also analyze the prevailing policy and strategies of relevant sectors (forestry, agriculture and power) and identify the additional measures needed for future development in the wood energy sub-sector. The planned field visits will hopefully allow participants an opportunity to observe the local wood fuel production, marketing and utilization practices in the area and allow them opportunity for direct interaction with the producers, traders and commercial/industrial users of wood fuels.

The knowledge acquired from field observations and class room sessions will be later synthesized in group sessions so as to present a list of recommendations which shall identify the required changes in existing policies and regulations in different sectors to promote the sustainable production, unhindered flow and open trade in wood fuel and related products in the county, through competitive marketing channels. Recommendations will also include a list of area specific draft training proposals which will serve as local level follow-up actions to the present national training course

To help enhance the participants' understanding of the factors that may affect household level farm management decision, including decisions related to the integration of woodfuel production and marketing in farming systems, a "Framework for Understanding Farm Household-Level Decision Making", developed by FAO-APAN will be presented. These factors may influence (independently or collectively) farm household level decisions pertaining to investment and marketing as well as production and conservation (see attachment 1).

Attachment 1:

Framework for Understanding Farm Household Level Decision-Making

(A tool used by APAN to explain the complex farm management systems in order to promote pragmatic agroforestry extension strategies in its member countries).

A. Farm household is used as the primary unit for analysis

1. Each household has a unique set of socio-economic and biophysical conditions.
2. Production technology and investment decisions are evaluated by farmers and entrepreneurs based on:
   (a) access to markets
   (b) access to support services
   (c) access to scientific and indigenous knowledge
   (d) policies, rules and regulations

B. Farm household makes resource allocation decisions

C. Farm household divides roles and responsibilities among different family members(i.e. male, female; productive youth, elderly, etc.)

D. Household-Level Farm Management Decisions(Part I)

1. Decisions regarding investment and marketing (identification of a need/market opportunity) may lead to selection of what is to be planted and what land to be used or what investment (labor, money, materials) will be required. Choice of agricultural enterprises; allocation of labor, land and capital; acquisition of inputs; marketing).

2. Decisions regarding production and conservation(farmers have to make choices regarding management of the production process - best farmers will select sustainable practices; perennial/annual, livestock/fish; conservation practices; off-farm employment; etc.)

E. Decisions are influenced by On-Farm Factors (Part II)

1. Socio-economic conditions (assets, level of control over land; household composition and allocation of responsibilities, risk tolerance, debts; off-farm employment and income, etc.)

2. Biophysical conditions (soil, moisture; slope; altitude; aspect; biological factors, including pests and diseases, etc, most important but beyond the control of the farm family).

F. Decisions are influenced by Off-farm Factors (Part III)

1. Markets and market channels (local, provincial, international; middlemen producers associations; brokers and traders, large-scale industries; commodities exchanges, international cooperation, etc).
2. Policies, rules and regulations (traditional laws, common practices, written legislation, national, international, etc).
3. Support services (roads, credit institutions, suppliers, subsidies, etc.)
4. Technical information (different aspects of growing crops, e.g. propagation).
5. Harvesting; information flow channels; from other farms, from research and extension workers, from industry and brokers etc). (People do not use a linear decision making process; farmers consider many factors simultaneously)

Alternative Extension Approaches

Four different approaches of extension have been identified which are applicable to certain conditions and may be appropriate at certain points in time. It would be a mistake to try to force any one extension system upon diverse sets of conditions.

Range of Extension Approaches

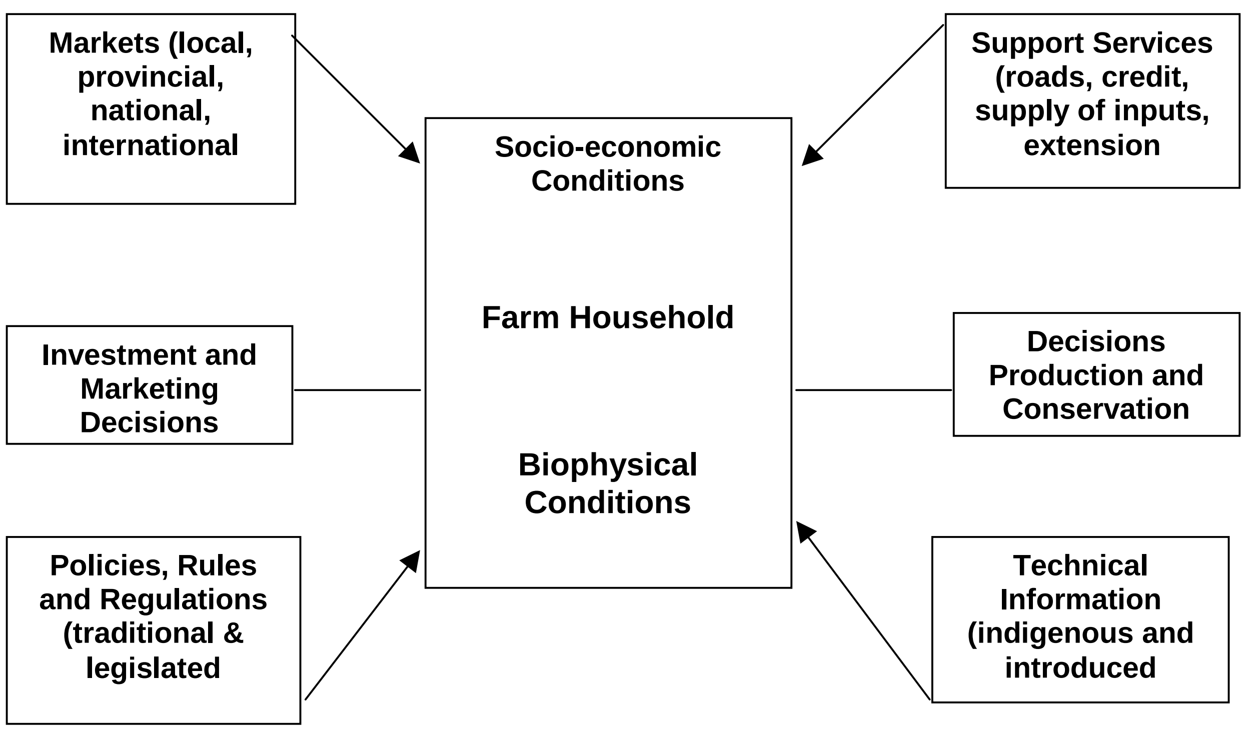
Authoritarian System	Participatory Extension System	Farmer-to-Farmer Exchange	Commercial & Market Driven

Attachment 2:

Participatory Extension Framework and Associated Interactions

A participatory extension framework with associated interactions as developed by (APAN) was presented by Mr. Tara Bhattarai and is summarized here.

In most of the countries of the region the major share of woodfuel currently comes from non-forest areas. Land use practices in non-forestry situations should thus incorporate woodfuel production so as to ensure its sustainability. This could best be achieved through farm extension activities. The more the extension programs are based on an understanding of the local needs, edaphic and socio-cultural backgrounds, technical suitability, market situations, support services, etc., the higher is the rate of success likely to be. This suggests the need for appropriate participatory mechanisms. To help design appropriate participatory interventions in a woodfuel development programme, a framework has been developed for analyzing farmers household decision making -diagrammatically this is presented below.2.



ANNEX 2. COURSE PROGRAMME

Tuesday,28 October 1997

1000 Arrival of guests
1030 Arrival of Chief Guest
1035 Recitation from Holy Quran
1040 Welcome Address by S.M.Hafeez, Director, PFRI.
1050 Overview of the training course - Mr.Tara Bhattarai, Rep. RWEDP, Bangkok
1125 Inaugural Address by the Chief Guest - Mr.Khushnood Akhter Lashari, Secretary FWF&T. Department, Lahore, Pakistan.
1135 Vote of Thanks - Mr. Rasheed Mehmood Randhawa, CCF P&E (Pb) C.Z.Lahore
1145 Tea Break

First Working Session

1215 Wood Fuel in the National Energy Balance
Director General, Pakistan Forest Institute, Peshawar.
1235 The Role of NGOs in Promoting Fuelwood Production in Pakistan-
A.S.Bukhari, IUCN, Islamabad.
1255 Forests and Forestry in Pakistan- Strategy for sustainable development
Mr.M.I.Sheikh, Resource Person.
1315 Break for lunch and prayer

Second Working Session

1430 Woodfuel production in Sind with reference to *Hurries*
Dr.G.R.Kereo
Conservator of Forests, Sind Forest Department.
1450 Development of Salt-affected Wastelands for Wood Production in Pakistan
Dr.Muhammad Aslam, University of Agriculture, Faisalabad.
1510 Patterns and Problems of Fuelwood Consumption and Production in Salt Affected Areas of Faisalabad.
Dr.Kishwar Ijaz, Dr.Ashfaq Mann,
University of Agriculture, Faisalabad.
1530 Woodfuel Trends and Prospects in Pakistan
Mr. Amjad Mehmood Cheema, CF. and Mr.Naseer Zia,
DFO, Punjab Forest Department.
1550 Woodfuel Distribution System in Sind
Dr. Lekhraj Kella,
CF, Sind Forest Department.
1610 NGO's & Development Projects of Fuelwood Production
Raja Muhammad Tariq,
DFO, Punjab Forest Department.
1630 Tea

Wednesday, 29, October, 1997

Third Working Session

0900 Production, Utilization and Distribution of Fuelwood in the Deserts of Punjab
Dr.Ghulam Akbar, Director, Arid Zone Research Institute, Bahawalpur

0920 Mangrove Forests- An Important Woodfuel Resource of the Coastal Belt
Mr.Najamuddin Vistro,
DFO, Sind Forest Department.

0940 Rural Women and Woodfuel Energy
Mrs. Nighat Chughtai,
PFRI, Faisalabad.

1000 Role of Irrigated Plantation in the Production of Woodfuel in Punjab
Mr. Riaz ul Haq,
DFO, Punjab Forest Department.

1020 Social Forestry and the Woodfuel Crisis-
Mr. Shahid Rashid Awan
DFO, PFRI, Faisalabad.

1045 Tea break and group photo

Fourth Working Session

1115 Strategy for Enhancing Future Woodfuel Production
Malik Muhammad Khan,
CF, Punjab Forest Department.

1135 Marketing of Woodfuel in Pakistan
Dr.Qamar Mohiyuddin,
University of Agriculture, Faisalabad.

1155 Environmental Impacts of Energy Production from Biomass
Mr. Imtiaz Ahmad,
PARC, Islamabad.

1215 Bioenergy for Meeting Growing Energy Needs
S.M.Hafeez,
Director, Punjab Forestry Research Institute,Faisalabad.

1235 Fuelwood Production from Public and Non-forest Areas in Pakistan
Mr.Hakim Shah,
Pakistan Forest Institute, Peshawar.

1300 Break for lunch and prayer

1400 Field Trip

Thursday, 30 October,1997

Fifth Working Session

0900 Group discussion participants will be divided into three groups, one each on production, marketing and utilization.
1030 Tea Break
1100 Drafting of recommendations by each group.
1130 Presentation of recommendations by each group's leader.
1230 Break for lunch and prayer
1400 Arrival of Chief Guest
1405 Recitation from Holy Quran
1415 Welcome Address by S.M.Hafeez,Director,PFRI,Faisalabad
1450 Award of certificates by the Chief Guest
1520 Vote of Thanks by Mr. Rasheed Mehmood Randhawa, CCF, Lahore.
1530 Training Course concludes

ANNEX 3. WELCOME ADDRESS

by

Sahibzada Muhammad Hafeez, Director, PFRI

Honourable Chief Guest,

Distinguished Delegates, Guests, Ladies and Gentlemen

It is my proud privilege and very pleasant duty to welcome you, sir, to the Punjab Forestry Research Institute, today. We are all grateful to you indeed for having consented to inaugurate the 3-days National Training Course on Woodfuel Production and Marketing in spite of your numerous preoccupations. All this is due to your sincere and keen interest in the development of forests and forestry.

We are also extremely fortunate to have with us on this occasion Mr.Tara Bhattarai, Resource Specialist from FAO Regional Wood Energy Development Programme, who has come all the way from Bangkok to Faisalabad despite many demands on his time and energy. He is also representing FAO in the course.

I am grateful to the participants from the University of Agriculture, PFI, IUCN, AARI and PARC for gracing this occasion.

I also appreciate the presence of senior and junior forest officers both serving and retired, especially the contingent from Sindh who have come in full force to take part in the deliberations.

I highly appreciate the interest and concern of the FAO in general and the RWEDP in particular for its collaboration in the organization of this training course and its sponsorship. This shows their keen interest in the woodfuel issue. We are also grateful to FAO for choosing the PFRI as the venue for the course.

Before requesting you, sir, to formally inaugurate this National Training Course, allow me to give a brief account of the reasons for holding this course and of its objectives.

In the eighties nearly half the world population depended for its energy needs on one fuel: wood. Wood is the most commonly used source of energy in the world. For the inhabitants of the developing countries, it is much more than that; it is the staple energy resource of three quarters of the population. The woodfuel situation in these countries revealed that 5% of the people were already unable to satisfy their minimum energy needs for cooking and heating. A further 53% people were in a "deficit situation" and could meet their needs only by depleting wood reserves. Of these 58%, more than 64%, lived in Asia.

The situation has been worsening rapidly since then. By the year 2000 the world woodfuel deficit is expected to reach 960 million cubic meters a year - the energy equivalent of 240 million tonnes of oil a year.

With regard to Pakistan, the share of non-commercial fuels (wood, dung cakes, agricultural residues, etc.) is 36.8% in the national energy consumption. The household and commercial sector is the largest consumer of energy in Pakistan and its share in overall energy consumption is 49.7%. The dependence of households on wood is paramount, especially in rural areas where 79% people use wood as the principal fuel. The share of non-commercial fuels in the household sector is 81.7%. The relative share of wood is 44.2% among the non-commercial fuels. These statistics indicate a serious energy crisis as well as the importance of woodfuel among the different energy sources. To solve the problem there is no better alternative than to produce more woodfuel - and the reason is that providing energy in the form of renewable wood solves far more than just the problem of a drastic energy shortage.

It is this urgency of producing more woodfuel and its marketing which has forced RWEDP/FAO, PFRI and University of Agriculture, Faisalabad to collaborate and organize this course. It is our intention that the need for development in the woodfuel energy sector will be further highlighted.

The main objectives of the training course are: to network of organizations contributing to woodfuel production, distribution and marketing in Pakistan; to enhance the understanding of the participants about the role and system of woodfuel production and marketing; to identify strategies for enhancing production and the sustainable supply of woodfuel in the future; and to assist in developing the institutional capacity to formulate policies, strategies and programmes which integrate tree production in farming systems and enhance economic benefits through sustainable land use practices.

This training course will provide an opportunity for a multi-disciplinary team of experts to sit together, consider all these factors in detail and frame definite recommendations which could help in the solution of the problems facing Pakistan.

I would like to state that at this moment the Punjab Forest Department is endeavoring to build up PFRI to the level of a Regional Center of Excellence for Agroforestry. For this, the technical and financial assistance of the FAO would be required.

Finally, sir, I sincerely thank you once again for agreeing to inaugurate this National Training Course. The presence of a man of your stature, experience and wisdom has greatly enhanced the importance of the occasion. I also once again welcome the distinguished delegates and guests who have come from long distances to participate in the course. I hope your stay at Faisalabad will be comfortable, pleasant and productive.

ANNEX 4. INAUGURAL ADDRESS

by

Mr. Khushnood Akhter Lashari
Secretary, Government of the Punjab,
FWF&T Department, Lahore, Pakistan.

Distinguished delegates, guests, ladies and gentlemen:

It is a great pleasure for me to participate in this forum of scientists, scholars and administrators. I am grateful to the organizers for providing me with this opportunity to inaugurate this National Training Course on Woodfuel Production and Marketing which is a subject of very high importance.

As you know, nearly half the world population depends for its energy needs on one fuel: wood. Wood is thus the most commonly used source of energy in the world. For the inhabitants of the developing countries it is much more than that: it is the predominant energy resource of three-quarters of the population. In some of the poor African nations it still accounts for more than 90% of the national energy consumption. The woodfuel situation in developing countries in the eighties revealed that of the 2000 million people who depended on wood, 96 million were already unable to satisfy their minimum energy needs for cooking and heating. A further 1050 million people were in a "deficit situation" and could meet heir needs only by depleting wood reserves. Out of this total of 1146 million people, more than 64% lived in Asia. These are the essential statistics of the 1980s' fuel wood crisis. However, the situation has been worsening rapidly since then. Projections for the year 2000 suggest that, without immediate action to improve the situation, 2400 million people will either be unable to obtain their minimum energy requirements or will be forced to consume wood faster than it is being grown. By the year 2000 the world woodfuel deficit is expected to reach 960 million cubic meters a year - the energy equivalent of 240 million tonnes of oil a year. In Pakistan, the situation may be less severe but it is cause for serious concern.

National energy consumption in Pakistan was 32.2 million tonnes oil equivalent in 1993-94 and this was 64.9% higher than the energy consumption in 1980-81. The share of non-commercial fuel is 36.8% and that of commercial fuel is 63.2 % of the national energy consumption. The consumption of non-commercial fuels has increased by 36.2% as compared to 1980-81. The household and commercial sector is the largest consumer of energy in Pakistan and its share in overall energy consumption is 49.7%. The share of non-commercial fuel is 81.7%. The relative share of wood is 44.2% among the non-commercial fuels. The figures indicate an increasing demand for energy.

Ways must be found to satisfy these ever increasing energy requirements. The best way would be to produce more woodfuel/ bio-energy. A few strategies that, in my view, could be considered by this group of specialists and planners are these:

I. Increasing the productivity of existing resources. This will require active and intensive management. Even simple protection measures can sometimes increase the yield by more than 50%. The use of existing bio-resources must be efficient;

II. creating new resources can also make good woodfuel shortfalls within a reasonable period if millions of trees are planted annually and well looked after. This formidable task will require active involvement of farmers and other people;

III. improving conversion and utilization technologies e.g. the efficiency of charcoal production, improved cooking stoves, biogas plants, etc.

Integration of production, conversion, utilization, and conservation of bio-energy aspects; and enhancement of knowledge of the participants about the role and system of woodfuel production and marketing should go a long way in achieving the desired results. I wish this gathering a great success and I hope that the three-days proceedings of this Training Course will result in concrete and productive recommendations. I wish the participants of the course a pleasant and enjoyable stay at Faisalabad.

Finally, It is my honor to inaugurate the "National Training Course on Woodfuel Production and Marketing".

ANNEX 5. VOTE OF THANKS

by

Rashid Mehmood Randhawa
CCF (P&E), Punjab Central Zone, Lahore.

Honourable Chief Guest

> Mr.Tara Bhattarai, Resource Specialist, RWEDP, FAO
> Dr.K.M.Siddiqui, Director General, PFI, Peshawar
> Mr.Shams-ul-Haq Memon, Chief Conservator of Forests, Sind
> Dr.Qamar Mohi-ud-Din, Chairman, Agricultural Marketing
> Mr.M.I.Sheikh
> Mr.A.S.Bokhari
> Representatives of the Farmer Communities

Distinguished delegates, ladies and gentlemen:

I am very grateful to you, sir, for having consented to preside over today's function. I am thankful to all the participants who have come here from far and near to attend the National Training Course on "WOODFUEL PRODUCTION AND MARKETING" to identify a future plan of action for the enhanced and sustainable supply of woodfuel and marketing. This training course is timely as we are in the midst of an energy crisis and that is why we have requested you to participate, discuss and provide useful practicable guidelines to streamline the strategy for meeting the ever increasing demand for bio-energy, so intimately linked with the improvement of socio-economic conditions of the rural poor.

Participation in the course by some farmers is a most welcome sign. I am really indebted to them. My thanks are also due to the Inspector General of Forests. We are particularly thankful to Mr.Tara Bhattarai and the RWEDP based in Bangkok for moral and financial support which has enabled the PFRI and UAF to hold the course.

We feel privileged to host a gathering of such distinguished scientists and experts on fuelwood production and marketing from throughout the country.

The presence of fuelwood producers and traders with us on this occasion and for the course duration will be of special value for discussions on the subject, and we are grateful to them for sparing their time.

The active collaboration of numerous scientists will also certainly benefit our deliberations.
Without further encroaching upon your valuable time, I once again on behalf of the Government of the Punjab, welcome you to this beautiful campus. I hope your stay with us will be comfortable, pleasant, and of course productive.

Thank you very much.

ANNEX 6. CLOSING ADDRESS

by

The Chief Guest
Mr.Rashid Mahmood Randhawa
CCF (P&E), Punjab Central Zone; Lahore

Mr. Bhattarai of the Regional Wood Energy
Development Programme,
Distinguished resource persons, eminent delegates, ladies and gentlemen:

I consider it a great privilege to be able to participate in the concluding session of this very important training course.

I take this opportunity to thank the Regional Wood Energy Development Programme, FAO, for selecting the Punjab Forestry Research Institute, Faisalabad as the venue of this important course.

In our country wood is the main source of energy for a great majority of the population in the rural as well as urban areas. Wood, in its raw form, has a long history of use as fuel all over the world. In several counties in Asia, including Pakistan, the introduction of multipurpose trees and other woody perennials into the farming systems has been the common survival strategy of farmers, and consequently 90% of fuel wood requirements in the country are met from private lands. The strategy serves primarily for meeting the household requirements of wood and food and also, to a limited extent, for cash income from the sale of surplus marketable products.

A review of forestry related development in Pakistan indicates that the incorporation of multipurpose trees into the farming systems by rural people may be the most feasible strategy for the future, particularly from the point of view of ensuring a sustainable supply of woodfuel to the people.

Woodfuel is one of the main energy resources in the country. The household sector is the largest consumer of energy in Pakistan and its share in overall energy consumption is nearly 50%. The share of non-commercial fuels (biomass etc.) is 82% of the total energy consumption in the household sector. The relative share of wood is 44.2% among the non-commercial fuels. There is thus an urgent need to enhance the woodfuel production to avoid further severity of the energy crisis in view of the ever-increasing demand of the growing population.

There is a need to strengthen the capabilities of government, private and community based organizations in implementing wood energy strategies and programmes. The ultimate target groups i.e., the woodfuel producers and consumers will benefit from these programmes. It is, therefore, necessary to integrate woodfuel production into the wider scope of programmes for agriculture, forestry and rural development. I am glad to say that this National Training Course is an important step in this direction.

As informed by the Director, PFRI, distinguished delegates from a number of organizations are participating in the course and quite a few papers have been presented by various speakers during the last two and a half days. I am further pleased to know that various groups undertook detailed deliberations on different aspects of the woodfuel issue and worked hard with dedication to arrive at practical recommendations which were later presented by group leaders. I am confident the immediate objectives of the course have been achieved.

I would like to take this opportunity to congratulate the scientists who have been awarded certificates. I am also thankful to all the delegates, guests and participants from different organizations for sparing their valuable time for attending the National Training Course and making useful contributions.

Thank you very much

ANNEX 7. VOTE OF THANKS

by

Sahibzada Muhammad Hafeez
Director, Pfri, Faisalabad

Honourable Chief Guest, Mr.Rashid Mehmood Randhawa, CCF (P&E), Punjab, Central Zone, Lahore.

Mr.Tara Bhattarai from the Regional Wood Energy Development Programme Bangkok, esteemed guests, resource persons, speakers, all other participants, ladies and gentlemen.

It is my pleasant duty today to speak to you at the concluding session of this Three-Day National Training Course in Woodfuel Production and Marketing. First of all, I would like to state that we all are very grateful to you, sir, for having agreed to preside over this concluding session at a very short notice.

This highly useful and productive course provided us with an excellent opportunity to get together in one place and discuss the problems relating to woodfuel production and marketing systems. For that we are indebted to Dr.W.Hulscher, the CTA of the RWEDP, Bangkok, Mr.Tara Bhattarai (also from RWEDP), the motivator behind the course and of course Rana Rafique Ahmad, the IGF.

The University of Agriculture Faisalabad collaborated with the Punjab Forestry Research Institute, and dealt with the marketing aspect of the training. The forest service is grateful for their contribution.

Being graduates from the same Alma Mater our colleagues in the Sindh Forest Department are here. Their participation in fairly sizable force shows how keen they are to exchange views and make suggestions for improvement in fuelwood production, marketing and the forest conservation system.

PARC is the biggest research organization in Pakistan as regards Agriculture Research. We are thankful to the representatives of the Council who participated in this course and enriched other participants with their valuable suggestions.

We are also very grateful to Mr. M.I. Sheikh and Mr. A.S. Bokhari who made their presence felt by making useful contributions as resource persons and as facilitators. I hope we shall continue to have words of wisdom from them in the future as well.

I will be failing in my duty if I do not acknowledge the active participation of the officers of the Punjab Forest Department who made some very useful suggestions regarding the woodfuel production system.

I would like to state on record, the strenuous effort and devotion with which Sahibzada Muhammad Hafeez, the Director of PFRI and his staff displayed by working day and night to make the training programme a resounding success.

We have made all possible efforts to make the stay of the participants comfortable and productive. I think we have been able to achieve it, but if there were any lapses or inconveniences, I hope these will be overlooked.

God bless you all.

Thank you.

ANNEX 8. LIST OF PARTICIPANTS

Resource Persons

1. Mr.K.M.Siddiqui,
D.G. PFI, Peshawar. Pakistan.

2. Mr.Tara Bhattarai
Wood Energy Resource Specialist,
RWEDP/FAO
Bangkok,Thailand.

3. Mr.A.S.Bokhari,
IUCN, Islamabad.

4. Mr.M.I.Sheikh,
Resource Person, Ex.D.G. PFI,
Peshawar & CCF, Punjab,
Pakistan.

5. Mr.G.R.Kereo
Conservator of Forests
Sind Forest Department, Sind,
Pakistan.

6. Dr. Muhammad Aslam,
University of Agriculture,
Faisalabad, Pakistan.

7. Dr. Ashfaq Mann,
University of Agriculture
Faisalabad, Pakistan

8. Mr. Naseer Zia,
DFO, Eonomics
c/o CCF(P&E)Pb. Central Zone
Lahore Pakistan

9. Dr. Lekhraj Kella
CF Sind Forest Department,
Pakistan

10. Raja Tariq Muhammad ,
DFO, Punjab Forest Department,
Pakistan

11. Dr. Ghulam Akbar,
Director, Arid Zone,Research
Institute, Bahawalpur, Punjab,
Pakistan.

12. Mr. Najam-ud-din Vistro
DFO, Sind Forest Department,
Pakistan

13. Mrs. Nighat Chughtai,
ARO, PFRI, Faisalabad, Pakistan.

14. Mr. Riaz-ul-Haq
DFO, Punjab Forest Department,
Pakistan.

15. Mr. Shahid Rasheed Awan,
DFO, PFRI, Faisalabad.

16. Malik Muhammad Khan,
CF, Punjab Forest Department,
Pakistan.

17. Dr. Qamar Mohy-ud-Din
UAF, Faisalabad, Pakistan.

18. Mr. Imtiaz Ahmed,
PARC, Islamabad, Pakistan.

19. Mr. Hakeem Shah,
PFI, Peshawar, Pakistan.

20. Sahibzada Muhammad Hafeez,
Director, PFRI, Faisalabad,
Pakistan.

OTHER PARTICIPANTS

21. Mr. Rashid Mehmood Randhawa,
CCF(P&E), Punjab Central Zone,
Lahore Pakistan.

22. Mr. Shamsul-Haq
CCF, Hyderabad Sind Forest
Department Pakistan.

23. Mr. Mehboob Ali Bhatti
DFO, Sindh Forest Department,
Pakistan

24. Mr. Muhammad Tahir
Farmer, Punjab.

25. Dr. Muhammad Arshad,
C.F.R.M., Lahore, Pakistan

26. Malik M. Nazir Awan
DFO. Faisalabad, Punjab Forest Department, Pakistan

27. Mr. M. Rasheed Kamboh,
DFO, PFSDP,
Faisalabad,Pakistan.

28. Mr. Zafar-ul-Hassan Shah
DGW Research, Punjab Wildlife Research Centre,
Gatwala, Faisalabad, Pakistan.

29. Mr. Nadeem Qureshi,
AGW, Punjab Wildlife Research Centre,
Gatwala, Faisalabad Pakistan.

30. Mr. Obaidullah Khan,
AD, PFRI, Faisalabad, Pakistan

31. Mr. Muhammad Rafique,
SRO, PFRI, Faisalabad,Pakistan.

32. Mr. Tariq Mehmood
SRO, PFRI, Faisalabad, Pakistan.

33. Mr. Abdul Khaliq,
SRO, PFRI, Faisalabad, Pakistan.

34. Mr. Yousaf Piracha,
DFO, PFRI, Faisalabad, Pakistan.

35. Mr. Aziz-ur-Rehman Dogar,
SRO, PFRI, Faisalabad, Pakistan.

36. Mr, Liaquat Ali Gill,
R.O., PFRI, Faisalabad, Pakistan.

37. Mr, Muhammad Faisal,
R.O., PFRI, Faisalabad Pakistan.

38. Mr. Ashaar Farooq,
R.O., PFRI, Faisalabad, Pakistan.

39. Mr. Muhammad Muslim,
R.O., PFRI, Faisalabad, Pakistan.

40. Mr. Amjad Ali,
R.O. PFRI, Faisalabad, Pakistan.

41 Mr. Barkat Ali Awan,
R.O., PFRI, Faisalabad, Pakistan.

42. Mr. Muhammad Mushtaq,
R.O., PFRI, Faisalabad, Pakistan.

43. Miss Shaheena Ramzan
A.R.O., PFRI, Faisalabad, Pakistan.

44. Miss Aqeela Mobeen Akhtar
A.R.O.,PFRI,Faisalabad,Pakistan.

45. Dr. Khalid Mustufa,
University of Agriculture, Faisalabad.

46 Chaudhry Bashir Ahmd,
Bashir Model Farm, Mananwala, Sheikhupura.

47 Mian Muhammad Tahir,
Farmer, Batala Colony Faisalabad.

ANNEX 9. COURSE EVALUATION SHEET PUNJAB FORESTRY RESEARCH INSTITUTE, FAISALABAD

TRAINING COURSE ON " WOODFUEL PRODUCTION AND MARKETING"

Please answer the following questionnaire as candidly as possible. Please encircle the appropriate choice: (where applicable)

1. What was your status in the training course?

i) Research scientist
ii) Field professional
iii) Resource person/ speaker
iv) Learning participant
v) Farmer/wood producer
vi) Wood trader/wood consumer
vii) NGO representative

2. Please list three topics in order of priority which most interested you:

i) ....
ii) ....
iii) ....

3. To what extent do you think your professional knowledge has been enhanced?

i) Less than 40%
ii) Between 41-75%
iii) More than 75%

4. To what extent do you think the professional knowledge gained during the course will be helpful to you in carrying out your job assignment?

i) Very helpful
ii) Moderately helpful
iii) Slightly helpful

5. Would you please list any important issues which you think have not been adequately addressed during the course:

i) ....
ii) ....
iii) ....

6. Would you like to attend this kind of course workshop in the future?

i) Yes
ii) No

7. How frequently would you like to be in contact with the PFRI regarding scientific information on the subject of this course?

i) Very often
ii) Often
iii) Seldom

8. To what extent did you benefit from group discussions and subsequent presentations?

i) A great extent
ii) A moderate extent
iii) A slight extent

9. Please complete the following:

i) Name..
ii) Organization..
iii) Educational status...

School Diploma Bachelor Masters Ph.D.

Mailing address:
....
....
....

Thank You

ANNEX 10. FRAMEWORK TO ORGANIZE FIELD OBSERVATION

	Production and Utilization	Marketing	Extension and Support Services (extension, credit, policies, etc.)
Current Situation			
Constraints			
Possible Solution			