RWEDP Report No. 51

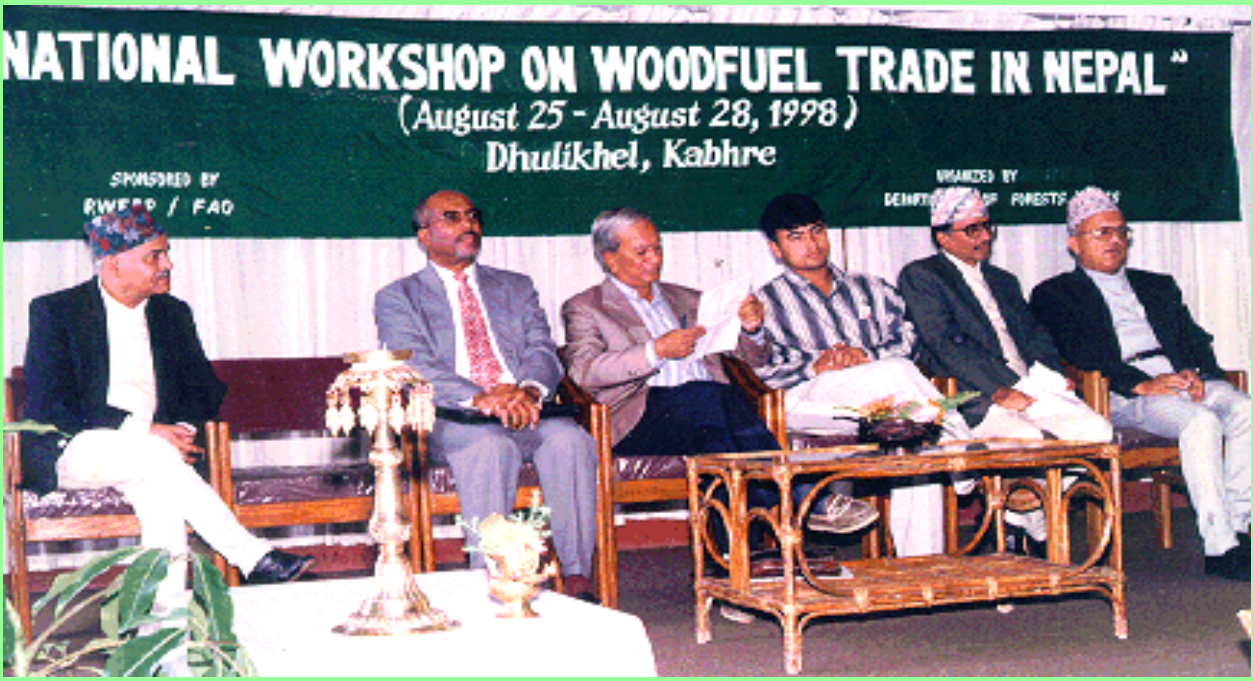
REGIONAL WOOD ENERGY DEVELOPMENT PROGRAMME IN ASIA
GCP/RAS/154/NET

# WOODFUEL TRADE IN NEPAL

# NATIONAL WORKSHOP

## DHULIKHEL, NEPAL

## 25-28 AUGUST 1998

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# FOREWORD

In the 1970s information on fuelwood, trees and forests in Asia was still far from adequate. This led to highly pessimistic scenarios predicting that the accessible forests in Nepal would disappear long before the end of the century. These scenarios were based on crude assumptions about woodfuel supply and demand. Since then much has been learned and Nepal is now one of a number of countries which have relatively abundant data on wood energy related matters.

Fuelwood supplies as much as 80% of Nepal's total energy consumption. Almost five million tonnes of woodfuel is being harvested annually from government forests, and another two million tonnes is obtained from community forests, leasehold forests, private forests and trees on farmlands. It is expected that in the coming years the demand for fuelwood will increase by 2.8% annually. In order to meet the demand, remote forests have to be made accessible or fuelwood production from non-forest land has to be stepped up drastically, or both. The important link between supply and demand is trade, which involves at least 100,000 people in Nepal, almost half the number employed in the entire industrial sector of the country. Fuelwood collection and trading provides an important source of livelihood for many local people in Nepal.

The present report highlights these issues and several other important aspects of wood energy.

RWEDP appreciates the excellent co-operation of Nepal. In recent years this has resulted in three national training workshops and one regional workshop in the country, in addition to various pilot projects, case studies and consultations. It is a pleasure to thank the Department of Forest of HMG for organizing the National Workshop on Woodfuel Trade in Nepal, in close co-operation with Mr. Tara Bhattarai, Wood Energy Resources Specialist at RWEDP.

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

# PREFACE

Woodfuel contributes about 80 percent of the total energy consumed in Nepal. It not only caters to the domestic energy needs of the rural populations but also to the energy requirements of the brick making and hand-made paper industries, and other cottage industries. Wood energy planning, programmes and trade are therefore important at policy, programme and field implementation levels.

The primary objective of this national workshop on woodfuel trade was to provide a forum where the participants could discuss various issues related to wood energy production, distribution and trade, and develop their understanding of the intricacies of woodfuel flow systems. The workshop participants consisted of 24 professionals representing governmental, non-governmental and academic institutions. Relevant technical papers and specific case studies were presented. The participants were also taken to a community forest area managed by the local people to produce fuelwood and other forest products. This report presents the proceedings of the workshop and includes the papers presented and the workshop recommendations.

I would like to thank the Regional Wood Energy Development Programme for entrusting the Department of Forest to organize this workshop and for their funding support. I would also like to thank the Water and Energy Commission Secretariat for their partial financial support to the workshop. I would like to express my gratitude to the authors of the technical papers and case studies, and to all the participants who contributed to the success of the workshop. This report was compiled and edited by Bikram Raj Tuladhar and Prakash Mathema. The Workshop was managed by Bal Krishna Khanal, Deputy Director General of the Department of Forest.

Lastly, I would like to thank Dr. W.S. Hulscher, Chief Technical Advisor of RWEDP, and Mr. Tara Nath Bhattarai, Wood Energy Resources Specialists of RWEDP, for their encouragement and support.

Indra Singh Karki
Director General
Department of Forest

# LIST OF ABBREVIATIONS

| | |
|---|---|
| CDR | Central Development Region |
| CF | Community Forest |
| CPFD | Community and Private Forestry Division |
| DDC | District Development Committee |
| DFPSC | District Forest Product Supply Committee |
| DoF | Department of Forest |
| EDR | Eastern Development Region |
| FORESC | Forest Research and Survey Centre |
| FPDB | Forest Product Development Board |
| FUG | Forest User Group |
| FWDR | Far-Western Development Region |
| GJ | Giga Joule |
| HLFFDP | Hill Leasehold Forestry and Forage Development Project |
| HMG | His Majesty's Government |
| LF | Leasehold Forest |
| LG | Leasehold Group |
| LPG | Liquefied Petroleum Gas |
| MFSC | Ministry of Forests and Soil Conservation |
| MPFS | Master Plan for Forestry Sector |
| MWDR | Mid-Western Development Region |
| NACFP | Nepal-Australia Community Forestry Project |
| NPC | National Planning Commission |
| NTFP | Non-Timber Forest Products |
| OFMP | Operational Forest Management Plan |
| Rs | Nepali Rupees |
| RWEDP | Regional Wood Energy Development Programme |
| TCN | Timber Corporation of Nepal |
| VDC | Village Development Committee |
| WDR | Western Development Region |
| WECS | Water and Energy Commission Secretariat |

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*Photo Credits: Department of Forests, Kathmandu, Nepal*
*Tara Bhattarai, WERS, RWEDP, FAO*

***Trees are an integral part of the hill farming system (DF)***

***Woody and non-woody biomass fuels for home consumption (TB)***

# PART I: WORKSHOP OVERVIEW

# 1. INTRODUCTION

Although Nepal possesses an enormous potential for hydropower generation, the reliance on traditional sources of energy has not declined significantly. The latest estimate shows that the total energy consumed (1995/96) is about 292 million GJ, of which 90 percent is contributed by woodfuel and other biomass fuels. The contribution of woodfuel alone is about 80 percent of the total energy consumed in the country.

Fuelwood supply sources in Nepal include forest and non-forest areas with the former having the larger share. The forest supplied fuelwood accounts for about 80 percent of the total supply, and is mostly produced from government forests, shrubland and non-cultivated inclusions. The remaining 20 percent of the supply is estimated to be produced from non-forest land, which is mostly privately owned. Although the share of fuelwood in the total energy consumed has been decreasing in recent years, the consumption of fuelwood has not decreased over the years. The residential sector is still the largest consumer of energy (90 percent) in the country. Evidently, traditional fuels, particularly fuelwood, will continue to play a major role in Nepal for decades to come. Its use for domestic cooking, space heating and food processing will be continued by the majority of the rural population. This will have a direct impact on the national economy as well as on the natural environment.

Considering the importance of sustainable woodfuel production, supply and utilization in Nepal, the Department of Forest organized a national workshop on woodfuel trade from 25-28 August 1998 in Dhulikhel. The workshop was funded by the Regional Wood Energy Development Programme (RWEDP) of the United Nations Food and Agriculture Organization (FAO). The workshop brought together 24 relevant professionals from governmental, non-governmental and academic organizations, along with Mr. Tara Nath Bhattarai, RWEDP's Wood Energy Resource Specialist.

# 2. WORKSHOP OBJECTIVES

The workshop had the following objectives:

- to enhance the participants' awareness of the role and importance of wood energy, including its production, distribution and trade in the larger urban centres and towns and to develop their understanding of the complexity and intricacy of the woodfuel flow systems for wood energy development;

- to network key actors of woodfuel production, distribution and trade;

- to provide a forum for mutual consultation and to identify the crucial issues affecting the woodfuel flow systems; and

- to enhance the participants' capabilities to plan and implement follow-up training courses at the local level. These courses would be designed to support the sustainable production, flow and utilization of woodfuel so as to contribute to the local socio-economy through the generation of income and employment opportunities in wood energy related activities.

# 3. PARTICIPANTS

The workshop participants consisted of 24 persons (one female) from various organizations. Nineteen participants came from government institutions, three from academic institutions, one from an NGO and one from the FAO Representation in Nepal. Out of the 19 participants from government organizations six were field based. All the participants were professionals with at least a Bachelor's degree but most had a Master's degree and one had a Ph.D. Sixteen participants were foresters and the rest were professionals in the fields of woodfuel energy planning, trade and training.

# 4. INAUGURAL SESSION

Mr. Narayan Raj Tiwari, Secretary at the Ministry of Forests and Soil Conservation, inaugurated the workshop. In his inaugural remarks, Mr. Tiwari highlighted the importance of woodfuel in Nepali society, especially in rural areas. He also said that the government's community forestry programme aims to meet the local people's basic needs for forestry products including fuelwood. He also thanked the workshop organizers for selecting "Woodfuel Trade in Nepal" as the theme of the workshop and said that the workshop outputs would be useful in formulating policies and programmes related to woodfuel production and trade. Mr. Bel Prasad Shrestha, Mayor of Dhulikhel Municipality, chaired the inaugural session. Mr. Ashok Benju, Vice Mayor of Dhulikhel Municipality; Mr. W.R. Rudder, FAO Representative in Nepal; Mr. Sushil Bhattarai, Joint Secretary at the Ministry of Forests and Soil Conservation. Mr. S. N. Poudyal, Executive Secretary at Water and Energy Commission Secretariat also spoke on the occasion.

Mr. Indra Singh Karki, Director General of Department of Forest, welcomed the participants and Mr. Bal Krishna Khanal, Deputy Director General of Department of Forest, proposed a vote of thanks at the end of the inaugural session.

# 5. WORKSHOP METHODOLOGY

The methodology used in the workshop was mainly classroom sessions with group discussions. Eight technical papers were presented and the topics covered a wide range of issues including woodfuel flow systems; the present status of wood energy in Nepal; wood energy sources; trade prospects; woodfuel trade through community forestry and leasehold forestry; and the socio-economic and environmental contribution of wood energy. Eight case studies were presented and their topics included – woodfuel trade in three districts; the woodfuel and charcoal trade in urban Kathmandu; firewood sales for cremation; experiences of Sagarnath Forestry Development Project in the fuelwood trade; bee-hive briquetting; and the wood energy curriculum. One paper on Participatory Rural Appraisal principles and processes was also presented.

The papers and case studies are given in Part 2 of this report. The papers and case studies have been slightly edited but their original essence focus/remain.

# 6. FIELD VISIT

A half-day field visit was organized as part of the workshop. The participants and resource persons split into three groups, and visited a sawmill, a blacksmith/goldsmith, and Thuli Forest User Group's community forest.

One group went to Khopasi and Panauti area to study the existing woodfuel trade in the area. The group visited a local sawmill where sawdust and wood chips were lying as a waste product. Participants explored the possibilities of using the waste as raw material to produce briquettes. If the briquettes could not be consumed locally, they could be sold in Banepa town or Kathmandu. The sawmill owners were delighted to know that the waste could be processed into a useful commodity.

The participants of another group realized that networking with relevant agencies working on wood energy is very essential for efficient wood energy planning and suggested a frequent interactive forum. An effective communication system and joint working schedule need to be developed to conduct studies and research. Research and Development should not be limited to computer hard-discs alone. Research agencies should try to extend the knowledge through extension agencies. Thus the mandates of different agencies should be used to benefit the target group. This group suggested that all potential and relevant agencies working on wood energy should be listed and frequent interactions and joint action planning for implementation should be facilitated.

The group that visited the community forestry area realized that the production of charcoal should be regulated. Charcoal used by blacksmiths comes mostly from national forest areas but the Department of Forest does not issue any license to produce charcoal. Thus, the illegal trade of charcoal is widespread. They also realized the importance of community forests in supplying fuelwood.

# 7. WORKSHOP OUTCOMES AND RECOMMENDATIONS

On the final day of the workshop the participants were divided into two groups to deliberate on various issues that emerged from the technical sessions and the field visit. Following group discussions, the findings were presented in the plenary session. The group presentations are summarized below.

**Group A: Non-Traded Woodfuel Supply in the Hills**

***I. Production***

*A. Community Forests*

- Community forests are unevenly distributed resulting in an uneven supply and demand scenario as well as conflicts. A possible solution for this is to follow the operational guidelines properly so that the users of community forests can be properly identified. Community forest areas need to be managed according to local needs.
- Due to the lack of focus on woodfuel production in community forestry, there

is pressure on existing government forests and on crop residues.

- Community forestry is protection-oriented, the people regard trees as timber and hesitate to use trees for fuelwood. Community forestry should be gradually made production-oriented with adequate focus on fuelwood production and use.
- Since pine is not a preferred fuelwood species, the pine-dominated plantations should be converted to broadleaf forests by encouraging natural regeneration of native broadleaf species.
- A special woodfuel promotion programme needs to be implemented on a pilot basis by co-ordinating the efforts of various institutions.

*B. Private Forests*

- Due to the small size of land holdings, there are few fuelwood trees on private land. Private forestry is further discouraged by the cumbersome bureaucratic procedure to obtain a permit to harvest and transport forest products. This procedure needs to be simplified and special fuelwood plantation programmes on private land implemented. Extension and training programmes focussing on fuelwood species plantation need to be promoted.

*C. Government Forests*

- The absence of scientific management is resulting in the declining productivity of forests. Management Plans should be implemented with woodfuel development programmes.
- Inaccessible forest areas need to be utilized by introducing the cable logging system.
- Briquetting and charcoal making should be promoted.

## *II. Utilization*

- Launch an orientation programme for policy makers to raise their awareness about the importance of woodfuel energy.
- Promote alternative sources of energy as well as fuel-efficient cookstoves compatible with local conditions.

## *III. Other Aspects*

- Establish woodfuel databases at district level and ensure that they also identify woodfuel deficit areas.
- Fuelwood is generally considered as a by-product of timber production. It needs to be recognized as an important commercial commodity.
- Encourage the private sector to invest in the commercial plantation of fuelwood species.
- Encourage local institutions – District Development Committees, Village Development Committees, NGOs, Forest User Groups – to be involved in woodfuel issues.
- Provide incentives/subsidies for efficient utilization of fuelwood.

### *IV. Trade Flow*

- Simplify legal procedures related to the trade of surplus forest products including fuelwood from community forests within and outside district boundaries.
- Resolve conflicts related to the utilization of forest products including fuelwood.
- Encourage the trade of fuelwood (and other forest products) among Forest User Groups.
- The role of middlemen in the woodfuel trade flow system should be eliminated or reduced so that the producer gets a better price.

## Group B: Woodfuel Trade in the Rural, Urban and Industrial Sectors

### *I. Production*

*A. Government Managed Forests*

- Due to the lack of management and fixed harvesting plans as well as the inaccessibility of hill forests, fuelwood production is irregular and insufficient. Possible solutions are: implementation of management plans; allowing the felling of dead, dying trees; allocating sufficient funds for implementing harvesting plans; and the introduction of the cable logging system in the hills.

- Charcoal is illegally made in government managed forests due to the absence of legal provisions and operational guidelines on charcoal production. Legal provisions and operational guidelines on charcoal making should be prepared.

*B. Community Forests*

- Enough fuelwood for trading is not produced from community forests because community forest management is mainly protection-oriented and the forests are far from road heads. The local forest office should make community forestry production-oriented through reviewing the management objectives, through extension, training and regular M and E.

*C. Private Forests*

- Fuelwood supply from private forests is substantial but mostly unrecorded. There is a lack of incentives for fuelwood plantation. This is further aggravated by frequently changing government policies and negligible technical backstopping. Private planters should be given appropriate incentives (e.g. tax subsidy, buy-back guarantee) and adequate technical support.
- Fuelwood is considered a by-product of timber production. Encourage plantation of fast growing fuelwood species.
- Fuelwood production data not available. Encourage VDC to record production data on private land.

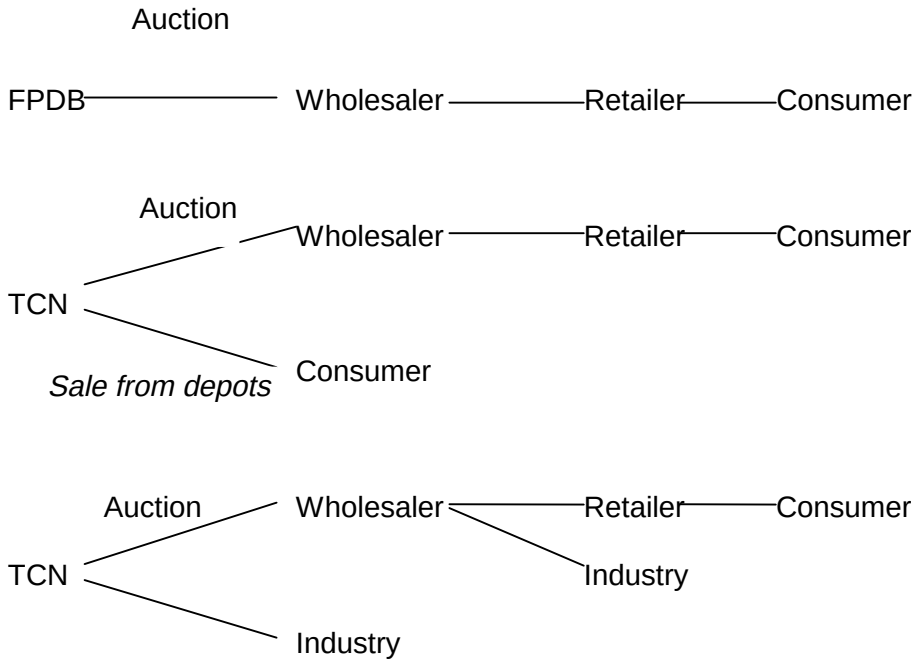
- People with small land holdings cannot plant more trees on their land. Encourage people with large sized land holding to participate in commercial plantation of fuelwood species. Technical support from the government will be necessary for this.

## *II. Trade*

### *A. Government Managed Forests*

#### *i Formal*

- The volume of traded fuelwood is small compared to the volume consumed. The trade flow can be summarized as follows:




- The flow system is characterized by frequent policy changes, limited access by the private sector, lack of an adequate network, uncertainty in supply and cumbersome procedures for harvesting and transport.

#### *ii Informal*

- The amount of fuelwood that is traded from informal means is substantial but not recorded. Due to unemployment/underemployment, the rural people grossly mis-use the one head-load of fuelwood privilege and sell the collected fuelwood to middlemen. The one head-load privilege should be regularized and recorded.

*B. Community Forests*

- The volume of fuelwood traded from community forests is almost absent and is localized, if at all. Enhance fuelwood production by intensifying management and simplify legal provisions to encourage forest user groups (FUGs) to trade forest products outside their districts.

*C. Private Forests*

- Trade of fuelwood from private forests is significant but there is no record of the volume traded. The cumbersome and lengthy bureaucratic procedures to obtain cutting and transport permits need to be simplified.

***III. Utilization***

- The users of fuelwood (commercial as well as residential sectors) have inefficient burning devices. So improved stoves need to be promoted.
- Simplify the trade flow process to avoid middlemen.

***IV. Other Aspects***

- A practical definition of fuelwood is lacking. The definition of fuelwood is based on fixed size only; leftover material after processing is not included in the definition. The definition of fuelwood needs to be broadened.
- Fuelwood is not recognized as an important commodity. It is merely considered as timber residue.
- A woodfuel development component should be included in all forestry development programmes.
- The contribution of fuelwood to the energy sector needs to be highlighted.
- Networking and regular meetings between all agencies involved in wood energy should be encouraged.
- Development and promotion of alternative energy should also be emphasized.
- Encourage small-scale charcoal and briquette making industries.

# 8. PARTICIPANTS' EVALUATION OF THE WORKSHOP

In general, the participants evaluated the presented papers and case studies as "good' and their subject coverage "adequate". The participants said that they gained knowledge from the workshop but some papers were more beneficial in this respect than others. About 70 percent of the participants thought that the workshop met more than half of the stated objectives and 30 percent thought that the objectives were fully met. Similarly, 70 percent thought more than half of their expectations were met and 30 percent thought they were fully met. About 40 percent of the participants evaluated the workshop as "comprehensive" and 60 percent as "moderate". The workshop facilities were "excellent" for about 30 percent of the participants and "satisfactory" for 70 percent.

Some participants said that the duration of the workshop should have been longer and should have offered more field visits. Some participants said that more case studies on specific topics would have been useful.

***Farm and community forest: Two important energy sources for the local people (TB)***

***Despite a high population density, privately-owned trees and community forests are still found in the middle-hills area. Both play an important role in meeting household energy needs (TB)***

# PART II: PAPERS PRESENTED

# A. MAIN PAPERS

# 1. PRESENT STATUS OF WOOD ENERGY IN NEPAL

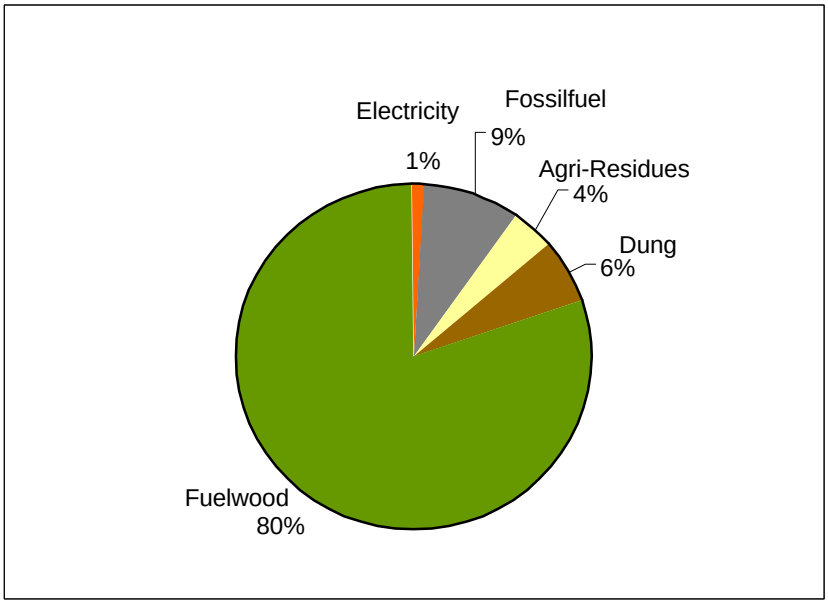
*by*

*D. L. Shrestha, Energy Planning Division*
*Water and Energy Commission Secretariat*

## BACKGROUND

Woodfuel resources play a major role in the overall energy sector of Nepal and will continue to be the main source of energy for most of the rural areas for decades to come. Traditional fuels such as woodfuel (branches, twigs, bark, split wood, logs, etc.) agricultural residues and animal waste are the only easily available and relatively cheap indigenous energy resource for almost all rural people of Nepal. This results from the absence of a commercial fuel distribution network and exploitable fossil fuels, and because of socio-economic constraints. Currently, over 13 million tonnes of woodfuel are consumed annually in Nepal. The overall energy supply by energy type for Nepal is presented in Figure 1.

***Figure 1: Energy Consumption by Fuel type – 1995/96***



## 1.1 NATIONAL ENERGY CONSUMPTION PROFILE

The residential, agricultural, industrial, commercial and transportation sectors are the sectors into which the energy sector has been categorized. It is estimated that the total energy consumption in 1995/96 was about 292 million GJ. The residential sector consumed over 91% of the total energy, primarily in the rural areas. The industrial sector accounted for 4% and the transport sector about 3% of the total energy consumption. Woodfuel alone met over 80% of the consumption followed by dung (6%) and agriculture residues (3.6%). Thus, biomass sources of energy met 90% of the total energy consumption in 1995/96. Of the conventional sources of energy, diesel and kerosene together met 6% of the consumption. These estimates are summarized in Table 1.

***Table 1: Aggregate Energy Consumption in 1995/96 (1'000 GJ)***

| **Description** | | | | **Commercial** | **Industrial** | **Agric.** | **Transport** | **Total** | **%** |
|---|---|---|---|---|---|---|---|---|---|
| | **Rural** | **Urban** | **Total** | | | | | | |
| Traditional | 246503 | 12523 | 259026 | 973 | 3635 | 0 | 0 | 263634 | 90.2 |
| Fuelwood | 220682 | 10427 | 231109 | 956 | 3430 | 0 | 0 | 235495 | 80.6 |
| Agri residue | 8964 | 1385 | 17568 | 17 | 205 | 0 | 0 | 10571 | 3.6 |
| Animal dung | 16857 | 711 | 8120 | 0 | 0 | 0 | 0 | 17568 | 6 |
| Conventional Energy | 4364 | 3756 | 15 | 2137 | 8535 | 582 | 8710 | 28084 | 9.6 |
| Coal/coke | 11 | 4 | 6083 | 366 | 2600 | 0 | 103 | 3084 | 1.1 |
| Kerosene | 4078 | 2005 | 790 | 1096 | 384 | 0 | 0 | 7563 | 2.6 |
| LPG | 1 | 789 | 0 | 119 | 0 | 0 | 0 | 909 | 0.3 |
| Diesel | 0 | 0 | 0 | 0 | 3418 | 577 | 5862 | 9857 | 3.4 |
| Aviation Turbine Fuel | 0 | 0 | 0 | 0 | 0 | 0 | 1287 | 1287 | 0.4 |
| Petrol | 0 | 0 | 0 | 0 | 15 | 0 | 1439 | 1454 | 0.5 |
| Other Oil Products | 0 | 0 | 1232 | 89 | 841 | 0 | 0 | 930 | 0.3 |
| Grid Electricity | 274 | 958 | 1232 | 467 | 1277 | 5 | 19 | 3000 | 1 |
| Non-Con. Energy | 563 | 0 | 563 | 0 | 0 | 0 | 0 | 563 | 0.2 |
| Decentralized | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Electricity | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gaseous Fuel | 563 | 0 | 563 | 0 | 0 | 0 | 0 | 563 | 0.2 |
| Liquid Fuel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solid Fuel | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 251430 | 15279 | 267709 | 3110 | 12170 | 582 | 8710 | 292281 | 100 |
| Sectoral Percentage | 86 | 5.6 | 91.6 | 1.1 | 4.2 | 0.2 | 3 | 100 | |
| Share of Wood Energy (%) | 87.8 | 64 | 86.3 | 30.7 | 28.2 | 0 | 0 | | |

### *1.1.1 Wood energy consumption in different sectors of the economy*

The residential sector is the largest energy consuming sector and accounts for over 90 percent of the total consumption in which woodfuel contributes about 87%. The industrial and commercial sectors also significantly depend on woodfuel for their energy requirements. At present 28% of the energy requirement of the industrial sector and about 31% in the commercial sector are supplied by woodfuel. The shares of woodfuel use in the urban and rural residential sectors are about 64% and 88%, respectively. In urban areas the woodfuel use varies widely. For example, woodfuel use in Kathmandu is only about 2% whereas woodfuel use in Bharatpur is about 76%. Compared to the rural people, urban people have a high level of income and therefore can use other modern forms of energy.

A large amount of woodfuel is still being used in the industrial sector. Currently, it is estimated that large-scale rural industries, including medium scale village enterprises, consume about 1.5 million tonnes of woodfuel annually and small-scale rural industries consume over 1 million tonnes. The main purposes of using the wood energy in the industrial sector are for process heating and firing boilers.

### *1.1.2 Wood energy consumption scenario by development region*

Out of five development regions, the Central Development Region (CDR) consumes the largest share of total energy followed by the WDR, EDR, MWDR and FWDR. Looking at the woodfuel side, FWDR meets 98% of its total energy requirement from woodfuel. Table 1.1 shows that there is a correlation between the distance from the capital of the country or level of economic development and the share of wood energy in the total energy consumption. This is because of the higher affordability of the people to substitute wood energy by more modern forms of energy. The higher share of commercial energy in the overall energy consumption also indicates a higher level of access to commercial energy and economic activities. However, access and availability of the woodfuel resource also has a bearing on the share of woodfuel in the overall energy consumption. This can be substantiated from the fact that the per capita forest area is less in the CDR than in other development regions. Another factor that affects this share is the urbanization rate, which is lowest in FWDR and highest in CDR.

***Table 1.1: Wood Energy Consumption by Development Region (1995/96) (GJ)***

| DESCRIPTION | EDR | CDR | WDR | MWDR | FWDR | TOTAL |
|---|---|---|---|---|---|---|
| Residential Sector | 38,634 | 69,916 | 49,140 | 41,669 | 31,751 | 231,110 |
| Industrial Sector | 513 | 801 | 189 | 986 | 941 | 3,430 |
| Commercial Sector | 157 | 496 | 65 | 198 | 39 | 955 |
| Agricultural Sector | 18* | 334* | 94* | 73* | 63* | 582 |
| Transport Sector | 945* | 5,599* | 1,370* | 558* | 240* | 8,712 |
| Sub-total: | 40,267 | 77,146 | 50,858 | 43,484 | 33,034 | 244,789 |
| Total Energy Consumption: | 48,798 | 103,955 | 59,267 | 46,613 | 33,648 | 292,281 |
| Percentage of Regional Consumption %: | 83 | 74 | 86 | 93 | 98 | 100 |
| Percentage Share of National Consumption %: | 16 | 36 | 20 | 16 | 12 | |

** Commercial Energy (Fossil Fuel & Electricity)*

## 1.2 WOOD ENERGY BALANCE

The Water and Energy Commission Secretariat (WECS) routinely publishes wood energy balances in aggregate national terms in its Energy Sector Synopsis Reports. These reports update and aggregate the findings of the five Regional Energy Studies to arrive at an overall national energy profile. Table 1.2 and Table 1.3 present summaries of the woodfuel balances at national and regional level for each of the three physiographic regions respectively. The balances indicate that all development regions of Nepal suffer from woodfuel supply deficits, with CDR having the largest deficit.

***Table 1.2: Summary of Woodfuel Balance in Tonnes, Whole Country (1995/96)***

| | PHYSIOGRAPHIC REGIONS | | | | | | ALL REGIONS | |
|---|---|---|---|---|---|---|---|---|
| | Terai | | Hills | | Mountains | | | |
| | **Gross** | **Accessed** | **Gross** | **Accessed** | **Gross** | **Accessed** | **Gross** | **Accessed** |
| Supply – Forest | 1437748 | 143742 | 6767846 | 2243233 | 3283560 | 1099541 | 11489153 | 4780517 |
| Shrub/On-farm | 561063 | 561063 | 1368018 | 1250268 | 509695 | 326740 | 2438776 | 2138071 |
| Total | 1998810 | 1998805 | 8135863 | 3493502 | 3793255 | 1426281 | 123927929 | 6918587 |
| Consumption | | 6478388 | | 5467869 | | 1925015 | | 13871272 |
| Surplus/Deficit | | -4479584 | | -1974367 | | -498734 | | -6952684 |

***Table 1.3: Regional Woodfuel Balance in Tonnes, by Region (1995/96)***

| | Surplus/Deficit in Terai | Surplus/Deficit in Hills | Surplus/Deficit in Mountain | Surplus/Deficit Total: |
|---|---|---|---|---|
| Eastern Development Region | -1128243 | 241123 | 88479 | -798642 |
| Central Development Region | -1644674 | -905217 | -140625 | -2690516 |
| Western Development Region | -745761 | -522564 | -180832 | -1449157 |
| Mid-Western Development Region | -559109 | -631733 | -7047 | -1197888 |
| Far-Western Development Region | -401796 | -155976 | -258709 | -816481 |

### *1.2.1 Aggregated energy demand forecast for the year 2005/06*

The estimates of energy consumption in the various sectors of the economy are based on current per capita consumption, population projection, specific energy consumption and the projection of various relevant parameters. The primary objective of presenting the future energy balance is to assist the planners in deciding policy interventions for the sustainable development of the sector. The utility of this projection should be limited to obtaining a broad indication of where the sector could head given the current trend of energy consumption.

It is estimated that the aggregate energy consumption in 2005/06 will be in the vicinity of 385 million GJ. This represents an annual growth of about 2.8% per annum with the residential sector energy consumption growing at 2% per year, the industrial sector consumption at 7%, commercial sector consumption at 7%, agriculture sector consumption at 6.9% and transport sector consumption at about 11%. The share of the residential sector energy consumption is estimated to decrease from the current 91.6% to about 85% in 2005/06. The share of industrial sector energy consumption is estimated to increase from the current 4.2% to 6.2% in 2005/06, transport sector from 3% to about 6.6% while the share of commercial and agriculture sectors is estimated to remain constant at about 1% and 0.3% respectively. The details of the tentative estimate of energy consumption in the year 2005/06 is shown in Table 1.4.

***Table 1.4: Energy Forecast for 2005/06 (1,000 GJ)***

| Description | Residential | Industrial | Commercial | Transport | Agri. | Total | Share (%) |
|---|---|---|---|---|---|---|---|
| **Traditional** | **314962** | **7150** | **1915** | **0** | **0** | **324027** | **84.40** |
| Fuelwood | 278511 | 6747 | 1881 | 0 | 0 | 287139 | 74.80 |
| Agri Residue | 13481 | 403 | 34 | 0 | 0 | 13918 | 3.60 |
| Dung | 22970 | | 0 | 0 | 0 | 22970 | 6.00 |
| **Conventional Energy** | **11654** | **16790** | **4202** | **25396** | **1138** | **59180** | **15.40** |
| Coal/coke | 21 | 5115 | 719 | 202 | | 6057 | 1.60 |
| Kerosene | 8240 | 755 | 2156 | 0 | | 11151 | 2.90 |
| LPG | 1416 | 0 | 234 | 0 | | 1650 | 0.40 |
| Diesel | 0 | 6724 | 0 | 18524 | 1135 | 26383 | 6.90 |
| Aviation Turbine Fuel | 0 | 0 | 0 | 2533 | | 2533 | 0.70 |
| Petrol | 0 | 29 | 0 | 4099 | | 4128 | 1.10 |
| Other Oil Products | 0 | 1655 | 175 | 0 | | 1830 | 0.50 |
| Electricity | 1977 | 2512 | 918 | 38 | 3 | 5448 | 1.40 |
| **Non-Con. Gaseous Fuel** | **685** | | | | | **685** | **0.20** |
| **Total:** | **327301** | **23940** | **6117** | **25396** | **1138** | **383892** | **100** |
| **Share (%)** | **85.30** | **6.20** | **1.60** | **6.60** | **0.30** | **100.00** | |

Also, it is estimated that woodfuel will account for about 75% of the total energy consumption in 2005/06 – a decrease from the current share of 80% of the total energy consumption but an increase of 50 million GJ in absolute terms. The increase in absolute quantity of woodfuel use represents an annual growth of about 2% per annum. The trend also shows a rapid increase in consumption of agriculture residues with a growth of about 11% per year. Its share in the total energy consumption is expected to increase from the current level of 3.5% to about 7% in 2005/06.

## 1.3 SOURCE OF WOODFUEL

The major source of woodfuel in Nepal is the country's forests. This resource is deteriorating because of the overwhelming demand of the growing population. At present the forests are being exploited unsustainably, resulting in their degradation. These resources are not homogeneously distributed. Districts situated in the Middle Mountain region have sufficient forest resources whereas Terai districts and those in the Siwalik area have not. Because of the country's diverse topography and the inaccessibility of the resource for many settlements, a horizontal distance of 4 km in hills and mountain regions is assumed to be accessible for woodfuel supply. But in reality rural people are compelled to collect woodfuel from forests situated more than 6 km horizontal distance. In most of the rural hills, woodfuel supply is non-monetized and is perceived by most of the rural population as a free good with no direct cost except the time and effort used to collect it.

## 1.4 WOODFUEL SUPPLY STATUS

Nepal's woodfuel is supplied mainly from accessible government forests, which also comprise shrubland, grasslands and non-cultivated inclusions. Non-cultivated inclusions are the forested shrub or grassland situated in the vicinity of farmlands. A considerable amount of woodfuel also comes from agricultural fields, private trees, private woodlots, community forests and from the industrial waste of forest based industries.

As per the woodfuel supply estimates in the year 1995/96, the sustainable supply of woodfuel was about 14 million tonnes of which about 7 million tonnes are accessible. The supply situation of woodfuel has been characterized by a widening gap between sustainable supply and demand. The wood energy balance for the year 1995/96 has indicated that about 6 million tonnes of woodfuel are supplied by over exploitation of accessible forest. At present, over 90% of the total woodfuel requirement is supplied from off-farm areas and the remaining 8% from farms. These supply figures indicate that only around 50% of the total woodfuel requirement of the country is sustainable if the woodfuel supply (industrial waste) from wood-based industry is unaccounted for. If the inaccessible forests are considered to be accessible, the sustainable supply of woodfuel can be increased up to about 14 million tonnes to cope with the present over-exploitation of accessible forests. It is now high time to introduce the cable logging system in remote forests to make the hitherto inaccessible resources accessible.

Currently, the woodfuel requirement of urban areas is met from forests situated at a distance of more than 400 km (e.g., the supply to Kathmandu Valley comes from the Far West). The transport of woodfuel requires imported commercial fuels. Such transported woodfuel has more than 60% moisture content. Therefore, from the energy content point of view, a large amount of foreign currency is being unnecessarily drained away.

## 1.5 MANAGEMENT OF WOODFUEL SUPPLY

Traditionally, woodfuel marketing was carried out in many urban areas by head-loaders and this is practised even today. Often, woodfuel collected by head-loaders comes from illicit sources. In addition to this, a number of private depots and dealers are engaged in woodfuel marketing. The Timber Corporation of Nepal (TCN) markets woodfuel through its depots in different urban centres. The Department of Forest has no incentive to allocate permits for felling trees to TCN. So, by indirect administrative feat, the urban woodfuel marketing and supply system in Nepal has been almost completely privatized.

## 1.6 DEVELOPMENT CONSTRAINTS IN WOOD ENERGY PLANNING

Wood energy planning exercises, whether it is project planning, or integrating woodfuel in macro-level planning or decentralized area-based planning face the problems of inadequacy and lack of reliable wood energy data; improper or lack of understanding of the wood energy system; and weak or no linkages among relevant agencies.

Other main constraints in wood energy development and planning are socio-economic, technical, and lack of national planning capabilities. Other problems include limited funds available to the forestry sector and the lack of effective policies to stimulate proper forest management practices and the efficient use of wood residues.

## 1.7 RECOMMENDATIONS FOR WOOD ENERGY DEVELOPMENT

Based on the constraints identified above, the following measures seem appropriate to stimulate woodfuel development.

- The supply of woodfuel should be increased by intensive management of all accessible natural forests and by planting trees on open grassland and uncultivated land adjacent to farms.
- There is a need for strong political commitment to forest-based energy programmes and careful evaluation of energy policies.
- Coordination between relevant institutions involved in wood-based energy development should be strengthened.
- Community forestry and agroforestry programmes should be implemented at an accelerated pace and should be closely monitored by the District Forest Offices, which should be strengthened to cope with the additional responsibilities.
- In commercial logging of the national forests, consideration should be duly given to fuelwood as a product.
- Ways and means of utilizing the NGO sector should be explored.
- The Alternative Energy Promotion Centre should be fully responsible for issues with respect to the dissemination of improved wood combustion technology.
- Adequate funds should be injected into wood-based energy development programmes.
- Public awareness on forest conservation should be increased.

# 2. FORESTRY STATUS AND WOOD ENERGY SOURCES IN NEPAL

*by*

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## INTRODUCTION

Fuelwood constitutes 80% of the total energy consumption in Nepal. It has been projected that in the Terai and Middle Mountains, where 85% of the people live, the fuelwood deficit could grow to 3.1 million tonnes by the year 2000. According to FORESC (1994), deforestation in the 20 Terai districts from 1978/79 to 1990/91 has amounted to 99,000 hectares in 12 years and the annual rate of deforestation during this period has been 1.3%. The decline of the forest has in turn created environmental problems such as accelerated soil erosion, downstream sedimentation and losses in agricultural productivity.

## 2.1 FORESTRY STATUS

According to the Master Plan for the Forestry Sector (MPFS) forests and shrublands make up about 59% of Nepal's total land area. The total forest area with at least ten percent crown cover is estimated at 5.5 million ha, i.e. 37% of the total land area. If we consider the distribution of natural forest by physiographic zones, the Terai has only 8%, the Siwaliks has 27%, the Middle Mountains has 32%, the High Mountains has 30% and the High Himal has 3%. Table 1 shows the distribution of forests by development regions.

***Table 1: Forest Distribution by Development Regions***

| S. N. | Development Region | Forest Distribution (%) |
|---|---|---|
| 1 | Eastern | 17 |
| 2 | Central | 19 |
| 3 | Western | 16 |
| 4 | Mid western | 30 |
| 5 | Far western | 18 |

***Source: MPFS (1989)***

**The main forest types found in Nepal are as follows:**

Tropical forest:
- *Shorea robusta* forest
- *Dalbergia sissoo-Acacia catechu* forest

Sub-tropical forest:
- *Schima-Castanopsis* forest
- *Pinus roxburghii* forest

Temperate forest:
- *Quercus* forest
- *Pinus wallichiana* forest

Alpine forest:
- *Rhododendron* forest

*Betula utilise* forest

Based on the estimates of MPFS, regeneration and poles (<25 cm dbh) make up only 1% of the forest area which is not good for the future of forests. The distribution of forest area in stem size or maturity class is skewed, almost 85% of the forest area is found in mature or over mature stands. This type of distribution means that many of the trees are deteriorating. Table 2 shows the proportional stem volume in the Terai by species.

***Table 2: Proportional Stem Volume in Terai, by Species (national parks excluded)***

| S.N. | Species | Stem Volume (%) |
|---|---|---|
| 1 | Shorea | 43 |
| 2 | Terminalia | 14 |
| 3 | Adina | 6 |
| 4 | Anogeisus | 4 |
| 5 | Others | 25 |
| 6 | Syzigium | 3 |
| 7 | Acacia | 2 |
| 8 | Lagerstoemia | 2 |
| 9 | Dalbergia | 1 |

## 2.2 WOOD ENERGY SUPPLY SOURCES

The forest area in Nepal is the main source of firewood, fodder, timber and NTFPs. A consideration of the utilization potential of the Terai forest confirms that, on the whole, the basic resource is substantial, and given the favourable growing conditions of the Terai it could produce a large volume of timber, fuelwood and biomass under a sustainable management regime. The average forest cover for the Terai is 21%, ranging from 3% in Dhanusha to 39% in Banke district.

The most heavily stocked forests are found in the far western and eastern regions, with Sunsari and Morang reaching 190 cu m/ha, Kailali ,180 cu m/ha, Jhapa, 170 cu m/ha, and Kanchanpur, 160 cu m/ha. The least stocked forests are in the Dang, Sarlahi, Mahottari, Dhanusha and Siraha districts (with about 100 cu m/ha)

The estimated total air dry biomass for the plains is 149 million tonnes, of which 26 million tonnes consist of timber and 123 million tonnes consist of firewood. The potential of firewood for energy production for both local consumption and the national market is enormous, even if the quality criteria for timber are lowered. The ratio between the timber and firewood biomass is approximately 1:4. Table 3 shows the estimated woodfuel biomass for some Terai districts.

***Table 3: Estimated Woodfuel Biomass for some Terai districts***

| S. N. | District | Woodfuel Biomass ($10^6$ tonnes) |
|---|---|---|
| 1 | Kailali | 21 |
| 2 | Banke | 13 |
| 3 | Bara | 10 |
| 4 | Morang | 9 |
| 5 | Kanchanpur | 8 |
| 6 | Bardiya | 7 |
| 7 | Kapilbastu | 6 |

## 2.3 FIREWOOD PRODUCTION

Based on the Operational Forest Management Plans (OFMP) prepared for 18 districts, total firewood production is estimated to be 211,795 cu m, i.e. an average of 11,766 cu m per year per district. Besides government forests, fuelwood is also obtained from community forests, leasehold forests, private forests and trees on farmlands. Table 4 presents the data compiled by the Department of Forest regarding the production of fuelwood by different agencies.

***Table 4: Production of Fuelwood by Agencies (Chattas)***

| Agency | 1993/94 | 1994/95 | 1995/96 | 1996/97 | Total |
|---|---|---|---|---|---|
| DFO | 718 | 1103 | 879 | 823 | 3523 |
| DFPSC | 3089 | 987 | 3569 | 1027 | 3523 |
| TCN | 5990 | 1421 | 2217 | 1888 | 7046 |
| Total | 9797 | 3511 | 6665 | 3738 | 14092 |

## 2.4 PROBLEMS ENCOUNTERED IN WOOD ENERGY USAGE

**The main problems associated with wood energy are as follows:**

- Approved OFMPs not being implemented for the sustainable management of forests;
- sole authority for firewood and timber distribution/sales rests with the TCN only;
- lack of proper distribution system - TCN depots established only in urban centres that are not in continuous operation and no depots in rural areas;
- no supply system to rural population, so illegal cutting of trees for firewood;
- lack of supervision and monitoring.

## 2.5 RECOMMENDATIONS

The following measures are suggested to improve the wood energy sources:

- Improve the distribution system, particularly for the rural population;
- Reduce wasteful use of available fuelwood;
- Promote fuel-efficient stoves;
- Promote plantation of preferred fuelwood species on farmlands and wastelands;
- Conserve existing fuelwood resources, and increase forest productivity;
- Encourage the use of alternative energy sources, such as biogas.

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# 3. FUELWOOD TRADE AND MARKETING IN NEPAL

*by*

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## INTRODUCTION

Fuelwood is a traditional energy resource. The demand for fuelwood increases along with increases in per capita income. However, as the per capita income exceeds some threshold level, per capita consumption of fuelwood declines as fuelwood is considered an inferior commodity and is substituted by other energy sources.

Nepal's economy is basically a subsistence economy with a predominant rural sector. Therefore, the majority of people collect their own fuelwood for self-consumption. Fuelwood as a purchased commodity is mainly used around urban, peri-urban or bazaar areas for residential, commercial and industrial purposes. Traded fuelwood passes through a series of supply chains before it reaches the end-users. Therefore, fuelwood marketing comprises of wood production on-farm or off-farm, harvesting and conversion of trees, transportation and the actual transaction of fuelwood between the end-users and the retailers or wholesalers.

The system of fuelwood supply and demand operates in various policy environments. These policies affect the cost of production, transportation, conversion (including wood processing units yielding fuelwood), and the ultimate use of fuelwood and their substitutes. These policies provide opportunities and constraints to the many actors involved in the fuelwood supply and demand system. The major determinants of the fuelwood demand are the price (including that of substitutes), income and the preferences of the end-users. The supply chain is affected by the property right regimes of the land and the forests from which fuelwood originates, the technology of production, and input costs associated with the production, transportation, transformation and transaction of fuelwood.

This paper describes the context of fuelwood in the total energy use pattern in Nepal. Then, it attempts to analyze the marketing and trade flow of fuelwood in the context of the economic and institutional environment, which is unique to Nepal. Efficient marketing of fuelwood should include efficiency in all the supply chains. The last section discusses the potential for the increased and efficient supply of commercial fuelwood from the national forests of Nepal.

## 3.1 THE CONTEXT

The per capita energy consumption of Nepal is about 14 Giga Joules (GJ) - one of the lowest in the world. It is about 30 and 346 GJ for China and USA, respectively. The latest economic survey of the country indicates that Nepal used about 7.16 million Tons of Oil Equivalent (toe) of energy during 1997/98 (HMG, 1998). If we convert this toe into fuelwood equivalent units, it would be about 15.7 million metric tons of fuelwood. About 80 percent of the total energy used is derived from fuelwood. Agriculture residues and animal dung provide 3.5 and 6 percent, respectively of the total energy. According to a recent report by the Water and Energy Commission Secretariat (WECS, 1997), the total energy used in 1995/96 was 292.28 million

GJ. About 235.5 million GJ, equivalent to 14.1 million metric tons of fuelwood, consisted of fuelwood. This indicates that about 90 percent of the total energy used in Nepal is derived from traditional sources of energy. The remaining 10 percent of the energy is composed of petroleum products, coal and electricity.

The WECS undertakes studies on the energy use pattern in Nepal. One of the reports, WECS (1995), mentions that about 16 percent of the total fuelwood used in Nepal passes through commercial channels. In other words, about 2.2 million tons of fuelwood is traded through the market in Nepal. This appears to be a high figure. If we assume it to be 10 percent, the total amount of fuelwood commercially marketed is about 1.4 million tons. This wood is mainly used for household cooking in urban and peri-urban areas as well as in commercial and industrial units.

## 3.2 CHARACTERISTICS OF THE FUELWOOD TRADE

Fuelwood is a bulky commodity in terms of energy content. In other words, the density of energy is low in comparison to the volume of fuelwood. Households and commercial and industrial units, which consume commercial fuelwood, are usually located far from the areas where fuelwood is produced. The locational differences between the centres of production and consumption, and the bulky nature of the commodity means that the cost of transportation is a major component of the total value of fuelwood.

Fuelwood is the lowest use value of wood. In Nepal, the highest use value of wood is the timber or poles and fuelwood production on-farm, off-farm and ex-mill is essentially a secondary activity. In fact, fuelwood is not produced per se, rather it is used as the residual value of wood. Forest or tree management devoted solely to fuelwood production is not financially rewarding. Thus, fuelwood is produced because other higher valued wood products cannot be produced without producing some quantity of fuelwood.

The latest economic survey of Nepal shows that during the fiscal year 1996/97 the Timber Corporation of Nepal (TCN) - a semi-governmental organization responsible for the procurement and distribution of fuelwood and timber in Nepal - marketed 882,227 cubic feet (cu ft) of logs, 113,493 cu ft of sawn timber, and 1,888 *chattas* of fuelwood. Assuming that about 50 percent of sawlogs is eventually used as fuelwood, the total fuelwood equivalent sold by the TCN was about 25,893 metric tons in that fiscal year. About the same volume of fuelwood must also have been sold through District Forest Offices (DFO), District Forest Products Supply Committees (DFPSC) and the Forest Products Development Board (FPDB). This calculation provides some indication of the share of officially harvested commercial fuelwood from the so-called national forests (excluding community and leasehold forests) of Nepal. According to the latest economic survey, the share is about 2.4 percent of the total commercial fuelwood marketed in Nepal. However, if we consider the figure provided by the WECS, the share is about 3.7 percent.

We do not have any hard data on the proportion of commercial fuelwood harvested and marketed from private forests. We know that many farmers are now planting and nurturing trees on their farmland. *Dalbergia sissoo*, in particular, is cultivated on farms of the Terai as a cash crop. Some proportion of fuelwood obtained from the private forests and trees is sold for cash and hence is traded through the market. It appears that the amount of commercial fuelwood derived from private forests and trees is in the same order of

magnitude as that obtained from the national forests. A negligible amount of fuelwood derived from community forests is traded in the market place.

Between 4.7 and 7.4 percent of the total commercial fuelwood marketed in Nepal is legally harvested either from national or private forests. In other words, a minimum of 92.6 percent of the total commercially marketed fuelwood is legally obtained from these two sources. The remaining proportion or about 2.1 million metric tons (16 percent of the total fuelwood) or 1.3 million metric tons (10 percent of the total fuelwood) of commercial fuelwood is unofficially or illegally collected from the national forests. The magnitude of this commercial harvest from the national forest is also reflected in terms of deforestation and the degradation of the forest resources of Nepal. The latest information provided by the Forest Research and Survey Centre shows that Nepal's deforestation rate is about 0.5 percent per annum. The highest deforestation rate is for the Terai, which is 1.3 percent per year.

## 3.3 MARKETING CHANNELS AND FUELWOOD FLOW

A comprehensive study on fuelwood marketing and trade in Kathmandu valley was completed in 1989 (Shaikh et al, 1989). Similarly, a study on energy pricing policy was completed in 1994 (DeLucia and Associates, 1994). The pricing policy study has also analyzed the existing situation of woodfuel in the country and the implications of current and reformed policy on the demand and supply of fuelwood in the country. These two studies describe the marketing system of fuelwood in Nepal.

TCN, DFOs, and FPDB employ contractors to harvest fuelwood from the national forest and bring it to the nearest depots. The fuelwood thus obtained is either sold to consumers at fixed price or is auctioned. TCN or any other contractor has to get a permit to harvest wood from national forests. Fuelwood is also produced during wood processing. Off-cuts derived from sawlogs during saw-milling are also used as fuelwood.

The marketing chain of commercial woodfuel obtained through informal or illegal collection from the national forests is different. Since no official permit is issued to these collectors, individual household members enter the national forests, harvest the fuelwood and bring it in head-loads, bicycle-loads, and shoulder-loads to the nearest road side. They either sell the fuelwood to a local trader or to an end-user. Some of the bus or truck drivers are the major carriers of this fuelwood to the urban centres. They purchase the fuelwood stacked on the road, and eventually sell it to wholesale or retail merchants of the town. The proportion of commercial fuelwood supplied by these "silent travellers" is significant. For example, it was about 30 percent in Kathmandu during 1991/92 fiscal year. The profit from the fuelwood supplied by these "silent travellers" is: 17 percent for back-loaders (collectors), 6 percent to shop keepers, 49 percent to drivers, 10 percent to wholesalers and 10 percent to retailers.

## 3.4 LABOUR MARKET, FREE RIDERS AND FUELWOOD TRADE

Based on the proportion of fuelwood used as a commercial commodity, it is estimated that at least 100,000 household members are now annually engaged in the collection and trade of fuelwood in Nepal. An industrial survey conducted by the Central Bureau of Statistics in 1993/94 shows that about 235,000 people are employed in various industries of Nepal (HMG, 1996). The number of people engaged in the collection and marketing of fuelwood

is significant in comparison to the ones employed in the industrial sector. Therefore, fuelwood collection (for trade) from the national forests is a booming industry in Nepal. This number does not include the members who are engaged in fuelwood collection for their own use. Labour used for timber harvesting, logging and trade is also not included in this calculation.

A distinction has to be made between those who collect fuelwood for their own use and those who collect fuelwood for sale (Gregory et al, 1996). The economic interpretation of this distinction lies in the opportunity cost of labour. People whose opportunity cost of labour is lower than the market price of fuelwood frequently engage in the collection and sale of fuelwood. These activities are associated with the widespread unemployment and underemployment that prevail in the rural areas of Nepal and which account for the fact that the individual collection and sale of fuelwood for the market is the predominant livelihood strategy adopted by the local people. Providing more productive jobs to these people would increase the opportunity cost of labour, and would divert them away from fuelwood collection (from the national forests).

The substantial amount of fuelwood collection for sale from these national forests is also a reflection of the *de facto* property right system of these forests. Presently, the access rights and duties regarding the collection of fuelwood from the national forests are not defined. Even if these access rules were defined, it is unlikely that they would be enforced, monitored or sanctioned. This type of institutional structure creates a social dilemma where every one of the potential collectors faces the 'free-rider' problem. Thus, each and every fuelwood collector attempts to equate his/her opportunity cost of labour to the market price of the bundles of fuelwood collected from the forest. In this situation, no consideration is given to the value of the forest on the stump. In fact, the forest rent dissipates virtually to zero. Therefore, the market price of the bundles of fuelwood is equal to the value of labour devoted to the collection and transportation of that fuelwood. In fact, a fuelwood collector is actually selling the value of labour employed in the collection and transportation of the bundle (s) of fuelwood. The only way to capture the value of forest products (including fuelwood) is to define, monitor, enforce and sanction property right rules in the management (including collection) of the forests. One possibility is to assign the *de facto* property rights related to the forest management and utilization to the local community forest user groups as per the present forest rules and act. This arrangement can also be augmented by designing and implementing fiscal policy measures so that the proceeds of the sale of the forest products are shared among the community forest user groups, adjoining village and district development committees and the national government. In any case, the partnership between the local people and the government has to be strengthened to expand the benefits from national forests.

## 3.5 REALIZING THE POTENTIAL

Various rules have been designed to control the illegal harvest and commercial marketing of fuelwood from national forests. However, given the *de facto* property right system inherent in the national forests of Nepal, and the macro-economic structure of the country, it would be difficult to control the household collection of fuelwood from the national forests of Nepal. The best way to improve the situation is to reform the institutional structure (property right system) related to the management of national forests, and to legally involve the households who are economically dependent on this forest in the process of management and utilization. In

essence, the reformed policies should focus more on incentives and less on command and control systems.

Presently, the market price of fuelwood is higher than its economic cost (De Lucia and Associates, 1994). However, opportunities exist to increase the legal supply of both fuelwood and timber from the better management of accessible (national) forests. Increased supply of wood from national forests would also result in the decline of the market price of fuelwood (Kanel, 1994). Better management of these forests would also lead to higher level of rent capture by the government and any other organization responsible for their management. The conceptual basis of the impact of this reform can be clarified from the following example.

The Terai has about 0.5 million hectares of national forest which can be commercially managed. The management regimes can be implemented in such a way that the chosen silvicultural operations would be sensitive to the conservation of biodiversity unique to the Terai. The growing stock of the Terai can be conservatively estimated to be about 120 cubic metres (commercially marketable) per hectare. Assuming the rotation of this forest to be 70 years, the annual yield of wood from this forest would be about 0.85 million cubic metres. This volume of wood would be equivalent to about 9.8 million cubic feet of sawn timber, and about 0.45 million metric tons of fuelwood. The annual rent (net) of this forest would be equivalent to about 1.5 billion Nepalese Rupees (NRs), most of which could be captured by the government. The necessary conditions to realize this potential are (a) the reform of property rights to the resources of the national forests, and (b) the involvement of local wood cutters in the management of these forests.

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# 4. AN OVERVIEW OF PRA PLANNING

*by*

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## INTRODUCTION

Participatory Rural Appraisal (PRA) is a useful tool for rural development planning. It comprises many techniques for data collection and analysis by a multidisciplinary team. It requires the team to talk extensively and informally with local people and to observe local conditions. PRA is a good method to obtain information in a cost-effective manner. It is a systematic activity designed to make inferences and assessments, including the acquisition of new information in a short period of time. Table 1 compares the conventional approaches with PRA.

***Table 1: Comparison of PRA with Conventional Approaches***

| Techniques Employed | Conventional Approaches | PRA |
|---|---|---|
| Methodology | Specified in advance/rigid | Wider choice of field methods and techniques/ flexible |
| Monitoring and Evaluation | Through submission of progress reports followed by formal meetings | Less formal, more discussions and evaluation left to the end |
| Nature of development work | More of a replicable nature so planned in advance | Mostly unforeseen, so need to be ready to help during the course of work |
| Formats | Specified in advance with quantification | More qualitative, often new, unanticipated information |
| Statistical analysis | Often plays a major part | Little or none |
| Formal questionnaires | Often included | Avoided |
| Interview with local farmers and key informants | Through formal questionnaires | A major component using semi-structured interviewing techniques |
| Qualitative descriptions and diagrams | Not as important as hard data | Considered to be important |
| Sampling | Statistically acceptable sample sizes necessary | Often small sample size selecting key areas, farms, households, etc. |
| Measurements | Detailed, accurate | Qualitative data or indicators used |
| Group discussion | Informal unstructured sessions | Semi-structured workshops and brainstorming |
| Cost | High | Economical |
| Time | Long time-span | Rapid, short time-span |
| Direction | Top-down | Participatory, mostly bottom-up |

PRA can be used for:

- assessing the development needs of a community;
- assessing the feasibility of a scheme;
- identifying priorities for development/research;
- implementing development activities in time;
- monitoring and/ or evaluating development activities in a short time; and
- tapping local knowledge.

## 4.1 PRA PLANNING

PRA can be conducted by an organization either using its own trained staff or through outside agencies with relevant expertise. When using outside agencies, it is necessary to find the right people, give workable Terms of Reference (TOR) and to ensure that all the arrangements being made will produce the desired results.

In preparing a contract for PRA work, particular attention should be given to the following:

**Needs and Expectations:** The purpose of conducting the PRA must be clearly mentioned in the TOR. To prepare the most practical and flexible TOR, the matter has to be discussed with experienced practitioners. The discussion can focus on how the whole process of PRA should be conducted from beginning to end, the special conditions involved, resources, field support needed, qualifications and training needs of the team, etc.

**Timing:** Timing for the PRA can be considered from two sides:

1. From the local situation, the best time should be considered. This will allow more time to get good information from the community. How much time is required depends upon the topic covered, the condition of the rural area, the season, etc. However, the best time/month for fieldwork in rural areas of Nepal to interact with the farmers is from December to March.
2. From the organization/institution point of view, the timing depends on specific objectives and when the findings need to be fitted in to other activities of the project cycle.

**Topic:** Every PRA should have a clearly defined objective. PRAs are needed for topics about which little is known in advance. It is risky to guess the issues in PRA. A long list of questions is not appropriate for PRA. Priorities should be mentioned and issues should be categorized. It is crucial to note that PRAs are not questionnaire surveys.

**Selection of team:** Based on the lists submitted either by different institutions or by advertising, the team members should be selected, largely on the basis of prior experience with PRA.

**Methods to be used:** The choice of methods depends on the nature of the topic and the expected output. The PRA team has to decide which tools and techniques are appropriate in a particular area. However, general methods like interviewing the local community, direct observations, use of existing data should be kept in mind by the team.

**Reporting the output:** PRA findings and recommendations are included in a written report. A report can be presented in a meeting or seminar to discuss the findings. The report should include the methodology adopted, tables, figures, maps, photographs, etc. It is better if the reporter prepares a summary of the report along with the main report. Translation of the report into the local language is also equally important.

**Costs required:** PRA is generally less expensive than conventional research. But it is important to ensure the budget allocated is sufficient. To cope with unforeseen circumstances contingency funds should be made available.

## 4.2 CONCLUSION

PRA is a good and rapid method of rural assessment. PRA can be used in several ways and is inherently participatory and diagnostic. It involves different professionals, development workers and local people. It is cost effective and less time consuming than conventional development research methods. Therefore, it is widely used by most development agencies, GOs, NGOs and individual researchers.

# 5. SHORTAGE OF WOODFUEL AND ITS IMPACT ON THE SOCIO-ECONOMIC CONDITIONS OF PEOPLE IN NEPAL

*by*

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## INTRODUCTION

In recent years there has been a rapid increase in deforestation caused primarily by two factors. First, a larger number of people depend on forests and forest products for their livelihood. More forest trees are cut to meet the demand of fuelwood and fodder and also to expand agriculture land. Table 1 shows an alarming rate of land-use change brought about by the loss of forest cover within just 15 years and its overall impact on the watershed condition in parts of Lalitpur and Kavrepalanchowk districts. Consequently, the forests around the villages have disappeared leaving only patches of forests in inaccessible areas.

***Table 1: Landuse Changes Between 1978 and 1993 in Selected Areas of Middle* Bagmati Watershed Area[1] *(in ha)***

| Landuse | Area In 1978 | Area In 1993 | Changes |
|---|---|---|---|
| Agriculture | 53787 (25.8%) | 76775 (36.9%)↑ | + 22988 (11.06%) |
| Open forest $F_{1*}$ | 32718 | 11188 | - 21530 |
| Dense forest $F_{2**}$ | 94224 | 87697 | - 6527 |
| Total forest | 126942 (61%) | 98885 (47.5 %)↓ | - 28057 |
| Shrubland | 18033 | 23323 | + 5290 |
| Grassland | 973 | 512 | - 461 |
| Erosion | 206 | 742 | + 536 |
| Water | 7873 | 7577 | - 296 |
| Total | 334756 | 306699 | -28,057 |

***$F_1$ = 10- 40 % cover density, $F_{2**}$ = > 40 % cover density***

Note that in just 15 years agriculture land increased by 30%, whereas, open forests decreased by 65%. Similarly, the dense forests area reduced by 7%. Eroded areas increased by more than 260%.

## 5.1 WOOD ENERGY ISSUES

The energy demand in Nepal is met primarily by traditional, commercial, and alternative energy sources. Traditional sources of energy include woodfuel, agricultural residues, and animal dung. Of these, woodfuel is the most commonly used source of energy. It is estimated that about 67.9% of the energy demand is met by woodfuel alone. The other 23% is supplemented by agricultural residues and animal dung. The major source of

[1] ***This is based on aerial photo interpretation carried out by Bagmati Watershed Project following the disastrous monsoon of July 1993.***

fuelwood is the natural and private forests. In recent years, community forests have also become a source of firewood. The gap between the wood produced and the required wood is about 3.5 million metric tonnes.

Electricity, petroleum products, and coal are included in commercial sources. Apart from electricity, all other forms of commercial energy are imported. Nepal spends about 40% of its export earnings on these. Because of the rising prices of these commercial sources even the industrial sector is increasingly using fuelwood as energy.

Alternative energy sources include small micro hydro power plants (<100 kW capacity), wind energy, solar energy (with a potential of 26 MW), biogas etc. Biogas has a great potential in Nepal. It is believed that there is a potential to establish about 1.3 million biogas units in the country. Between 1974 and 1994, however, only about 26,000 units, or 2% of the total potential were installed.

According to an estimate made in 1988, the total woodfuel demand in the country is about 15.5 million metric tonnes per year, whereas, only about 10 million metric tonnes are available. However, the estimate made by WECS in 1994 indicates that the gap between supply and demand is about 3.5 million metric tonnes. Estimates indicate that there is a huge deficit (about 33%) of woodfuel in Nepal. This deficit has resulted not because the forests producing woodfuel are limited but because of the factors mentioned below.

1) In the Middle Mountain areas, the forests around the villages have already disappeared. Forests in the ridge areas, which are far from the villages, still have good forest stands. But they are practically difficult to harvest thus effectively creating a shortage of woodfuel in the villages.

2) In the high altitude areas, forests grow slowly due to low temperatures and other climatic stresses. These places are thinly populated, but people living here need more woodfuel for cooking and heating. Furthermore, these areas have become popular tourist destinations. The need to run restaurants and provide hot water in the hotels for tourists puts additional pressure on the existing forests. Such areas have started to experience acute shortages of woodfuel. In places such as upper Mustang and Dolpa goat excreta is widely used as fuel.

3) In areas with high population density such as the Terai, forests have long been exploited for woodfuel and timber. Many areas in the Terai lack woodfuel. This is obvious from the fact that these places have a long history of using animal dung in cooking.

4) In recent years community forestry has become a popular programme especially in the Middle Mountains. These forests have been protected by the communities who can only harvest a limited sustainable amount of woodfuel. This forces people to look for other source of energy.

5) The distribution of woodfuel is very skewed in Nepal. There are places where wood lies rotting in the forests but in other places woodfuel is difficult to find. So far there has been no effort to bring the surplus wood to deficit areas. Accessing these surplus areas is uneconomical for farmers.

6) While collecting wood, traditional tools are used which leaves a lot of wastage. Similarly, wood collectors do not regard small branches and twigs as fuel. These small parts are left in the forests. There is thus a horrendous wastage of woodfuel.

## 5.2 EFFECTS OF WOODFUEL SHORTAGE

1) Shortage of woodfuel puts additional burden on woodfuel collectors, especially women who need to spend extra time and energy to walk to distant sources. The time spent in collecting woodfuel could otherwise have been used for economic activities. As the wood collection becomes more time consuming and more difficult, food processing too becomes more difficult.

2) As woodfuel becomes scarce, farmers are forced to use animal dung for cooking. These practices of using dung for fuel mainly in the Terai and high altitude areas have had an adverse impact on agricultural productivity. Animal dung, which should be used to manure farms, is burned in the kitchen, resulting in the depletion of soil nutrients and the gradual decline in crop productivity.

3) The import of chemical fertilizer doubled in the ten years between 1984 and 1994. Of course, many farmers are aware of chemical fertilizer and more areas have been connected with roads during this period. But as shortages of woodfuel force farmers to burn animal dung, they have to use more and more commercial fertilizer just to maintain the production level. This has created an additional burden on farmers' finances.

4) A shortage of woodfuel is also responsible for changes in the country's social dynamics. For example, as wood charcoal is a valuable source of energy for blacksmiths and goldsmiths, many people have become engaged in its production and marketing. Charcoal making and marketing remain important sources of income for many poor people. However, with the shortage of firewood to make charcoal, and with the imposition of restrictions on charcoal production they have had to forgo this occupation and look for some other means of livelihood.

5) Similarly, in remote areas, villagers process milk to make more durable products such as *Ghee* or *Khuwa* which are easier to transport to the market. As woodfuel becomes more scarce such operations become difficult to continue. For example, farmers who formerly produced *Khuwa* in parts of the Lalitpur area have started to produce *Ghee* only because there is not enough woodfuel to turn the milk into *Khuwa*. Unfortunately, *Ghee* is less profitable than *Khuwa*.

6) The import of kerosene in Nepal increased from 38,000 KL in 1985 to 176,000 KL in 1995. This is partly because many forests have been protected under community forests legislation and users can only collect a limited quantity of woodfuel in a specified time. This has made the use of kerosene common in areas with access to roads over which kerosene can be transported easily

## 5.3 THE ECONOMICS OF WOODFUEL IN *KHUWA* PROCESSING

The economics of woodfuel can be better explained using the following case study of Khuwa processing, which is practised by thousands of farmers in the hill areas where food shortages are acute.

Livestock is an important part of the farming community in the remote hills of Lalitpur District in central Nepal. Because of the low agricultural productivity, there is a food deficit period of about 3-6 months in the area. Only a small number of farmers can produce enough to feed their families all year round. Therefore, many people depend on other sources of income to meet their basic needs. As an alternate source of income they raise buffaloes to produce milk. People who can walk to the nearest road head within three hours sell fresh milk to the National Dairy Corporation at a government fixed price. But farmers in remote villages across the valley are not as fortunate. They cannot transport fresh milk without it turning sour. Therefore, they resort to making *Khuwa*, (the concentrate left after boiling down milk), which keeps even without refrigeration for five days. Making *Khuwa* is more time consuming, and more environmentally damaging, and ironically less profitable, than selling milk. Table 2 shows the economics of *Khuwa* preparation. *Khuwa* is sold for almost 30% less than fresh milk.

***Table 2: The Economics of Khuwa Preparation[1]***

| Sample household | Qty. of milk (lt.) | Price/litre (Rs.) | Cash return on milk (Rs.) | Qty. of *khuwa* (kg.) | Price/kg (Rs.) | Cash return on *khuwa* (Rs.) | Cash difference (Rs.) |
|---|---|---|---|---|---|---|---|
| 1. | 22.5 | 13.25 | 298.08 | 5.15 | 45.45 | 234.06 | 64.02 |
| 2. | 25.0 | 15.59 | 389.70 | 6.22 | 45.45 | 282.91 | 106.79 |
| 3. | 25.0 | 14.89 | 370.80 | 5.95 | 45.45 | 270.42 | 100.38 |
| 4. | 25.0 | 13.97 | 349.20 | 6.10 | 45.45 | 277.24 | 71.96 |
| 5. | 22.5 | 12.78 | 287.55 | 5.85 | 45.45 | 245.42 | 42.13 |
| Total | 120.0 | | 1695.33 | 29.27 | | 1310.05 | 385.28 |

***Note: Price of milk is calculated on the basis of fat content, taken as RS. 2/ lit/fat %.***

| | |
|---|---|
| Average return from milk | 1695.33/120= Rs. 14.12/ lt. of milk |
| Average return from *Khuwa* | 1310.05/120= Rs. 10.89/ lt. of milk |
| The difference in cash return | Rs. 14.12 - 10.89 = Rs. 3.21 |
| The difference in percent | 29.42 % |

Again, for every four litres of milk boiled down into one kilogram of *Khuwa*, farmers collect between three and five kilograms of firewood. In fact, as much wood is damaged as is actually gathered. If a village sells 10,000 kilograms of *Khuwa* a month, they are cutting about 10 tons of wood just to make the *Khuwa* and still earn 30% less than the value of milk. Once firewood becomes difficult to find, either they have to somehow sell fresh milk, which is difficult unless the villages are connected with roads, or resort to making Ghee, which is sold for a lot less than *Khuwa*. Without enough firewood to make *Khuwa* the survival of the farmers in these hills will be in jeopardy.

[1] ***This study was carried out in 1992 to assess the economic consideration of Khuwa preparation and its impact on forest resources. Five households in the village of Ikudol in Lalitpur district were selected for the study.***

## 5.4 OPPORTUNITIES TO IMPROVE THE WOODFUEL SITUATION

The overall scenario of the woodfuel situation in the country is not satisfactory. The gap between demand and supply needs to be narrowed. It will be a long time before other alternate sources of energy can be sufficiently produced to supplement the energy demand. Therefore, it is important to look into the opportunities available to reduce the gap.

1) **Wastage can be minimized** - fuelwood harvesting, collection, and utilization is done in traditional ways. There is heavy wastage in its collection and utilization. Small pieces of wood, twigs and branches are not considered as valuable. This is also because wood is considered to be abundant. Such losses can be minimized by improving fuelwood harvesting techniques, harvesting tools, and the method of harvesting. Some education might help.

2) **Efficiency in use can be improved** - the traditional stoves used by the majority of people are generally considered to use woodfuel inefficiently. There has been quite an effort in improving the stoves in the past decades. The introduction of improved stoves has not received wide acceptance yet. Woodfuel use efficiency must be improved.

3) **Increased access to distant forests** – the problem of woodfuel shortages mainly arises from the fact that many areas are still uneconomical for people to collect wood from. These forests can be made accessible for collecting woodfuel by using cableways. Such techniques have been successfully used by logging companies in countries like Pakistan and Bhutan. Nepal has not yet used such simple and environmentally less damaging tools to collect forest products.

4) **Need based development** - other development sectors such as agriculture, and livestock should develop programmes which enhance not only the use of woodfuel but also encourage farmers to produce their own source of woodfuel. For example, farmers cultivating sugarcane in the hills in the past used firewood from nearby forests to process sugarcane juice. There are places where farmers have stopped cultivating sugarcane due to shortages of firewood. However, some farmers have started to grow fast growing species such as *Alnus nepalensis* in order to continue their sugarcane processing business operation. Such opportunities should be examined.

5) **New products can be explored** - in urban and semi-urban areas encouraging the production of rice husk briquettes can be useful in meeting part of the woodfuel demand.

6) **Alternate sources of energy** - Nepal has a great potential for producing alternate sources of energy such as biogas. It is believed that there is a potential to install 1.3 million biogas units in the country. This will produce energy equivalent to 3.3 million tons of firewood.

7) **Fuelwood plantation** - plantation of fuelwood species needs to be promoted on a massive scale. It can be done through community forestry and private plantation.

# 6. PROSPECT FOR WOODFUEL PRODUCTION AND TRADES BY COMMUNITY FOREST USER GROUPS AND COMMUNITY- BASED LEASEHOLD FORESTRY GROUPS IN NEPAL

*by*

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## INTRODUCTION

Community forestry is being implemented all over Nepal, intensively in the hill districts, and with the support of bilateral and multilateral donors. At the same time, the leasehold forestry project covers nine hilly districts namely: Kavre, Makwanpur, Sindhupalchok, Ramechhap, Dhading, Dolakha, Sindhuli, Chitwan and Tanahu. Both community and leasehold forests thus constitute a large area for the production of woodfuel.

The Timber Corporation of Nepal (TCN) and the private sector are the most prominent actors in the woodfuel trade at present. However, Forest User Groups (FUG) of community forests and community-based leasehold groups (LHG) are ready to participate in the woodfuel business. This paper discusses the potential of and the prospect for these groups to participate as producers and traders of woodfuel.

## 6.1 PROSPECT FOR FUGS AND LHGS IN THE PRODUCTION AND TRADE OF WOODFUEL

**Policy framework**: Community forestry and leasehold forestry are the first and second priority programmes, respectively of the Master Plan for the Forestry Sector (1989). Both have been designed to meet the people's basic needs for fuelwood, fodder, timber and other forest products on a sustained basis. As per government policy, national forests are being gradually handed over to the forest user groups or leasehold groups for their management. Nepal has an estimated 9.2 million hectares of potentially productive forest, shrub, and grassland, of which 3.4 million hectares are considered to be accessible for fuelwood collection (WECS, 1994). Of the potential area of community forest, 411,483 ha of forest area have already been handed over as a community forest to 6,160 forest user groups including 653,658 households (CPFD, 1998). Similarly, 2,844 hectares of forest land have been allocated to 599 leasehold groups, including 4,104 poor families (HLFFDP, 1997).

**Tenure period:** There is no time limit in community forestry. The Forest Act 1993 and the Forest Rules 1995 presume that a community forest can be managed forever by forest user groups if no environmental damage is done. On the other hand, forest land can be leased to any organized body or community for a maximum of forty years, and upon satisfactory performance, the same forest land can be leased again for another term of forty years (MFSC, 1995).

**Organizational framework:** At the local level, improved marketing usually requires organizations such as cooperatives or other forms of associations. Through these organizations, decisions relating to matters of common interest can be made and acted upon. By working together, members of an organization can gain bargaining power with traders and middlemen so that they can maximize their incomes. At the same time, producers' scarce resources must be allocated wisely to yield the best returns. An organization's marketing strategies can help reduce farmers' risks (FAO, 1996). Both community forestry user groups and leasehold groups have their organizational set-ups at grassroots level. FUGs of community forests are groups of diverse socio-economic characteristics. They have their own constitutions, standing committees and are officially registered in the District Forest Office. The leasehold forest groups on the other hand are more homogenous and generally include groups of 5-10 poor families who are living close to each other. These groups are registered as `small farmers groups' in the Small Farmers Development Project of the Agricultural Development Bank of Nepal. The FUGs or LHGs, or their networking organizations, can facilitate the marketing of their members' products so that a better price is received.

**Type of species planted or promoted through natural regeneration:** The majority of the community or leasehold forests have promoted the natural regeneration of local species. For example sal (*Shorea robusta*) in the Terai to the Mid Hills, chilaune (*Schima wallichii*), katus (*Castanopsis sp*), chirpine (*Pinus roxburghii*) and utis (*Alnus nepalensis*) in the Mid Hills and bluepine (*Pinus wallichiana*) and utis in the High Hills. In man-made forests, sissoo (*Dalbergia sissoo*) is the most important species that is planted widely in the Terai and the Inner Terai. Chirpine and utis have been mostly planted in the hills. However, none of these species have been genetically improved to get straight boles for high value timber like teak (*Tectona grandis*). Thus, there is a high possibility that the principal product of community or leasehold forests will be woodfuel.

**Forest management systems in CF and LHF:** A Selection Forest Management System has been applied in community or leasehold forests removing the dead, dying, diseased, and mature trees. Thinning, pruning and removal of less desired trees are also carried out. No other scientific management system has been introduced. Thus, the selection system also indicates that the main product of community or leasehold forests, will be woodfuel.

**Popular participation in the forestry sector**: The overwhelming participation of local people in the management of community forestry and community-based leasehold forestry is the key to the success of both programmes. It has not only reversed the deforestation and the degradation of the environmental conditions in CFs and LHFs but has also enabled them to meet local needs and produce surplus forest products.

**Rights over the products:** Rights over the forest lands of the community and leasehold forests will always remain with the government. However, the Forest Act 1993 has clearly invested the product rights in community forests and leasehold forests with the concerned FUG or LHG. They have rights over CF or LHF related to their protection, management, development, and utilization. Moreover, they have freedom to decide on the selling price and sale of the forest products.

**Freedom of FUGs or LHGs to sell and trade the woodfuel and timber - as mentioned in the OP:** Both the FUGs and LHGs have freedom to make decisions within the framework of the Operational Plan. Their first responsibilities are to satisfy the basic forestry needs of the members and then they have freedom to sell the surplus forest products in the market. However, they have to get permission to transport the forest products from one district to another.

**Conversion to production forests:** At present the average yield from natural forests is rated at less than two cubic metres per hectare per year. The reasons for such a low yield are unregulated and excessive felling, lopping, grazing and fire (Suwal, 1992). The protection of community or leasehold forests has had a very positive result in promoting natural regeneration. Forest fires have been controlled in community and leasehold forests. Likewise, many FUGs and LHGs have controlled free grazing in the community and leasehold forests. The management of community and leasehold forests is leading in the direction of their conversion to production forests.

**Maximum benefits from the forest**: For marketing to be successful, all participants in the process must make a profit (FAO, 1996). The FUGs or LHGs can decide whether to produce fuelwood in the short-term or timber in the long-term, or both. In order to create income, community forestry user groups are gradually moving from a subsistence economy to a monetized economy (Singh, 1998).

**Institutional support from the government:** The government of Nepal is providing legal and institutional support to community and leasehold forestry user groups to make them self-reliant. Different kinds of training have been provided, through bilateral and multilateral donors and government agencies, to forest user groups to strengthen their institutional capabilities. This has enabled FUGs and LHGs to manage their community and leasehold forests in a sustainable manner.

**Production of woodfuel - technically feasible in short-rotation**: Woodfuel production is a technically feasible option to be applied in short rotation of 6-10 years in CF or LHF. Fast growing species such as *Eucalyptus sp*, utis (*Alnus nepalensis*), *Leucaena sp*, bakaina (*Melia azedarach*) etc. are generally planted for the short-term depending on the ecological conditions.

**Woodfuel production - a renewable resource**: Woodfuel is not like cooking gas and kerosene that will be exhausted after a few decades. It is a renewable natural resource that can be produced even on wastelands. Woodfuel is at present the main product of CF or LHF and will remain so in short-term, medium-term and long-term strategies.

**Possibility of charcoal production from community forests and leasehold forests**: Charcoal-making is usually carried out, illegally and covertly, in government forests by blacksmiths (Kami) and goldsmiths (Sunar). Charcoal has a higher carbon content per unit weight compared to fuelwood. Moreover, the cost of fuelwood is compounded by the high cost of transportation. The price of charcoal is generally higher than fuelwood. For example the price of charcoal in Pokhara is Rs 140-150 compared to Rs 35-45 per backload (20-25kg) for fuelwood (IOF, 1992). There is a high internal demand for charcoal for traditional metal work. Conversion and transportation of charcoal can generate employment and income to the rural poor. Further, charcoal can be used by industries like bakeries, distilleries, carpet making, paper manufacturing, brick making, etc. A study carried out by the Industrial Service Centre (ISC) has shown that during 1985/86, there was an annual national consumption of around 11,000 metric tonnes of charcoal in the industrial sector of Nepal.

Thus, appropriate technology should be introduced to FUGs for charcoal making. A large component of the wood transported from remote locations consists of water and volatile matter, which have no energy value. If these non-beneficial contents of wood can be removed it will be easier to carry the energy in a concentrated form and thus save unnecessary transport costs.

**Employment for the rural poor**: There is a greater possibility that the production, conversion and trading of woodfuel in CF or LHF will generate employment opportunities and a good source of income for the rural poor.

## 6.2 GOVERNING FACTORS IN THE MARKETING OF WOODFUEL IN THE CF AND LHF

According to the Forest Act, Section - 43, FUGs are independent entities. They can make their own decisions regarding the marketing of forest products. The key factors governing the marketing of products from CFs and LHGs are:

- Liberal and clear forestry policy, laws, operational guidelines and procedures regarding the marketing of the forest products;
- marketing skills of the FUGs and LHGs;
- organizational capacity of FUGs and LHGs;
- competition with other sectors involved in marketing, e.g. the Timber Corporation of Nepal, and the private sector;
- diversification of products including woodfuel - e.g. charcoal, wood-briquettes;
- transportation cost of forest products;
- middlemen and contracts for the marketing of products;
- transparent transactions - large amounts of money are involved;
- employment for the rural poor.

## 6.3 CHALLENGES

Trading is an important managerial tool for increasing income, but it is often not fully exploited due to lack of know-how or the inability to invest in marketing. Producers often do not know how to develop products, what delivery systems are available, and how to tailor services to customer needs. Both FUGs and LHGs lack professional skills and experience related to planned marketing. There is a great possibility that middlemen and distributors will have an important role in the marketing of woodfuel from community and leasehold forests. The marketing of the forest products poses a huge challenge for user groups. The Terai forests and the private sector forests have a greater role in the production of woodfuel and thus strongly compete with the FUGs and LHGs in the woodfuel trade.

## 6.4 RECOMMENDATIONS

**Policy and laws:** Liberal policy should be formulated for the marketing of forest products. The FUGs and LHGs should be permitted to export surplus goods and locally non-usable materials. India and Bangladesh could be a big market for woodfuel and other forest products.

**Marketing guidelines:** Marketing of forest products is still vague. Thus, clear guidelines should be prepared and made clear to the FUGs.

**Research and study:** Study and research regarding the diversification and marketing of forest products should be done to provide the outlets for the export of finished or semi-finished goods.

**Training and orientation regarding the diversification and marketing of wood products:** The organizational capacity and skills of the FUGs and LHGs should be strengthened through training and orientation. For example, simple charcoal making technology should be introduced to FUGs and LHGs so that marketable quality product can be produced.

**Diversification of products**: More firewood than any other product comes from the CFs and LHFs. Initiatives should be taken to diversify the forest products including woodfuels such as charcoal, briquettes etc.

## 6.5 CONCLUSION

FUGs and LHGs have the potential to produce a large amount of woodfuel. The production, conversion and marketing of woodfuel in CF and LHF could play an important role in generating employment opportunities for the rural poor.

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# 7. FUTURE PROSPECT FOR THE WOODFUEL TRADE IN NEPAL

*by*

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## INTRODUCTION

The energy situation in Nepal is characterized by the prominent use of woodfuel resulting in an imbalance between its consumption and its supply. About 96% of the total biomass fuel is estimated to be consumed in the residential sector alone. The commercial and industrial sectors are estimated to consume only 4%. Unless currently unexploited potential sources of woodfuel are exploited and traded it will not be possible to find enough wood energy for industrial and commercial uses.

The future prospect for woodfuel consumption largely depends upon the growth in the use of alternative sources of energy. It also depends on efficient transport and communication systems. The institutional sustainability and monetization of community forestry, leasehold forestry and national forestry programmes will also have a direct impact on the future of the woodfuel trade. Operational Forest Management Plans have been prepared for many Terai districts and their implementation their will affect the quantity of woodfuel produced and its trade.

The Timber Corporation of Nepal markets Woodfuel in Nepal. It is an entirely non-technical body and has nothing to do with forest management or any forestry development issues. It just acts as an intermediary between the Department of Forest and the consumers, mostly in urban areas. Nevertheless, it has an important role to play in the trading system.

Community forests have a great potential to produce increasing amounts of woodfuel. At present there are more than 6,000 community forest areas managed by Forest User Groups (FUGs) and the number is growing. However, at present it is difficult to forecast the yield of woodfuel from community forests.

A major constraint on the future trade of woodfuel could be transportation. If transportation costs are prohibitive, then it will not be economical to transport woodfuel from areas of surplus to deficit areas. This will result in further pressure on already scarce forest resources in the deficit area. To avoid such a scenario, the woodfuel trade should be promoted and other sources of energy should also be developed and sold at an affordable price to the people. The woodfuel trade process should be simplified and left to private entrepreneurs and Forest User Groups. The government should simply play a regulatory role.

# 8. WOODFUEL FLOWS: DISTRIBUTION AND MARKETING OF WOODFUELS

*by*

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## INTRODUCTION

The wood energy system encompasses three interrelated but self-functioning systems: the wood energy resources system, the wood energy flow system, and the wood energy utilization system. The resources system includes different types of woodfuel production sources. The woodfuel resources system covers the raising of trees from seed to the management of forests for sustainable woodfuel production, both in forest and non-forest lands. The woodfuel flow system covers another complete set of activities. These start from the procurement of standing trees in forests or non-forest areas to their harvesting and conversion, or from the collection/gathering of the fallen trees and branches at source, to their sizing/bundling and transportation to market or consumption centres. During the process of woodfuel flows there may be a few actors collectors-cum-headloaders-cum-consumers or a much more complex chain of actors in different stages of the flow process. Mode of woodfuel transportation may depend upon the size of the market, volume and value of trade, distance from the supply sources, existing infrastructure and the comparative cost of different transportation means, etc.

The wood energy utilization system encompasses another set of activities that are related to woodfuel applications, both in primary and secondary energy forms as well as in technological terms. The household level use of woodfuel is mostly in primary energy form, which involves the direct combustion of fuelwood for generating heat for cooking or agro-processing. A limited amount of charcoal, which is a secondary form of energy generated from wood is also used by some households for specific uses. Similarly, many traditional industrial and commercial activities also use woodfuel in its primary energy form, others may use the heat and power generated from wood and other biomass fuels. The technologies required for different applications may also differ significantly, depending upon the form of energy required for specific end-uses,

Recently, cogeneration of heat and power from wood and other biomass residues in industries has been gaining wider recognition, both on economic and environmental grounds. Many developed countries in Europe and North America have already promoted the development of modern wood energy for application in different uses, primarily due to its carbon neutral role if when sustainably produced. Though slowly emerging, some fast developing countries in Asia have also started to adopt modern applications of wood energy, at least to cut their high cost of energy use by substituting it with the energy produced from the residues generated domestically. The development potential of modern wood energy for commercial application in Asia is not fully known.

## 8.1 WOODFUEL DISTRIBUTION

A large proportion of the locally consumed woodfuel is usually gathered by the users themselves, mostly free of cost at the source in rural areas. Others, mostly the poor, collect it partly for self-consumption and partly for sale to generate cash income to meet their basic household needs. In some urban areas, woodfuel may have become solely a tradable commodity, for use in both households as well as in the activities of the industrial and commercial sectors. Between these two extremes, may be numerous variations with a greater or lesser amount of woodfuel collected for own use with the remainder used to barter, earn cash income, to convert into charcoal, etc. The exact volume and value of the woodfuel trade in the region is not known, neither is the amount consumed as self collected or free supplied woodfuel. However, studies in different countries suggest that a substantial amount of woodfuel consumed by the households in urban areas is purchased. Generally the poor, both in urban and rural areas, have a tendency to search for free supply sources and depend on nearby natural forests and/or public lands for free fuelwood collection. The urban poor, as far as possible search for cheap supply sources, and mostly meet their requirements from waste or recovered wood available locally, if free supply sources do not exist locally.

The Pakistan study report of 1993 shows that some 100,000 people were employed in the woodfuel trade, 73% permanently and 27% temporarily. This figure does not include the number of people involved in woodfuel gathering and charcoal making for trade. On the other hand, the number of households involved in the collection of woodfuels for own use was reported as 7 million (RWEDP, 1996a). The estimated number of people involved in the woodfuel trade in India, according to Agrawal, 1987 (in RWEDP, 1996a) is between 3-4 million. In Nepal, according to Poudyal, 1986 (in RWEDP, 1996), out of 48,000 people in the nearby villages, about 6% were involved in supplying woodfuel to Pokhara city.

## 8.2 WOODFUEL MARKETING AND TRADE

Supplying woodfuels to markets in large towns and cities has evolved into a woodfuel business in the informal sector. It has developed its own network between the tree growers and woodfuel producers, transporters and traders, and consumers or end-users. The non-traded woodfuel flow is a simple distribution system. There may be only one actor performing the complete task of woodfuel production and transportation up to the household where it will be consumed. The consumer may serve as the producer/gatherer, converter and transporter and no other actor may be involved in between. The traded or commercial woodfuel flow systems may vary from place to place depending upon local conditions, not only between countries but also between places within one country. Many factors play a role in the design of a flow system in a particular area. The system may be a simple one, linking the producers with traders and consumers, or it may be a very complex one, having many actors in between the producers and the consumers of woodfuels, i.e., contractors, labourers, transporters, middlemen, wholesalers and retailers.

A thorough understanding of the resources systems, which may include the public, community or privately owned/managed tree production systems of different kinds that may be based on forest or non-forest lands, will be essential to assess the woodfuel production potential, including the amount available for sustainable utilization. This information will also help to identify the different linkages that may prevail between the producers and

consumers in the flow process, depending upon the type of the supply sources and the characteristics of end users. The prevailing woodfuel flow system in a given area may have both vertical and horizontal linkages of variable nature, to link the different production systems with diverse end-users. A free or self-collected supply for self-use may exhibit the closest link between the resources and the consumer of woodfuel. A self-collected supply partly for own-use and partly for market trade may have a shorter route, whereas a purchased supply for market trade could involve a much more complex chain of actors in the flow process.

## 8.3 CONSTRAINTS AND ISSUES OF WOODFUEL FLOWS

**(a) Harvesting and Conversion.** These examples are based on Bhattarai (1998). In Gujrat, India, the government-imposed ban on harvesting of trees in public forests has encouraged the production of charcoal on private and community lands. Different end-users compete for the charcoal available in local markets and the demand appears not to be declining. Both the Revenue and Forest Departments control the procedures established for harvesting the trees for conversion to charcoal. The procedures to be followed for obtaining a tree harvest permit are very complex, cumbersome, time consuming and non-productive. Seven steps have to be followed by the charcoal manufacturers to fulfill the government-imposed formalities for charcoal production and transportation. First, an initial application for a permit to harvest trees, second, the validation of private tree ownership, third, the issue of a felling permit, fourth, the conversion into charcoal, fifth, the official assessment of the total volume of charcoal produced, sixth, official clearance for loading and transportation, and seventh, the issue of a transit pass for transporting the charcoal to market for sale (RWEDP, 1993a).

In Peshawar City of Pakistan, woodfuel is supplied from the mountainous and sub-mountainous natural forests in the adjoining tribal areas and some from adjoining farmlands. Part of the supply also comes from the Punjab province, mostly for tobacco curing. In order to preserve the natural forests in tribal areas, special support is needed to the social forestry development programme to boost woodfuel production (RWEDP, 1993c).

**(b) Transportation and Trade.** Since woodfuel trade is an informal sector activity, the trade related issues are not adequately studied and clearly documented in many countries. Some examples are cited below based on the information available from member countries.

In Gujrat, India, the formalities to be fulfilled in order to produce and trade charcoal are very complicated. Numerous steps are involved. But despite the imposition of such control measures, the controlling authorities generally do not possess the information or rarely make use of the available information to improve the condition through policy revision. It is reported that the price of charcoal is fixed according to its grade. Saxena (in RWEDP 1997a) suggests a stop in the subsidies on wood sold by government forestry agencies to industries in India, primarily to force them to buy the wood produced by private land owners and pay the economic price.

In Nepal, 3-6% of the woodfuel supplied in Kathmandu valley was supplied as head- and back-loads, another considerable amount by occasional and non-professional traders in the form of piggyback loads. Some of these carriers may also be receiving extra cash income from the woodfuel trade. In many areas of Nepal, head loading of woodfuel and charcoal making for trade do act as a survival safety net to the rural poor and underprivileged members of society. But the act is generally illegal, despite the fact that markets clearly exist for these products, and people dare to take a risk to benefit from the opportunity. In Pokhara, Nepal a shop owner is reported to have made a substantial profit within a few months by selling the charcoal made in the local public forest (RWEDP, 1991).

In Pakistan, the traded woodfuels in Peshawar City are transported over long distances (200-350 km). The transportation cost of woodfuel accounts for 25% of the retail price. Transport by train costs about half of the truck cost but involves official formalities for obtaining railway wagons which is a difficult task. It also involves one extra loading and unloading. The market price of woodfuel varies according to species and thickness of the billet. Local retail sale is on the basis of weight measurement, but the contractors purchase it from the FD on stack volume basis. The weight of wood stacks varies considerably according to species, size, moisture content, etc., and the royalty rate of stacks may change accordingly. Charcoal, on the other hand, is not graded and fetches a uniform price. The marketing system has evolved over a long period of time, but it is functioning well in the informal sector. No attempt has been made so far to enhance the product quality and yield through the introduction of efficient charcoal making techniques. The lower prices of gas and kerosene are fostering the replacement of woodfuel. To reduce the retail sale price of this essential commodity it has been recommended (RWEDP, 1993c) that *octroi* charges and *zila* taxes on woodfuel movement be abolished.

Haider (in RWEDP, 1996b) raises the issue of tax on wood transport across district/division boundaries in Pakistan, and suggests a countrywide review of it, particularly the transit tax. In NWFP it amounted to 30-35% of typical tree producer prices for firewood and small timber. It included the District Council export tax (*zila* tax) and the *octroi* tax, on top of the 12.5% sales tax levied on most retail goods. This is considered a large tax burden for a primary commodity like woodfuel with fairly low value added content. Further, the tax system is also reported to be very complex and poorly understood, and is subject to widespread abuses. Therefore it is suggested unnecessary government interventions in the working of the privately run woodfuel and timber markets should be avoided.

## 8.4 COMMON ISSUES RELATED TO FORESTRY LEGISLATION

A list of issues that have been commonly observed, documented, or repeatedly expressed in different fora by the experts in the region are presented below. Many of these issues are related to the prevailing rules and regulations in the forestry and related sectors.

- Prevailing rules and regulations governing land ownership and holdings, tree tenure, tree planting and harvesting in privately owned and/or community managed lands often adversely affect the woodfuel production in non-forest lands as well as the participation and investment by the people.

- Government imposed restrictions on privately raised and/or community managed tree harvest, transportation and trade does not encourage commercial forestry development in non-forest lands, a crucial problem in most countries.

- Artificial division of responsibility between the forestry and agriculture sectors for tree planting and management (the former for commercial forestry in forest and public lands and the latter for trees in private farms and homesteads, particularly fruit and cash crop trees) has unnecessarily created inter-sectoral antagonism. One agency has difficulty to impinge upon the territory of the other and this has resulted in the creation of duplicate extension services in the sectors.

- In some countries only planted species are allowed for harvest and trade - mostly commercially inferior and traditionally unutilized species for heavy construction – and most naturally growing prime species are prohibited from harvest and trade. This has affected the development of commercial forestry in non-forest lands.

- The preference of the agriculture sector for cereal and cash crops, and some high value fruit trees does not sufficiently address the need for sustainable land use and production. It could also affect non-forest area based woodfuel production.

- Most country legislation allows the harvest of planted trees for local level consumption (self-use), but official permits are required to bring the products to other places and markets.

- Technical, institutional, social, economic, and environmental issues, both in the forestry and agriculture sectors affect wood energy development.

- Physical barriers, inadequate infrastructure, and designation of special areas for conservation purposes could reduce local wood energy availability.

- Government-imposed restrictions on certain tree species (mostly native high value commercial wood producing trees) and a ban on the use of woodfuel for certain end-uses (e.g. brick making in Bangladesh) may adversely affect commercial wood energy development.

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***The traditional practice of integrating trees into the farming system (TB)***

***Participants on a field visit to Thuli community forest (TB)***

# B. CASE STUDIES

# 1. FUELWOOD TRADE IN NEPAL: A CASE STUDY FROM SAGARNATH FORESTRY DEVELOPMENT PROJECT

*by*

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## INTRODUCTION

Sagarnath Forestry Development Project is one of the three projects operated by the Forest Products Development Board (FPDB). The main objectives of the project are:

- To plant fast growing tree species in degraded forest areas to convert them into production forests for the sustainable supply of forest products to local people and industries;
- to develop employment opportunities; and
- to develop and disseminate the knowledge and skills related to forest management and plantation.

The project covers areas of Sarlahi, Mahottari and Rautahat districts, with about 11,000 ha under plantation and the rest under natural forest. The main species selected for plantation are Eucalyptus sp (60%), *Tectona grandis*, *Dalbergia sissoo*, *Dalbergia latifolia*, *Ceiba pentandra, Albizia* species (about 40%).

## 1.1 FUELWOOD TRADE BY SAGARNATH FORESTRY DEVELOPMENT PROJECT

### A. Production

Fuelwood is obtained by different silvicultural operations on natural and planted forests.

1. **Thinning and pruning -** Thinning and pruning are carried out in sissoo and teak plantations at intervals of five years. Products obtained are stocked in *chattas* (20 feet x 5 feet x 5 feet) and are auctioned off.

2. **Clearing of Eucalyptus plantations -** Ten year old plantations of Eucalyptus are clear felled and the products are used for electric/telecommunication poles and fuelwood. The lops and tops are used for making particleboard. After harvesting, the remaining shoots are managed under a coppice system.

   Logging operations are carried out to produce the maximum number of poles (usually 8-9 m long), with a small number 10 m long. After production of the poles the residues of the harvested trees (such as branches, rejected poles, lops and tops and unusable parts for poles) are converted into fuelwood and stocked at the site for sale.

3. **Singling of coppice shoots -** These materials are obtained by the singling of coppice shoots in the years after felling. They are used by local people for fuelwood. About 3,000 people living around the project area have benefited from these coppice products. People co-operate and help the project to protect the forest in order to benefit from early coppice products.

4. **Managing regeneration -** *Shorea robusta* (sal) is regenerating profusely in the project area. In some places plantations of Eucalyptus and *Dalbergia sissoo* are being replaced by sal. Besides sal, regeneration of *Tectona grandis* can be seen in patches. To encourage such regeneration, thinning and regeneration felling have been carried out and products thus obtained are suitable for fuelwood. The fuelwood data obtained by different silvicultural operations are given in Table 1.

***Table 1: Fuelwood production and sales in Sagarnath Forestry Development Project***

| Fiscal Year | Fuelwood Production (Chatta) | | | Total Production *(chatta)* | Total Sales (*chatta*) | Total Sales Amount (Rs.) |
|---|---|---|---|---|---|---|
| | Thinning | Clearing of Eucalyptus Plantation | Clearfelling (*murtia*) | | | |
| 2046/47 | 78.75 | - | - | 78.75 | - | - |
| 2047/48 | 74.25 | - | - | 74.25 | 21.00 | 48,594.00 |
| 2048/49 | 102.25 | 288.75 | - | 391.00 | 192.75 | 446,023.50 |
| 2049/50 | 98.75 | 233.25 | - | 332.00 | 153.50 | 582,763.50 |
| 2050/51 | 188.75 | 667.75 | - | 856.50 | 464.00 | 2,021,489.50 |
| 2051/52 | 206.00 | - | 1,264.00 | 1,470.00 | 1,307.25 | 7,374,264.25 |
| 2052/53 | 211.75 | 645.75 | 2,380.00 | 3,237.50 | 1,545.25 | 10,203,695.00 |
| 2053/54 | 235.00 | 760.25 | - | 995.25 | 2,121.75 | 11,376,622.50 |
| 2054/55 | 252.50 | 1,115.25 | - | 1,367.75 | 1,842.75 | 11,638,806.57 |
| Total | 1,448 | 3,711 | 3,644 | 8,803 | 7,648.25 | 43,692,258.82 |

***Source: Sagarnath Forestry Development Project official records***

In the fiscal year 1997/98, sal regeneration management in a 51 ha area produced 76 *chattas* of fuelwood and thinning of planted teak/sissoo in 335 ha area produced about 200 *chattas* of fuelwood.

**B. Marketing of Fuelwood**

1. **By Auction -** Fuelwood is sold to local people and industries using an auction system. Brick kilns and sugar mills are the prime users but they do not participate directly in the auction process. The Board of Directors of FPDB fixes the price of fuelwood. These fixed prices are only minimum prices to begin the auction and people/agencies that offer the highest price are awarded the fuelwood lots. Minimum prices for fuelwood are listed in Table 3.

### *Table 3: Fuelwood Price*

| S.N. | Fuelwood Type | Price Per chatta (Rs.) |
|---|---|---|
| 1 | Fuelwood of Eucalyptus species | 7,200 |
| 2 | Fuelwood of sal regeneration (thinning) | 5,000 |
| 3 | Fuelwood of teak (thinning) | 4,700 |
| 4 | Fuelwood of sissoo (thinning) | 4,550 |
| 5 | Fuelwood of miscellaneous species (other than teak, sissoo and Eucalyptus species) | 4,500 |

2. **By Agreement -** To promote national industries, the FPDP also provides raw materials to the industrial sector through formal agreements with the concerned industries so as to guarantee the material requirements for a definite period of time.

In the fiscal year 2054/55 (1997/98), the project earned Rs. 35 million from the sale of forest products. Of this sum more than Rs. 10 million has been paid to HMG as royalty. Plantation management, conservation and utilization of the project's forest area are financed by a revolving fund of the FPDB.

## C. Management of Forests

Fuelwood production plays an important role in the management of plantation and natural forests.

1. **People's participation -** Local people are getting free fuelwood to meet their basic needs. Thus they co-operate and help in the protection and management activities. Local people are hired to carry out plantation-related work.

2. **Eucalyptus fuelwood -** Eucalyptus can be used as fuelwood; even if it is green it still provides constant heat. People prefer Eucalyptus for fuelwood and this has encouraged the project to plant this species for the fuelwood trade. However, dry fuelwood of Eucalyptus has a lower monetary value than the fuelwood of other species.

The woodfuel trade in Nepal has a high potential to generate income to the local people. Private forestry and farm forestry should also be encouraged to plant seedlings of fast growing species for woodfuel. Degraded land in national forest areas should also be planted with high yielding and fast growing species to improve soil texture and to produce fuelwood for trade.

# 2. WOODFUEL TRADE IN MORANG DISTRICT

*by*

*Sharad Kumar Rai, District Forest Officer*

## INTRODUCTION

Morang district falls in the Eastern Development Region of Nepal with Biratnagar as its district headquarters. Biratnagar is an industrial town and the second largest city of Nepal. In terms of domestic use the energy use pattern in Morang is assumed to be similar to that of other Terai districts of Nepal. However, it may vary in terms of industrial use, as the district has many industrial establishments. Based on the national average, 72.5% of the energy for domestic use comes from forests. With the limited number of private plantations, the major source of wood energy is government owned forests. The apparent need for fuelwood and the heavy population of the district has exerted enormous pressure on the forests and has led to the degeneration of the forest quality. Woodfuel trade in Nepal is governed by government policy on national forests, as there are limited private forests in the country. The trade pattern and the problems in Morang are similar to those in other Terai districts.

## 2.1 ENERGY RESOURCES OF MORANG

### *2.1.1 Forests*

Morang has 55,000 ha of forest land. Most woodfuel in Morang come from government owned forests. However, there has been a tremendous increase in the number of private plantations in the past. This is being set back by the mass dying of *Dalbergia sissoo* plantations. The Department of Forest has not been able to find a satisfactory solution to this problem. The area of private plantations far exceeds the area recorded in the local forest office. Besides major plantations, there are plantations in cultivated fields, along canal banks and on common lands.

### *2.1.2 Agricultural residues*

Despite being a major industrialized district, Morang still has a strong agriculture based economy. Eighty three percent of the population is dependent on agriculture. In total, 105,270 ha of land is under agriculture. The production of agriculture residues and its use as energy for domestic consumption is very common.

***Table 1: Agriculture Production and Residue Estimates 1996/97 (Morang)***

| Agri. Crop | Production (M.Tonne) | Ag.Res./Tonne Of Production | Res. Used As Fodder | Res. Available As Fuel (M. Tonne) |
|---|---|---|---|---|
| Paddy | 237380 | 3.30 | 0.66 | 626683 |
| Maize | 25650 | 2.30 | 0.28 | 51813 |
| Wheat | 30490 | 1.75 | 0.28 | 44820 |
| Sugarcane | 560 | 0.30 | 0.00 | 168 |
| Total | 294080 | | | 723485 |

***Source: CBS, Statistical YearBook 1997***

## 2.2 WOODFUEL TRADE/ COLLECTION

Customarily, the collection of one head-load of fuelwood is allowed from the government forests, provided the collection is from fallen and dead branches. The felling of even dead trees is not allowed for fuelwood or any other purpose. However, the fuelwood collectors do not strictly follow the rules. With increasing population and subsequent decrease in the availability of specified fuelwood, the tendency of illegal felling has increased. The collection of fuelwood using any vehicle is also prohibited.

The Timber Corporation of Nepal (TCN) has sole authority to collect and sell fuelwood from the government forests. In areas not covered by the TCN, the local forest office has the right to sell forest products. The collection and sale of fuelwood from the community-managed forests is governed by the decisions of local Forest User Groups. The Forest Product Development Board also sells some fuelwood from its plantation sites in Sagarnath, Kerkha and Nepalgunj. Table 2 shows the recorded trade of fuelwood in the last five years.

***Table 2: National Fuelwood Trade (Chatta)***

| S.N. | Fiscal Year | DOF | TCN | DFPSC | Total |
|---|---|---|---|---|---|
| 1 | 1993/94 | 703 | 5,989 | 3,089 | 9,781 |
| 2 | 1994/95 | 633 | 1,421 | 987 | 3,041 |
| 3 | 1995/96 | 879 | 2,216 | 3,569 | 6,664 |
| 4 | 1996/97 | 822 | 1,888 | 1,026 | 3,736 |
| Total | | | | | 23,222 |

***Source: DoF Records***

Table 2 clearly suggests the volume of woodfuel trade is very small. All the requirement of woodfuel is met through unrecorded sources. The practice of taking one head-load of fuelwood free from the forest meets all the requirements of the people.

## 2.3 WOODFUEL TRADE IN MORANG

As in the rest of the country, all fuelwood trade is the domain of the TCN and the practice of taking one head-load of fuelwood from the forest is carried out very intensively. As fuelwood is in short supply through proper channels, the privilege of one head-load has turned into a lucrative business. Table 3 shows the extent of the fuelwood trade in Morang in the last five years.

***Table 3: Woodfuel trade in Morang ( Chatta )***

| S.N. | Fiscal Year | Dof | Private Forests |
|---|---|---|---|
| 1 | 1993/94 | 88 | 0 |
| 2 | 1994/95 | 75 | 33 |
| 3 | 1995/96 | 54 | 215 |
| 4 | 1996/97 | 51 | 64 |
| 5 | 1997/98 | 79 | 162 |
| Total | | 347 | 474 |

***Source: DoF Morang Office Records***

Morang has a population of about 800,000. The official quantity of fuelwood traded is a drop in the ocean compared to the total requirement. All requirements are met through unrecorded sources.

## 2.4 WOODFUEL DEMAND/ SUPPLY IN MORANG

Per capita fuelwood requirement for Morang district is 3,710 kg per household (DoF, 1998). According to the Operational Forest Management Plan of Morang, there is an astronomical gap between the recorded supply and the demand. This clearly indicates that the demand is being met through unrecorded and illegal supplies.

## 2.5 PROBLEMS AND CONSTRAINTS IN WOODFUEL TRADE

**Common property regime.** Forests in Nepal are considered to be common property at least for the collection of fuelwood. Common property regimes are often managed inefficiently leading to their degradation. Rural unemployment, inefficient supply mechanisms and fuelwood shortages in the market have lead to the gross misuse of the one head-load privilege and this has resulted in forest degradation.

**Uncertainty in supply.** As the forests in Nepal are not under a scientific management regime, there is no prescribed harvesting system for timber and fuelwood. The current practice of collecting fallen trees only does not assure any certainty in supply. The uncertainty in supply creates a vacuum in the market.

**Weak Marketing and Networking.** Currently, TCN is the sole agent for collecting and distributing timber and fuelwood in Nepal. Due to its weak organizational set up and marketing network, TCN has not been able to supply fuelwood to all consumers. All sales depots are located near the harvesting sites, where no one comes to buy.

**Defective pricing policy.** TCN's current fuelwood pricing policy is defective. Compared to the economic standard of Nepal, the fuelwood price set by TCN is very expensive. There is a large gap between the purchase price and the sale price. For example, the royalty of one *chatta* (500 cu ft stack volume) is Rs 1,000, whereas the sale price of the same volume is Rs 10,700.

## 2.6. CONCLUSIONS

Woodfuel is a major source of energy in Nepal. But the management of the forest resources for the production of fuelwood is limited to the collection of fallen and dead trees. With increasing population and decreasing forest resources, the pressure on the existing forests is increasing, leading to the further deterioration of forest quality.

There is a need to ensure the supply of fuelwood by adopting a scientific management regime for forests. The gap between the fuelwood demand and supply has to be filled by more fuelwood plantations, strengthening the marketing network and a proper pricing policy. There is a need to encourage private plantations for increased on-farm supply. The current dying back phenomenon of sissoo has discouraged private plantations. The Forest Department should identify other planting species and ensure the supply of seedlings or seeds along with appropriate technology. The policy of free access to forests for the collection of one head-load of fuelwood probably needs to be reconsidered.

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# 3. FUELWOOD SITUATION IN BANKE DISTRICT

*by*

*Diwakar Pathak, District Forest Officer, Banke*

## BACKGROUND

Government forests are the principal source of fuelwood for household use and for trade to the towns. The forests of the Terai are the main source of fuelwood marketed in towns. Marketing is mainly carried out by the Timber Corporation of Nepal. The private sector also contributes substantially to the harvesting and marketing of fuelwood both from government forests and private lands. Fuelwood is the major source of energy as it is readily available and is a free commodity. Fuelwood comes from public forests, shrub and grassland areas, and private land holdings. The predominant use of fuelwood has put tremendous pressure on the forests, mainly in the Terai where the quality of the forests has sharply declined in the last few years. The increasing demand for fuelwood by the rising population and the rapid deforestation have created an acute scarcity of fuelwood.

Banke district is situated in the Terai region of the Bheri zone in the Far Western Development Region of Nepal. The district headquarters is at Nepalgunj, which has established itself as a leading commercial centre for the Mid and Far Western regions of Nepal. According to the 1991 census, the total population of Banke district is 285,604. Due to the commercial importance of this area, a large number of migrants from hill districts of the mid-western region have settled here. Records show that the population increased by 38.53% between 1981 and 1991. Significant seasonal migration also takes place in Banke District(people come during winter and return to their home villages in summer).

The major source of income is agriculture. Many people also live off illegal cutting of firewood, which they sell at the markets of Kohalpur, Nepalgunj and adjoining towns of India. The basic energy source for cooking for all rural communities is fuelwood (98%). About 1.5% of the population also uses cow dung and a very limited number of people, especially from urban areas, use coal and LPG. Some leading farmers use biogas.

## 3.1 HISTORICAL BACKGROUND OF FUELWOOD USE

The total land area of Banke is 225,836 ha. Of this, forest covers 148,111 ha i.e. 65.55% of the total area. The bulk of the forest area is in the steep Siwalik zone and only about 25,000 ha of forest come undertake ‘productive forest’ category. The forest has had no scientific management so far. In the past, heavy selective fellings were made in order to supply railway sleepers to India. The Forest Resources Survey Office has prepared a few working plans, but they have never effectively been implemented.

Fuelwood for domestic use is collected by individuals (as back or head-loads). Traditionally, free collection of firewood is done in government forests on a head-load basis. Some people go to the forest, cut the firewood and transport it on bicycles to Nepalgunj and adjoining towns in India. A large quantity of fuelwood is used by brick kilns, distilleries etc. Brick kilns especially require a large amount of fuelwood for drying. It is estimated that a

brick kiln, if fully operated, consumes more than 100 *chattas* (20ft x 5ft x 5ft) of fuelwood per season. Many local people are engaged in supplying fuelwood illegally to brick factories. They first bring the firewood either as a head load or in an ox-cart to their houses to demonstrate that they are taking it for personal use, and afterwards supply it to brick factories. There are 27 such factories registered in Banke district. The forests in the vicinity of settlements are thus highly degraded.

The unchecked and over exploitation of forests has resulted in the loss of forest area and a decline in crown cover. According to the Forest Research and Survey Centre, the deforestation in Banke district during 1979-91 was 9,700 ha. An Operational Forest Management Plan (OFMP) has been prepared for Banke district. The plan divides the forest into Production Forest and Potential Community Forest. A detailed forest inventory has been made for the Production Forest only.

## 3.2 PRESENT SITUATION OF FOREST PRODUCTS

According to the OFMP of Banke district, the annual fuelwood demand is 123,190 $m^3$. The per capita consumption of fuelwood is as high as 1,095 kg per annum in the case of people living near the forest. The same report shows that the annual allowable cut is only 77,352 $m^3$. This clearly shows that a wide gap exists between the sustainable supply of fuelwood and the actual needs of the people. The Timber Corporation of Nepal also extracts fuelwood from dead and dying trees and supplies Kathmandu and other urban areas. It also supplies fuelwood to some industries. The OFMP prescribed that 0.5% of the total growing stock could be harvested and accordingly the District Forest Office allows the concerned agencies like TCN, District Supply Board etc. to harvest timber and fuelwood. For the fiscal year 2054-55 (1997-98), DFO Banke had a programme to extract 144,000 cu ft of timber and 592 c*hattas* of fuelwood from dead and fallen trees.

## 3.3 FUTURE STRATEGY

The forests of the Terai are deteriorating rapidly due to fire, grazing, and illegal felling for timber and firewood both for sale and subsistence. This decline in the resource base has caused great hardship to the common people who are exclusively dependent on the forest for fuelwood. The degradation of the forest has other consequences like land degradation, flooding, gully erosion, etc. Policies and actions to stop this trend and counteract the situation are urgently needed.

There are clear needs to enhance the production and productivity of the national forests, encourage people to plant trees on their farmlands, involve the local people in the protection and development of forests, especially in the vicinity of their homes, and to create awareness of efficient and economic uses of fuelwood.

### *3.3.1 National forest management*

The production forests of Banke need immediate attention. A look at the age class distribution of the forest shows there are virtually no regeneration, no saplings and no pole size trees. The only stock left are mature and over-mature trees. This is all due to the excessive fire, grazing and harvesting of pole size trees for firewood purposes. The conservative policies of removing only dead and fallen trees and the lack of sound management policies have led to this situation.

The Operational Management Plan for Banke district proposes to manage about 1,450 ha of forest and the plan shows that around 68,000 $m^3$ of wood products will be available in five years if the prescribed activities are undertaken. This quantity of wood will help to reduce some of the pressure of fuelwood collecting but as the need for fuelwood is very high, it is advisable to cover a larger area.

Apart from the products that are commercially sold, the following products can be made available to the local people free of cost or at a nominal price:

- non-commercial fuelwood;
- bark of logs;
- residues, lops and tops;
- forest products obtained during clearing, fire line construction etc.

### *3.3.2 Community forestry*

A community forestry programme is being implemented all over the country. The programme aims to actively involve local people in the protection, development and utilization of forests according to their perceived needs. Community forestry supports the development of national forests once they become self-sufficient in forest products. Parts of the national forests, which are in the immediate vicinities of the communities, are normally handed over as community forests. The Operational Forest Management Plan of Banke has prescribed 3,880 ha as potential community forests. At present about 1,590 ha of community forest has been handed over to 22 Forest User Groups. The amount of fuelwood produced from community forests was 985,425 kg (equivalent to approximately 1,600 $m^3$).

### *3.3.3 Private forestry*

Trees planted on the private lands (homesteads, farms) also contribute to meeting the firewood demand. It is estimated that almost 25% of the total firewood consumed comes from private sources. Private plantation activities gained momentum in the Terai once the World Bank funded the Terai Community Forestry Project was implemented. In Banke district, eight nurseries, each with a capacity of producing 100,000 seedlings, were established. Seedlings were distributed free of cost to interested farmers. Private planting was more popular with the farmers who lived far away from the forest. Sissoo, Eucalyptus and mango trees are most popular among private planters. With the national forest area declining due to various reasons, private planting will emerge as the main source of firewood.

## 3.4 CONCLUSION

Fuelwood is, and will remain, the most important source of energy in Nepal, especially in the rural areas. The high level of dependency on State forests for fuelwood is causing the forests to deteriorate at a fast rate. As a result, both socioeconomic as well as environmental problems have resulted. The solution to these problems does not lie with only one agency. The Department of Forest, local communities and individuals all have a role to play. The productivity of the forest area has to be increased by implementing sound forest management techniques and for this a management plan has to be implemented immediately.

# 4. FUELWOOD USE IN SINDHUPALCHOWK

*by*

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## INTRODUCTION

About 80 percent of Sindhupalchowk's energy requirement is met from woodfuel and is consumed for cooking purposes only. There is a severe shortage of fuelwood in the Terai and burning of cattle dung has already become a common practice there (HMG/MFSC, 1988). Community forestry in the Midhills has relieved the shortage of fuelwood to some extent but there is still a shortage of fuelwood in many rural areas. Except in the high mountain areas, all other regions face severe shortages of fuelwood. Alternatives to woodfuel are also limited in Nepal.

Much of the literature (Bajracharya, 1982; Eckholm et al, 1984; and Mahat et al, 1987) about the fuelwood crisis and deforestation in Nepal at the macro and micro levels is rather old. More recent information about the fuelwood problem, especially after the successful development of community forestry in Nepal, is lacking. Thus, this paper attempts to discuss the recent situation of fuelwood at the micro level in Sindhupalchowk district where community forestry was started about two decades ago.

## 4.1 STUDY AREA

Sindhupalchowk district is located to the north east of Kathmandu. The district covers an area of 2,528 $km^2$. The total population of the district in 1996 was about 261,045 with females and males distributed equally. The predominant forms of economic activity in Sindhuplachowk are agriculture and livestock production and various combinations of the two. A large portion of all agricultural and pastoral production is used for subsistence, but the marketing of surplus production is important and many farmers are involved in the market economy. Producing a surplus is, however, a second priority and comes into effect only after subsistence needs are met. The patterns of occurrence and utilization of forest in Sindhupalchok are intricately interwoven with the patterns of settlement and farming systems. The total forest area is 126,543 ha (including shrubland).

**Source and Pattern of Consumption and Supply**

Major sources of firewood supply in Sindhupalchowk are community forests, private forests or trees in homestead areas, government forests, and local sale/purchase. In town areas such as Chautara, Barhabise and Melamchi, commercial fuels such as kerosene and LP gas are also used. A study done in seven FUGs in the vicinity of district headquarters and in the remote rural areas shows that the firewood demand in the rural areas is met largely from private and community forests. Farmers in Sanosirubar and Thulosirubari meet about 57 percent of their total fuelwood requirement from community forests, while farmers of Thorka and Phulpingkot meet their requirement from private forests or trees.

**Types of Fuelwood (Daura)**

Types of fuelwood used in the district by size and season in which they are used can be classified into: *Jhikra, Phoruwa* and agricultural residues. *Jhikra* is generally collected from homestead surroundings and also from community forests and consists of dead and dying small branches, twigs, dried bamboo pieces and residues of tree fodder. Old wooden fences and posts; thankra (stands for local vegetables and fruits) can also be classified into Jhikra. Agricultural residues generally include maize and millet stalks, maize cobs, and stalks of various other cereals. *Jhikra* and agricultural residues are commonly used during Hiunde (winter season) *Phoruwa* during Barkhe (rainy season).

Barkhe daura is generally split and stacked for a longer period of time. It is generally green and relatively bigger than *Jhikra*. It is collected from lopping or pruning branches of trees in private and community forests (CF). In the case of CF, Barkhe daura is actually collected from various silvicultural operations such as cleaning, and thinning. Trees cut from thinning being of bigger size are frequently split. In the case of government forests, trees are cut, converted into logs and then split using an axe and then dried in the forest for about a month. After that they are transported and stacked in the shade and are used only after the commencement of the rainy season.

Hiunde daura generally consists of dead and dying wood, mainly obtained from the existing government or community forests and is used for immediate use. Hiunde daura is also supplemented by agriculture residues. It is smaller in size than Barkhe daura, and consists mainly of Jhikra types.

**Season of Collecting Daura**

The collection of daura depends on many factors such as labour availability, size of the family, access to forests and availability of dead and dying materials, size of the forests and agricultural season. The normal practice is to collect Barkhe daura in March-April. Daura collected in this season is sufficient to last up to November. From November onwards, the collection of Hiunde daura resumes.

**Forest Products Collection and Division of Labour**

A study done by the Nepal Australian Community Forestry Project Phase 4 (NACFP4) in the project area in 1996 showed that the division of labour for firewood collection depends on many factors such as location, ethnicity/caste, and season. For example, in Kiul VDC, men generally spend more time than women in cutting and collecting fuelwood, but one women from Hagam VDC spent as much as 15 hours for the same. Similarly, in Pipadanda VDC of Sidhupalchowk and Chaubas VDC of Kavre Palanchowk women spend more time than men. In general, boys spend more time collecting firewood and leaf litter than other forest products (Collet et al, 1996).

Ethnic and cast differences play a vital role in the division of labour. In Tamang community, men work alongside women. In Kami (Blacksmith) community, women take primary responsibilty for all farming activities while their husbands work in their traditional occupations. In Brahamin and Chhetri communities women spend most of the time cutting and collecting firewood, grass and others.

Average fuelwood collection time per household member is 2.5 hours in Hagam, one of the two sites where fuelwood was most critical. However, average collection time depends on many factors. In some areas, fuelwood is in such short supply and access to forests is so restricted, that wood has been significantly replaced as a fuel by crop residues.

**Types of stove used in the district**

Generally, four types of stove are used by the local people. They are 'steel ring', 'stone', 'formed mud' and 'improved'. In most cases, traditional stoves such as the steel ring type are used for preparing breakfast and animal feed. Fuel-efficient stoves such as improved chulahs or mud formed chulahs are used simply for cooking lunch and dinner.

## 4.2 DISCUSSION

The firewood situation of the district discussed earlier demonstrates that the existing forest area (government, CF or private forests) has the capability to supply the required amount of fuelwood. If no changes are assumed in present consumption patterns, there will still be an increase in the fuelwood demand due to population increase. This will increase the stress on the forests. Also, the supply of fuelwood will be further curtailed due to possible deterioration of the forest ecosystem caused by factors other than fuelwood demand. It has been estimated that to fulfill the demand for fuelwood will require approximately 1.2 million ha of reasonably high yielding forests by the year 2000 and 1.5 million ha by the year 2010 (Haque, 1986: 115-117).

It has been observed that the deficit fuelwood demand is met either by heavy pruning or by clear felling trees on private lands and also by increasing the use of agricultural residues. Moreover, the distribution of forests in the district is not uniform and not all the forests are equally productive, and not all the farmers have trees on their farm land, therefore, it is very difficult to generalize about the problem of fuelwood in the district.

At present, most of the demand for fuelwood is met from private forests, but there arises the question of its sustainability. Studies done in the past by NACFP have shown that about 72 percent of the farmers in the district cultivate between 5-25 ropanis of land. The NACFP study has also shown that on average 67 trees have been planted by farmers on their own land during the last 6-8 years.

Most of the fuelwood is used for preparing snacks, breakfast and animal feed. For this, almost all the farmers are using the most fuel inefficient stoves such as steel ring or stone types. Therefore, it is possible to reduce the fuelwood demand in the rural areas if improved stoves replace all fuel inefficient stoves. Similarly, there are also opportunities to change the attitudes and traditional beliefs of the farmers so that they discontinue the unnecessary practice of cooking animal feed for their cattle.

Not all the farmers have planted trees on private lands. About 28 percent still do not have trees on their farmland. These are farmers who have less land and in fact, they are already experiencing severe shortages of fuelwood. In the past, the free distribution of seedlings encouraged many farmers to grow trees but now the DOF does not have any programme of free seedling distribution. Farmers have to buy seedlings either from the FUGs nursery or private nurseries. Forests have been handed over to the users but users do not have any programme to improve the productivity of the forest.

At present, no FUGs have programmes for improving the productivity of their forests. Most of the operation plans focus on protection rather than management of the forests. Many plantations and natural forests are well established and too dense. They need immediate silvicultural operations and if managed properly, they can produce a significant amount of forest products, especially fuelwood. In summary, the present trend of FUG forest management is oriented toward developing forests to produce large sized timber rather than meeting the urgent needs of the users, such as for fuelwood and fodder.

## 4.3 POTENTIAL PROGRAMMES FOR SUSTAINABLE FUELWOOD MANAGEMENT

Studies carried out by researchers and organisations such as FAO suggest that effective wood energy management requires a coordinated 'systems approach' in which all actions relevant to wood energy production and use support and reinforce one another (FAO, 1996:13). Thus, a more balanced and orchestrated approach is required to take a long-term view of wood energy development and its economic, social and environmental connection. The approach focuses on wood energy for sustainable development rather than on wood energy simply for survival. Forestry strategies that attempt to deal with fuelwood shortages alone seldom attract farmers' interest. Very limited use of biogas and improved stoves by the farmers of Nepal clearly illustrates that an integrated approach of fuelwood management is essential in order to mitigate the problem.

The following programmes are suggested for the management of the fuelwood crisis in Sindhupalchowk district.

**Management of Plantation Forests**
Plantation forests could play a vital role in increasing the supply of fuelwood. There are about 15,000 ha of plantation forests aged up to 15 years. At present most of the plantation sites are heavily lopped or pruned, but thinning and removal of multi-stems is already overdue.

**Management of Natural Forests and Shrublands**
Improving the productivity of existing natural forests through scientific management can also increase the supply of firewood. The area with the greatest potential for fuelwood production is the shrubland. Shrublands, if managed under various coppice systems, can produce a considerable amount of fuelwood in addition to timber and foliage.

**Alternative Energy**
To reduce the pressure on forests and agriculture residues, biogas, micro-hydro power, and solar power have to be introduced.

**Extension and Training**
Despite many advantages of fuel-efficient stoves and biogas, very few farmers are interested in these. In addition to this, many farmers cook animal feeds, which is actually unnecessary. Farmers have to prepare snacks or breakfast for agriculture labour. As the improved or mud formed stoves take a long time to prepare breakfast, farmers usually use stones or steel ring stoves. Similarly, many people in the hills serve local beverages as one of the major items of breakfast and for preparing the beverages people generally use stone stoves. Therefore, intensive extension and training programmes to make the local people

aware of the demerits of traditional practices and the great advantages of fuel efficient stoves and alternative energy have to be conducted.

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# 5. WOODFUEL AND CHARCOAL TRADE IN URBAN KATHMANDU: CONSTRAINTS AND OPPORTUNITIES

*by*

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## INTRODUCTION

In Nepal much of the energy use is in the household (domestic) sector where it is used mainly for cooking. In Kathmandu valley, especially in urban areas, woodfuel has been replaced to some extent by commercial energy such as kerosene and LPG. Woodfuel comes from government and public forests, community forests as well as private holdings. It is transported to Kathmandu valley by trucks. There are also illegal roadside supplies, found mainly along the east-west highway, that are transported in smaller amounts by all kinds of vehicles including trucks and buses. There are also some supplies from within and around the valley.

Woodfuel use in sweetmeat shops, restaurants, alcohol preparation, paper and soap making, wool dyeing, etc. has declined rapidly. In Kathmandu valley, woodfuel is still used in small-scale industries and village applications such as feasts, bakeries, brick-kilns, aluminum smelting, cremation, tyre retreading, space heating, etc.

Charcoal, a refined form of woodfuel, still remains an important energy source for a wide range of industrial and processing applications such as metal smelting, blacksmithing, goldsmithing, water filtration, tobacco smoking, clothes ironing, earthing, meat grilling, nan making, chicken roasting, etc. The Water and Energy Commission Secretariat (WECS) in 1990 estimated that the annual charcoal consumption was more than 11,000 tons only for industrial purposes. Charcoal making is considered a traditional source of income in certain rural areas of Nepal such as Lalitpur, Kavrepalanchowk and Makwanpur districts.

## 5.1 WOODFUEL AND CHARCOAL TRADE IN URBAN KATHMANDU

### Woodfuel

Private agents or dealers handle the commercial supply of woodfuel in the valley. It is either in the form of logs (mudha), timber production waste (bakal) or split wood (chiruwa). Because of the scarcity of woodfuel, the bulk of it comes from the remote forests of West Nepal, which are more than 600 km from Kathmandu. Therefore, the supply has been decreasing and its price increasing (Sulpya, 1991).

The urban woodfuel trade is somewhat complex and traders sell woodfuel in a variety of different forms and quantities depending on their location and clientele. The mode of transport of woodfuel in urban areas is by truck up to Thankot or Sat Dobato area. From these points, the urban wholesalers or retailers bargain the price per truck and take it to their destination. In some cases, larger consumers can often bypass the intermediate

stages in the market structure by buying directly from the source or arranging longer-term bulk contracts, resulting in lower costs. Some buses, which run long distances also, carry chiruwa from the roadside. The woodfuel from the roadside mostly comes from natural forests and has been illegally gathered.

Sat Dobato is the major market to which the middlemen carry woodfuel to sell. This area is the nearest point to the brick and tile industries. Wholesalers from this area also sell woodfuel to Bhaktapur. Depending upon the users, woodfuel is carried either by truck, rickshaw or tractors. This paper discusses a number of case studies of the woodfuel trade in some areas of Kathmandu.

**Charcoal**

The urban charcoal traders are limited in Watu, Pyukha, and Kilagal area. Charcoal is produced in remote areas of Lalitpur, Kavrepalanchowk and Makwanpur districts. Charcoal production to supply takes three days including preparation, transformation, packing and transportation. In some cases, middlemen are also involved in the trading system. The mode of charcoal transport in urban areas is by back-load, normally in the night and brought to the destination early in the morning around 4 am to avoid police or forest guard patrols. In some cases, van and mini buses also transport charcoal.

Charcoal trading is a good source of income. The small-scale charcoal based industries and services in the urban areas require high heat intensity and are compelled to use charcoal at any price for their energy source. Thus, the poor people living in the surrounding hills of Kathmandu, who depend on charcoal production can be expected to continue charcoal production and charcoal trading.

## 5.2 CASE STUDIES

**Case study 1.** Ganga Lal Shrestha of Thankot area has run a woodfuel business since 1989. He used to travel a lot to collect good quality woodfuel and timber for his trade. Thankot is the entry point in Kathmandu so it is easy to get woodfuel when there is enough demand. He sells hardwood species like sal (*Shorea robusta*) in the form of mudha (log). He splits the woodfuel by using a saw that is available in his sawmill. Besides sal, he also sells woodfuel of lower quality.

Sal woodfuel sells for Rs. 3.00 per kg while other low heating value woodfuel sells for Rs. 2.50 per kg. The chiruwa woodfuel sells for Rs, 3.15 per kg. The price of woodfuel goes up during the winter season. At that time, the woodfuel becomes dry and is in high demand for ceremonies, and the brick and tile industries. People prefer sal wood if it is available. According to Ganga Lal Shrestha, the woodfuel trade business has declined drastically because it is very competitive. For example, there are now 15 more traders in Thankot, Khanikhola and Sat Dobato. His clients use woodfuel for ceremonies, cremations and tyre retreading.

**Case study 2.** Keshab Prashad Poudel of the Matatirtha area has run a woodfuel business since 1989. He sells sal in the form of mudha (log) and also chiruwa. Besides sal, he also sells masala (*Eucalyptus sp*.), saj (*Terminalia sp.*) and other species of woodfuel. The selling price of chiruwa sal woodfuel ranges from Rs. 120 to 125 per maund (Rs. 3.43 per kg to Rs. 3.57 per kg). Interestingly, when he buys, he measures 37.5 kg per maund but sells at 35 kg per maund. He sells mudha sal at Rs. 110 to 115 per maund (Rs. 3.14 to Rs. 3.29 per kg) and other low quality woodfuel at the rate of Rs. 100 to Rs. 110 per maund (Rs. 2.85 to Rs. 3.14 per kg).

He sells about 82 tons of woodfuel per year. About 10 percent of woodfuel is lost during handling (loading, splitting). Normally, he gets 15 to 18 percent profit during the off-season. But the profit goes up during the winter months. The woodfuel buyers use woodfuel for ceremonies, bakeries, restaurants, and brick kilns, aluminum smelting and wool dyeing.

**Case study 3.** Ram Bahadur Lama of Teku area has run a woodfuel business since 1959. He sells sal in the form of mudha, bakal and chiruwa. Besides sal, he also sells masala (*Eucalyptus sp*.), saj (*Terminalia sp*.), bothdhainro (*Lagerstroemia parviflora*), chilaune (Schima wallichii), sissoo (*Dalbergia sissoo*) and other species of woodfuel. The chiruwa sal woodfuel sells at Rs. 4.30 to 4.50 per kg. If the woodfuel buyers select thin and good quality woodfuel then it sells at Rs. 5.00 per kg. Bakal sells at Rs. 4.25. Other type of woodfuel sells at Rs. 4.00 per kg.

He sells about 121 tons of woodfuel per year. About 11 percent of woodfuel is lost during handling (loading, splitting). Normally, he gets 9 percent profit during the off-season. The woodfuel business lasts from October to March/April. The profit goes up during these months. During the rainy season, he covers the chiruwa and bakal, but leaves the mudha as it is. The woodfuel buyers use woodfuel for ceremonies, bakeries and wool dyeing.

**Case study 4.** Prakash Bahadur Shrestha of Sat Dobato area has been engaged in the woodfuel and timber trade since 1997. He sells sal only in the form of mudha but he does not charge for splitting. The woodfuel sells at Rs. 3.50 per kg. From October to March/April, the price goes up.

He sells about 162 tons of woodfuel per year. About 14 percent of woodfuel is lost during handling (loading, splitting). Normally, he gets 9 percent profit during the off-season. The woodfuel business lasts from October to March/April. The profit goes up during these months. The main buyers of his woodfuel are from brick industries. Other woodfuel buyers use woodfuel for ceremonies, bakeries and aluminum smelting.

**Case study 5.** Naina Lama of Boudha area has been selling woodfuel since 1992. He sells sal, masala, and sissoo in the form of mudha but he does not charge for splitting. The sal woodfuel sells for Rs, 4.00 per kg, masala Rs. 3.50 per kg and sissoo Rs. 3.25 per kg. Eighteen months before, sal woodfuel sold at Rs. 3.00 per kg, masala at Rs, 2.00 per kg and sissoo at Rs. 1.75 per kg. After sal, the most preferred woodfuel species in Boudha area is masala.

Five years ago he used to sell 360 tons of woodfuel per year. But the business has declined since 1996. He stated that about 6 percent of woodfuel is lost during handling (loading, splitting). The woodfuel buyers in this area use woodfuel for ceremonies, bakeries and cremation. Nobody buys woodfuel for alcohol preparation because unlicensed alcohol making is illegal and there are frequent police checks made to see if it is occurring. Most alcohol makers use kerosene as a source of energy.

**Case study 6.** The family of Raj Bhai Shakya of Watu area, has been involved in the charcoal trade for generations. The charcoal species that he trades are angeri (*Lyonia ovalifolia*), katus (*Castanopsis indica*), gurans (*Rhododendron sp*.), utis (*Alnus nepalensis*) and salla (*Pinus sp.*). He sells charcoal for Rs. 40.00 to Rs. 70.00 per tin (approximately 2.5 kg). The price depends on the availability of charcoal. During the rainy season, the price of charcoal goes up to Rs. 70.00 per tin. Normally, he gets Rs. 15.00 to Rs. 20.00 profit per tin.

The preferred species of charcoal is gurans but it is not readily available. The next preferred species is angeri. Sometimes, wet charcoal is also supplied but for him there is no difference in terms of the quantity of charcoal. Wet charcoal is sold especially for water filter and earthing purposes. Charcoal is also used to clean the well water during the dry season.

## 5.3 CONSTRAINTS AND OPPORTUNITIES IN THE WOODFUEL AND CHARCOAL TRADE

In urban areas, the consumption of kerosene and LPG for domestic and industrial purposes has been increasing rapidly. The transition from the use of traditional fuel to modern commercial fuels is significant in the energy consumption patterns of domestic and small-scale cottage industries. In particular, it widens the range of possible options open to consumers who are under the pressure of an increasing woodfuel scarcity. On the one hand, it brings many benefits – for example, it helps to reduce the over-exploitation of biomass resources – but it adds greatly to the pressure on the scare resources of capital and foreign exchange (Sulpya, 1991).

The woodfuel trading business is still of the traditional type in Nepal. For 30 years there has been no change in the business. It lacks consumer orientation. Woodfuel is kept in open fields and there is no mechanism of covering the woodfuel during rainy days. Only one woodfuel trader, Ram Bahadur Lama covers the chiruwa woodfuel partially during the rainy season but leaves mudha as it is. Consumers have to buy moist woodfuel for their use. Because of this, the woodfuel users complain a lot. As the wood stoves or ovens used by them do not have grates, the combustion is poor and produces a lot of smoke.

Woodfuel is supplied in the form of logs, which are more than 60 cm long. The use of short logs or split woodfuel will improve energy management during cooking or processing. This will increase the efficiency of the end-use and ease of operation during processing. Wood energy based systems should be improved in terms of its end use efficiency, cleaner combustion, ease of operation, marketing and trading systems, etc. The best alternatives to woodfuel are kerosene and LPG which are economically more feasible in comparison to

the high price of woodfuel and electricity in the market. However, improved end-use systems can compete with kerosene and LPG.

Mostly low-income groups in the rural areas near Kathmandu valley are involved in charcoal production and trade to earn their livelihood. It is observed that economic operation is very low in terms of charcoal recovery and the labour used. Charcoal production by exploiting government forests is illegal and the producers, middlemen, traders and even buyers face the risk of prosecution. But most small-scale charcoal based industries and services in urban areas require high heat intensity and are compelled to use charcoal at any price. Therefore, charcoal is expected to remain an important source of energy in the urban areas.

## 5.4 CONCLUSION

In Nepal wood energy has not been accorded sufficient attention and has received little investment. This study shows that there is increasing evidence that woodfuel and charcoal will continue to be one of the main sources of energy for urban Kathmandu especially for certain applications and small-scale industries. Thus, in the woodfuel trade business, there should be a future strategy for investment in the wood energy sector and fuel in the forestry sector.

Law enforcement and a ban on charcoal production would mean stripping the socio-economic benefits that charcoal production and trading provide to the economically disadvantaged groups. It would also have a disastrous effect on some cottage and small industries like metal crafts, metal smiths, metal potters, and other services like hotels and food vendors that do not have the flexibility or capability to shift to other fuels. It seems, there is a strong rural-urban charcoal energy interdependency. These activities should be promoted with special programmes. Experiences in many countries show that woodfuel and charcoal making promotes tree production (in the form of planting trees as cash crops) and wiser use of tree resources, in addition to generating income and employment for local people.

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# 6. A Case Study on Firewood Sales for Cremation through Pashupati Depot, Kathmandu

*by*

*Rebant Ram Dhakal, Planning Division Chief, Timber Corporation of Nepal*

## Introduction

The Timber Corporation of Nepal (TCN) was established in 1959 as a Public Limited Company under the Company Act. From the very beginning TCN was under the Ministry of Forest and Soil Conservation. In 1998 it was placed under the Ministry of Supplies. TCN, from its establishment, dealt in only round and sawn timber and the Fuelwood Corporation was responsible for the supply or trade of fuelwood. In 1989, the then Fuelwood Corporation, and the marketing functions of the Forest Product Development Board were merged in TCN. The major objective of TCN is to extract timber and fuelwood by logging from government forests in a managed way, and saw milling and marketing throughout Nepal in general and in the urban areas in particular.

TCN extracts fuelwood and timber in 27 districts of the Terai and distributes them in 33 districts including Kathmandu valley and the Inner Terai. It has 13 branch offices, 124 depots and *ghatgaddis* (fuelwood and timber dumping sites) and 36 authorized dealers for the extraction and distribution of fuelwood and timber. TCN also has 17 sawmills in different districts of the Terai. Basically fuelwood is used for cooking, heating, cremations and for industrial purposes. But the sales recording system of TCN can not distinguish the quantity sold for different purposes. Anyone can buy fuelwood for any purpose.

## 6.1. Firewood Sales for Cremations

According to Hindu culture, dead bodies are burnt using firewood. TCN has separate depots for supplying firewood for cremations throughout its working area. TCN has its own sales depot for selling firewood for cremations at Pashupati Nath temple area in Kathmandu. This depot provides a 24 hours sales service. The firewood sales figures are shown in Table 1.

The ten year data for firewood sales in 33 districts indicate that the sales of firewood for cremations are increasing every year and are decreasing for other purposes due to the growth of alternative energies such as electricity, coal, LP gas, kerosene.

## 6.2 Impact of Firewood Sale for Cremations

About 300 kg of firewood are used for cremating one dead body. Last year's sales figures show that 4,500 dead bodies were cremated or approximately 12 dead bodies were cremated daily. A minimum of 3 hours time is required for cremating one dead body. If 12 dead bodies were burnt every day, either cremations take place continuously over a twenty-four hours period or 2-3 dead bodies are cremated at the same time in Pashupati area.

During cremations the smell is very bad and the smoke is so thick that sometimes the sky above Pashupati Nath temple appears to be covered with a thick cloud. This sort of smell and smoke is polluting the local environment.

***Table 1: Firewood Sales Figures***

| S.N. | Fiscal Year | Firewood Sales for Cremation (kg) | Firewood Sales for Miscellaneous Purposes (kg) | Total (kg) |
|---|---|---|---|---|
| 1 | 1988/89 | 460,300 | 69,539,700 | 70,000,000 |
| 2 | 1989/90 | 573,950 | 63,620,450 | 64,194,400 |
| 3 | 1990/91 | 587,424 | 65,267,276 | 65,854,700 |
| 4 | 1991/92 | 598,450 | 50,261,050 | 50,859,500 |
| 5 | 1992/93 | 770,000 | 40,584,200 | 41,354,200 |
| 6 | 1993/94 | 949,635 | 45,874,565 | 46,824,200 |
| 7 | 1994/95 | 1,039,200 | 16,861,500 | 17,900,700 |
| 8 | 1995/96 | 1,042,400 | 10,621,600 | 11,664,000 |
| 9 | 1996/97 | 1,118,900 | 10,209,100 | 11,328,000 |
| 10 | 1997/98 | 1,379,200 | 8,832,800 | 10,212,000 |
| | Total | 8,519,459 | 381,672,241 | 390,191,700 |

It has been realized that if an alternative way of cremating is not adopted, the temple area will be polluted very badly. Supplying the firewood for cremations has several impacts, which are given below:

1. It leads to continual pressure on natural forests.
2. It causes an annual loss of Rs. 114,933.00 royalty to the government because the government's royalty for cremations is subsidized by 50%.
3. TCN is selling firewood for this purpose at the rate of Rs. 95.00 per quintal in Kathmandu valley. The transportation cost for one quintal is Rs. 85.00. Including royalty, transportation, and extraction cost and overhead expenses it comes to be Rs. 186.00 per quintal. TCN is losing Rs. 82.67 in each quintal of firewood sold (the approximate annual loss of Rs. 1,140,139).
4. The burning of the firewood for cremations is polluting the sacred temple area.
5. The ashes produced from burning are polluting the Bagmati River.

## 6.3 RECOMMENDATION

The government should introduce incinerators for cremating dead bodies and should stop providing a royalty subsidy for firewood. Instead, the subsidy should be used to install incinerators. This will gradually motivate the people to cremate their dead bodies using incinerators. This will also stop pollution from firewood and decrease the pressure on the natural forests.

# 7. BEE - HIVE BRIQUETTING: A NOVEL APPROACH TO THE UTILIZATION OF AGROFORESTRY RESIDUES IN NEPAL

*by*

*Krishna Raj Shrestha, Centre for Energy and Environment*

## INTRODUCTION

The increasing per capita energy demands and the limited stock of fossil fuels necessitate the exploration of alternative energy resources to meet the country's requirements. Of the various renewable sources bio-residues/agro-residues form a major component and hold special promise due to their inherent ability to store energy and the relative ease with which they can be converted to convenient solid, liquid and gaseous fuels. Biomass residues are produced in Nepal as a result of forestry activities, timber production and agro-industrial processes.

## 7.1 TECHNOLOGIES FOR USING LOOSE BIOMASS RESIDUES

Loose agro-residues are inconvenient fuels and give low thermal efficiencies and more pollutants compared to wood. But this problem can be solved by compacting the agro-residues to improve the handling characteristics and provide clean combustion. The technologies used are direct briquetting and carbonization followed by briquetting of the char.

**Direct briquetting**
There are two types of high-pressure briquetting machines and these do not require binders. Another type uses low-pressure and needs special binders like ligno-sulphonates or bentonite clays. The screw press provides the briquettes with a central hole, which facilitates combustion. The ram press briquettes are solids with inferior combustion characteristics compared to briquettes with concentric holes.

**Carbonisation and briquetting of char**
This technology involves partial carbonisation of biomass residues, mixing of char with binders followed by briquetting. The char obtained is crushed and mixed with binders like bentonite clays or with inert materials like lime as an energy extender and then briquetted into cylindrical or bee-hive briquettes. Briquettes are either formed by different machines or done manually. In the small scale units the briquettes are sun dried and in large scale units, the flue gases produced from the carboniser are used for drying. These bee-hive honey comb briquettes are far superior to any other shape of briquettes. Only one briquette is needed for a stove and gives clean gaseous combustion like LPG. The nineteen holes in the briquette act like gasifiers and produce gases for uniform combustion. In addition to its convenience, these are delightful to watch and suitable both for cooking and space heating.

**Village level briquetting unit**
The biomass is charred in a drum-charring unit and the char thus obtained is mixed with local potter's clay and then briquetted. The drum can be made out of an empty crude oil drum of 200 litres capacity. It is filled with a conical shaped grate with fixed chimney and a top cover and water seal arrangements. The briquetting mould is made of mild steel. It consists of three parts: a) the bottom plate with nineteen protruding rods each 13 mm $\phi$ in diameter; b) an outer cylindrical cover to fit the bottom plate; and c) a perforated plate to slide down along the rods into the cylinder.

## 7.2 CHARRING PROCEDURE

The production of char in the drum-charring unit is very simple. Even a layman can be trained in a day to produce char. It can be used for all types of biomass material. In this unit, depending upon the type of biomass, about 40-100 kg of biomass can be carbonised to give 25-40% yield of charred material over a period of 3-5 hours.

First of all, the conical grate with fixed chimney is placed inside the drum and the telescopic chimney is placed over the fixed chimney. About 2 kg of dried leaves are spread uniformly over the conical grate and ignited. Once the ignition starts, biomass material is added to it in small portions so that the material inside the drum does not burn too fast and completely. Once the drum is full and the top layer is partially carbonised, the telescopic chimney is removed and the drum is covered with its cover. Water is filled in the channel so that there is no leakage of air through the water sealing arrangement. At this stage, smoke will come out of the hole provided at the centre of the cover. Slowly the smoke ceases to come out and then the hole should be blocked with mud. There should be no leakage of air during cooling. The drum is allowed to cool for 2-3 hours before it is opened for removing the char and starting the next batch operation. The biomass residues should be sized properly and sun dried with 15-25% moisture. Depending upon the type of biomass and its moisture content, char yields of 25-40% can be obtained. During charring, a large amount of volatiles are released so it is advisable to use these drums in open spaces.

**Briquetting of Char**
The biomass char is crushed to a coarse powdery form so that the maximum size is not more than 0.8 mm. It is mixed with 20-30% by weight bentonite clay or local potter's clay, which acts as a binder as well as an energy extender. Molasses or cooked starch may also be used as binders for briquetting. The amount of water that is sufficient should be judged by taking the mixture in hand and pressing it so that it forms a firm ball. If needed, some extra water can be added to the mixture. The mixture thus obtained is covered with wet gunny bags and is left for 24 hours for maturing.

For making bee-hive shaped briquettes from the char-clay mixture, different parts of the briquette mould set are placed one over the other in a sequence. The mould set is filled compactly with the mixture and after filling up to the brim the top layer is leveled with a flat wooden piece. Now, the mould is turned upside down on firm ground. The mould is removed and the briquette is allowed to dry in the sun for 2-3 days. For speedy and bulk drying, briquettes can be baked in an enclosed chamber with a chimney and controlled heat can be supplied through flame gases by burning some biomass.

**The Briquette Stove**

The briquette stove is a simple, cylindrical stove. It is made of mild steel sheet. Towards the base there is a hole for an air inlet and a grate made of 5mm iron rod is placed about 100 mm above the base of the stove. The inside of the stove is lined with clay and sand so that the internal diameter is about 145 mm. The stove can also be made out of locally available materials like sand and clay , but an iron grate should be placed near the bottom of the stove for the inlet of primary air.

The bee-hive briquette is very easy to ignite. The briquette is gently placed on the grate and dried leaves or waste paper etc. are placed below the grate and ignited. In about 5-7 minutes the flame from the combusting paper ignites the bottom end of the briquette. After a short while flame starts coming up through 19 holes. The heat thus generated can be used according to one's requirement by placing a pan on the stove. One briquette generally lasts for one to one and half-hour. The length of the stove can also be increased to accommodate two briquettes.

## 7.3 BEE-HIVE BRIQUETTING AS A MICRO ENTERPRISE

Bee-hive briquetting technology has the potential to be propagated as an income generating activity. The major inputs required are only manpower and biomass residues. It can be started as a family unit and also as a mechanized unit. A cost analysis of a small-scale model unit is presented below to indicate its potential as a micro-enterprise.

**BASIS:** Four drum-harring units, and two sets of briquetting moulds.

**a) Material Balance**

| | |
|---|---|
| Char=20 kg per drum per batch and two batches /day | = 160 kg |
| Clay required =20% of char | = 32 kg |
| Residual moisture | = 10 kg |
| Briquettes production per day | = 202 kg |
| No. of briquettes (each weighing 400 grams) | = 500 |
| Raw materials required (average 30% yield) | = 540 kg |

**b) Manpower**

| | |
|---|---|
| Labour (Full time) | 2 persons |
| Labour (part time) | 2 person (as and when required) |

**c) Costs**

| | | |
|---|---|---|
| Cost of 4 drums (Rs 6,000/drum) | | =Rs 24,000.00 |
| Cost of 2 sets of mould( Rs 2,000/set) | | =Rs 4,000.00 |
| Miscellaneous hand tools etc | | =Rs 2,000.00 |
| | Total | =Rs 12,000.00 |

**d) Sales**

| | |
|---|---|
| Saleable at Rs 5 /briquette (5x 500) | =Rs 2,500.00 |
| Less 20% commission and transport charges | =Rs 500.00 |
| Net sales | =Rs 2,000.00 |

**e) Operating expenses (8 batches in two days including briquetting)**

| | |
|---|---|
| Labour(Rs 100/-person day full time and Rs 50/person day part time | =Rs 600.00 |
| Labour(For collection and transportation of raw materials @ Rs 1/kg | =Rs 540.00 |
| Miscellaneous | =Rs 150.00 |
| Total | =Rs 1,290.00 |

**f) Gross profit=Rs 2000-Rs 1,290 = Rs 710 in two days.**

Taking ten such operations per month, it can generate an income of Rs 7,100 after payment of wages. If the family members provide the labour, the total income can be Rs. 185,000 per month.

| | |
|---|---|
| Income per month | =Rs 18,500 |
| Interest on fixed capital | =Rs 450 per month |
| Depreciation (20 years) | =Rs 125 per month |
| Total Income | =Rs 17,925 per month |

Since sales are location specific, the project economics should be analyzed for each location.

## 7.4 CONCLUSION

The bee-hive briquetting technology is simple, pollution free and eco-friendly. It provides a smokeless domestic fuel, which is easily ignitable and exhibits sustained uniform combustion. It is economical at any stage of operation from 200 kg/day to 25 tonnes/day. The use of agroforestry residues can replace fuelwood and wood charcoal. Being eco-friendly with high social relevance and having the potential to contribute to forest conservation, this technology should be widely promoted throughout Nepal.

# 8. INTEGRATION OF WOOD ENERGY INTO THE CURRICULA OF FORESTRY EDUCATION INSTITUTES IN NEPAL

*by*

*Abhoy Kumar Das, Dean Institute of Forestry, Pokhara*

## INTRODUCTION

More than 90% of the total population of the country live in rural areas. They require large amounts of fuelwood to cook their daily meals. Fuelwood, which is the major energy source in Nepal, requires special consideration in terms of development, management, and training. Environmentally friendly ways of using fuelwood and advanced technology applications for conservation and higher energy output are urgently required.

The National Planning Commission, Water and Energy Commission Secretariat and the Ministry of Forests and Soil Conservation are primarily responsible for planning and policy related to wood energy, however, they have not developed any plan for training in wood energy. The Institute of Forestry (IOF) offers some courses that deal with wood energy but they are not systematic. The courses related to fuelwood and wood energy offered at IOF are listed in the subsequent sections of this paper.

Considering the importance of wood energy in Nepal, more emphasis needs to be given to training and education in this sector. In fact, a separate course on wood energy has been proposed for integration into IOF's curricula. The proposed curricula of IOF, however, still requires some improvements. The addition of advanced technology related to wood energy such as gasification, co-combustion, and cogeneration etc. and eco-friendly aspects of wood energy use should also be incorporated into the proposed curricula.

Other formal and informal institutions do not have any training curricula related with wood energy except some short training packages on wood energy conservation and development issues. Their role, however, is very important for in-service training on energy issues. Extension approaches in the energy sector through such institutions are very important.

1. Forest Utilization - 213 courses at Certificate level (CL) and 315 at B.Sc. level deal with the following topics related to wood energy:
   - Energy resources
   - Wood as fuel
   - Wood charcoal
   - Improved cook stoves

2. Agroforestry - 208 courses at certificate level include a unit on selection criteria for agroforestry species for fuelwood.

3. Forest Policy Rules and Regulation Course - 211 courses at certificate level which include units on sales and distribution of fuelwood, policy, rules and regulations on the management of fuelwood.

4. Forest Mensuration - 113 courses at certificate level and 411 at B.Sc. level which include the topic “Measurement of Fuelwood”. This deals with the measurement of the dimensions and volume of chatta (stacked fuelwood) in relation to proper pricing and sale of fuelwood.

5. Forest Management – 210 courses at certificate level include the topic “Interaction of Man and Environment”. Human dependence on fuelwood is discussed along with collection of fuelwood and human impact on forests.

6. Social/Community Forestry – 211 courses at certificate level deal with the role of the community in forest protection and development for fuelwood.

7. Forest Economics – 410 courses at B.Sc. level include the topic “Consumption of Forest Products”. This deals with the demand for fuelwood. In the same course, the topic “Markets and Marketing for Forest Products” deals with the pricing and marketing of fuelwood.

8. Forest Utilization - 511 courses at B.Sc. level include the topic “Wood and Water”. This deals with the impact of moisture in the utilization of wood and fuelwood.

9. Silviculture – 513 courses at B.Sc. level include the topic “Appropriate Silviculture Systems for Fuelwood Species”.

10. Range Management – 601 courses at B.Sc. level include the topic “Multiple Uses of Forest Grazing Land for Fuelwood Production”.

11. Community Forestry – 609 courses at B.Sc. level, deal with integrated resource management and appropriate planning for the sustainable supply of fuelwood.

## 8.1 PROPOSED WOOD ENERGY COURSE FOR IOF

The course on wood energy has been designed to enable the students to work for the development, management and efficient utilization of wood for energy purpose. After completion of this course, the student will be able to:

i. Plan for resource development,
ii. Work on the proper management of fuelwood resources,
iii. Work on the conservation and improved utilization of fuelwood,
iv. Assess the demand and supply of fuelwood, and
v. Suggest appropriate sources of alternate energy.

**Course Content**

1. Introduction
   - 1.1 Historical background
   - 1.2 Use pattern
   - 1.3 Ethno-cultural impacts on use pattern

2. Resource Analysis
   - 2.1 Sources of fuelwood
   - 2.2 Resource identification
   - 2.3 Assessment of resources
   - 2.4 Supply situation

3. Fuelwood Management
   - 3.1 Supply and demand assessment
   - 3.2 Sustainable management of fuelwood
   - 3.3 Fuelwood marketing and sale
   - 3.4 Measurement and pricing of fuelwood
   - 3.5 Fuelwood depot management

4. Resource Development
   - 4.1 Scope of resource development
   - 4.2 Energy plantation
   - 4.3 Community forestry and fuelwood strategy
   - 4.4 National programme on resource development
   - 4.5 Technical application for resource development

5. Policy and Planning
   - 5.1 National policies and regulations on wood energy
   - 5.2 Planning for stable supply
   - 5.3 Institutional establishment for fuelwood distribution
     - 5.3.1 Private sector
     - 5.3.2 NGOs
     - 5.3.3 Government agencies

6. Wood Energy
   - 6.1 Wood as fuel
   - 6.2 Species and energy relations
   - 6.3 Wood energy measurement
   - 6.4 Moisture content and energy liberation
   - 6.5 Wood treatments for optimum heat energy

7. Wood Charcoal
   - 7.1 Importance
   - 7.2 Charcoal making
   - 7.3 Charcoal storage and packaging
   - 7.4 Charcoal promotion and marketing

8. Energy Conservation
   8.1 Importance
   8.2 Improved stoves
   8.3 Stove design and efficiency assessment
   8.4 Energy conserving pots and utensils

9. Briquetting
   9.1 Importance and scope
   9.2 Raw materials
   9.3 Methods of manufacturing
   9.4 Storage, packaging and sale

10. Alternate Energy
   10.1 Importance and scope
   10.2 Biogas
   10.3 Solar energy
   10.4 Petroleum gas
   10.5 Electricity
   10.6 Effective sources of alternate energy
   10.7 Impacts of alternate energy

## 8.2 RECOMMENDATIONS FOR INCORPORATION OF WOOD ENERGY INTO THE FORESTRY CURRICULA OF IOF

- The existing curricula of IOF already include so many courses that there is little possibility of adding a separate course on wood energy. However, all topics related to wood energy scattered throughout different courses should be placed together to form a separate course on wood energy.

- In case a separate course on wood energy is not approved, the various topics wherever they are located in existing courses should be improved.

- The following wood energy topics should be incorporated into the Forest Utilization course at the B.Sc. level.

    - Conversion, extraction, transportation, and marketing of fuelwood.

    - Wood energy conservation, wood charcoal, briquetting, modern applications and technology related to wood energy.

    - Species and moisture of wood in relation to energy value.

    - Wood energy and environmental aspects.

- Policy level institutions (NPC, WECS, MFSC, etc.) should emphasise wood energy issues and education.

# APPENDICES

# APPENDIX 1: WORKSHOP AGENDA

## NATIONAL WORKSHOP ON WOODFUEL TRADE IN NEPAL
## 25 – 28 AUGUST 1998

**August 25, Tuesday**
Arrival and Registration of Participants

**August 26, Wednesday**

**Inaugural Session / Session I**
**Chairman – Mr. Bel Prasad Shrestha, Mayor, Dulikhel Municipalty**

09.00 – 09.10 Welcome Address by Mr. Indra Singh Karki, Director General, Department of Forest
09.10 – 09.15 Inauguration of the Workshop by the Chief Guest, Mr. Narayan Raj Tiwari, Secretary, Ministry of Forests and Soil Conservation
09.15 – 09.20 Statement by Mr. Ashok Benju, Vice Mayor, Dhulikhel Municipalty
09.20 – 09.30 Statement by Mr. W. R. Rudder, FAO Representative, Nepal
09.30 – 09.40 Statement by Mr. S. N. Poudyal, Executive Secretary, Water and Energy Commission Secretariat
09.40 – 09.50 Statement by Mr. Sushil Bhattarai, Joint Secretary, Ministry of Forests and Soil Conservation
09.50 – 10.00 Inaugural Address by the Chief Guest, Mr. Narayan Raj Tiwari, Secretary, Ministry of Forests and Soil Conservation
10.00 – 10.10 Chairman's Remarks by Mr. Bel Prasad Shrestha, Mayor, Dulikhel Municipalty
10.10 – 10.15 Vote of Thanks by Mr. Bal Krishna Khanal, Deputy Director General, Department of Forest
10.15 – 11.30 Lunch

**Session II**
**Chairperson: Mr. Sushil Bhattarai, Joint Secretary, Ministry of Forests and Soil Conservation**

11.30 – 12.45 Introduction of Participants
Introduction of Workshop, Objectives, Expected Output, and Woodfuel Flows: Distribution and Marketing of Wood Fuels by Mr. Tara Nath Bhattarai, Wood Energy Resource Specialist, RWEDP.
Discussion
12.45 – 13.25 Present Status of Wood Energy in Nepal by Mr. D. L. Shrestha, Energy Planning Division, Water and Energy Commission Secretariat.
Discussion

13.25 – 14.05 Forestry Status and Wood Energy Sources in Nepal by Mr. Shesh Hari Bhattarai, Deputy Director General, National Forest Division, Department of Forest.
Discussion
14.05 – 14.20 Tea

**Session III**
**Chairperson: Mr.D. P. Parajuli, Joint Secretary, Ministry of Forests and Soil Conservation**

14.20 – 15.00 Fuelwood Trade and Marketing in Nepal by Dr. Keshav Kanel, Forest Officer, Ministry of Forests and Soil Conservation
Discussion
15.00 – 15.40 Future Prospect for Woodfuel Trade in Nepal by Mr. B. K. Khanal, Deputy Director General, Planning and Training Division, Department of Forest.
Discussion
15.40 – 16.40 Case study – Woodfuel Trade in Morang District by Mr. Sharad Kumar Rai, District Forest Officer, Morang.
Case study – Fuelwood Situation in Banke District by Mr. Diwakar Pathak, District Forest Officer, Banke.
Case study – Fuelwood Use in Sindhupalchowk by Mr. Nav Raj Baral, District Forest Officer, Sindhupalchowk.
Discussion
16.40 – 17.10 Case study – Bee–hive Briquetting: A Novel Approach to the Utilization of Agroforestry Residues in Nepal by Mr. Krishna Raj Shrestha, Centre for Energy and Environment.
Discussion

**August 27, Thursday**
09.00 – 09.15 Review of previous day's sessions

**Session IV**
**Chairperson: Mr. B. K. Khanal, DDG, Department of Forest**

09.15 – 10.05 Case Study – Woodfuel and Charcoal Trade in Urban Kathmandu: Constraints and Opportunities by Mr. K. M. Sulpya, Lecturer, Research Centre for Applied Science and Technology, Tribuhvan University, Kirtipur.
Discussion
10.05 – 10.45 Case Study – Firewood Sales for Cremation Through Pashupati Depot, Kathmandu by Mr. Rebant Ram Dhakal, Planning Division Chief, Timber Corporation of Nepal.
Discussion

10.45 – 11.15 Tea

11.15 – 11.55 Case Study – Fuelwood Trade in Nepal: A Case Study from Sagarnath Forestry Development Project by Mr. D. D. Pandey, Project Manager, Sagarnath Forestry Development Project and Mr. B. R. Adhikari, Logging Officer, Forest Product Development Board.
Discussion

11.55 – 12.35 An Overview of PRA Planning by Mr. P. M. Shrestha, Programme Officer, FAO Representation, Nepal
Discussion

12.35 – 14.00 Lunch

14.00 – 14.40 Case Study – Integration of Wood Energy into the Curricula of Forestry Education Institutions in Nepal by Mr. Abhoy Kumar Das, Dean, Institute of Forestry, Pokhara
Discussion

**Session V**
**Chairperson: Mr. I. S. Karki, Director General, Department of Forest**

14.40 – 14.50 Group formation and allocation of tasks to working groups
14.50 – 15.10 Tea
15.10 – 17.00 Group Discussion
17.00 – 17.30 Briefing for field visit

**August 28, Friday**

**Session VI**
09.00 – 12.00 Field visit
12.00 – 13.00 Lunch

**Session VII**
**Chairperson: Mr. S. N. Khanal, Chief, Monitoring and Evaluation Division, Ministry and Forests and Soil Conservation**

13.00 – 13.40 Prospect for Woodfuel Production and Trade Through Community Forest User Groups and Community-based Leasehold Forestry Groups in Nepal by Mr. J. K. Tamrakar, Project Coordinator, Hills Leasehold Forestry and Forage Development Project and Bijay K. Singh, Community Development Advisor, Hills Leasehold Forestry and Forage Development Project
Discussion

13.40 – 14.20 Shortage of Woodfuel and its Impact on the Socioeconomic Condition of People in Nepal by Mr. Madhukar Upadhya, Soil Conservation Officer, Department of Soil Conservation and Watershed Management
Discussion

**Session VIII**
**Chairperson: Mr. K. B. Shrestha, DDG, Community and Private Forestry Division, Department of Forest**

14.20 – 15.30 Group Discussion
15.30 – 15.45 Tea
15.45 – 16.30 Presentation by group leader/member and discussion

**Session IX**
**Chairperson: Mr. I. S. Karki, Director General, Department of Forest**

16.30 – 17.5 - Finalization and adoptation of recommendations
- Workshop evaluation by participants
- Address by Mr. T. N. Bhattarai
- Concluding Address by Mr. I. S. Karki

18.30 - Farewell Dinner

# APPENDIX 2: LIST OF PARTICIPANTS

1 Mr. Adhikari, Balaram
Logging Officer
Forest Product Development Board

2 Mr. Amatya, Vishwa B.
Energy Planner
Water and Energy Commission Secretariat

3 Mr. Baral, Nav Raj
District Forest Officer
District Forest Office,
Sindhupalchowk

4 Mr. Chand, Padam Bahadur
Forest Management Officer
National Forest Division
Department of Forest

5 Mr. Dhakal, Rebanta Ram
Division Chief, Planning
The Timber Corporation Of Nepal

6 Mrs. Gautam, Munni
Assistant Forest Officer
Community and Private Forestry Division
Department of Forest

7 Mr. Gyawali, Achyut Raj
Lecturer
Institute of Forestry, Pokhara

8 Mr. Joshi, Badri Raj
District Forest Officer
District Forest Office
Dhulikhel, Kavrepalanchowk

11 Mr. Pandey, Diwakar Dutt
Project Manager
Sagarnath Forestry Development Project

12 Mr. Pathak, Diwakar
District Forest Officer
District Forest Office
Banke

13 Mr. Pokharel, Krishna Prasad
Asst. Planning Officer
Ministry of Forests and Soil Conservation

14 Mr. Rai, Sharad Kumar
District Forest Officer
District Forest Office, Morang

15 Mr. Shakya, Chakra Man
Regional Director
Central Regional Forestry Office

16 Mr. Shrestha, Biju Kumar
Section Officer
National Planning Commission Secretariat

17 Mr. Shrestha, Dhan Lall
Water and Energy Commission Secretariat

18 Mr. Shrestha, Hari Shankar
Monitoring and Evaluation Officer
Ministry of Forests and Soil Conservation

9 Mr. Joshi, Surya Prasad
Forest Product Development Officer
National Forest Division
Department of Forest

10 Mr. Khanal, Bal Krishna
Deputy Director General
Planning and Training Division
Department of Forest

21 Mr. Sulpya, Kayeswar Man
Researcher
Research Centre for Applied Science and Technology

22 Mr. Trivedi, Ramesh Chandra
Lecturer
Institute of Forestry, Hetauda

23 Mr. Tuladhar, Bikram Raj
Planning Officer
Planning and Training Division
Department of Forest

24 Mr. Uprety, Batu Krishna
Asst. Planning Officer
Ministry of Population and Environment

19 Mr. Shrestha, Krishna Raj
Vice President
Centre for Energy and Environment

20 Mr. Shrestha, Pratap Man
Programme Officer
FAO Representation in Nepal