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WOOD PRODUCTION AND MARKETING IN BHUTAN

NATIONAL WORKSHOP

TABA, BHUTAN

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2) Tara Bhattarai (TB), Wood Energy Resources Specialist, RWEDP, FAO, Bangkok

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

FOREWORD

Bhutan presents a unique case of energy production and consumption amongst the16 RWEDP member countries. From a net importer of virtually all (over 91%) commercial energy consumed in 1979, it has become a bulk exporter of hydroelectricity. Hydroelectricity production has grown from 3.5 MW to almost 342 MW during 1981-1988, and new schemes are in the pipeline. Despite these changes the largest single energy consumer in Bhutan is still the household sector. Its share is about 81% of total energy consumption of which 98% is from woodfuel. Only 2% of the energy in the household sector is from commercial sources like electricity, kerosene and LPG. Even in the non-household sector, 50% of the energy demand is met by traditional biomass fuels. This heavy reliance on wood energy is not expected to change within the foreseeable future in this Himalayan Kingdom, since the majority of the people still live in rural areas with a limited transportation network and an extensive forest cover of about 64% of the land area.

Sustainable production and efficient use of woodfuel is the priority task ahead in the forestry sector, particularly in high population density areas. The ever increasing woodfuel demand from the urban population and private and public sector institutions have contributed to localized degradation of the high value mixed-hardwood forests in the vicinity of places like Thimpu.

Bhutan has been an active member of RWEDP and has benefited from its long-term participation in numerous meetings, seminars, workshops and training courses related to wood energy development. Therefore, the basic knowledge necessary to initiate wood energy development, enhance the production and flow of woodfuel from both forest and non-forest lands, as well as the efficient utilization of wood energy through innovation and adoption of appropriate technology already exists in Bhutan. In order to disseminate the knowledge among experts in related agencies, national training courses and workshops are being implemented.

The present publication on Woodfuel Production and Marketing in Bhutan is a report of the National Workshop on Integrating Woodfuel Production and Marketing into Forest, Agriculture and Tree Production Systems in Bhutan, sponsored by RWEDP. The workshop was hosted in Thimpu by the Forestry Services Division (FSD) of the Ministry of Agriculture. Mr. T. Bhattarai, Wood Energy Resources Specialist from RWEDP, provided technical assistance. The report addresses important issues related to woodfuel production, marketing and utilization in Bhutan, which were discussed in-depth by the experts from government agencies, selected industries and NGO's. Recommendations designed to further strengthen the wood energy sector were an important outcome of the workshop and are included in this report.

RWEDP expresses its sincere thanks and appreciation to *Dasho* Sagay Thinley, Joint Secretary, and other colleagues in FSD, for successfully hosting the national workshop and compiling the report in its present form.

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

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Exhibition of Improved Stoves (TB)

Metallic stove with chimney for combined application of cooking and space heating (TB).

Multiple models of biomass fuel burning metallic stoves with chimney used for different applications (FSD).

PART I: OVERVIEW

1. INTRODUCTION

A large number of households and numerous traditional industrial commercial activities in Bhutan use wood and other biomass for energy. Although there has been a trend of inter-fuel transformation (in favor of commercial fuels like electricity, coal, gas and other fossil fuels) in Bhutan during recent years, at least in urban households and in the modern industrial, commercial and transportation sectors, the share of traditional fuel, mostly woodfuel, in total energy consumption, has hardly declined. Its share was still as high as 85% in 1993. And in absolute terms, its use has remained constant between 1991-1993, at 12 petajoules per year.

Bhutan presents a unique case concerning energy production and consumption in the region. From being a net importer of virtually all (over 91%) traded commercial energy consumption in the country in 1979, it has become a bulk exporter of hydroelectricity in recent years. Its hydroelectricity production increased from a meagre 3.5 MW in 1981/82 to 341.6 MW in 1987/88, an average growth rate of 65% per annum. It is also interesting to note that the major consumer of energy in Bhutan is still the household sector. It consumes about 76% of the total energy supply of which 98% is accounted for by traditional fuels. The remaining 24% is the combined share of all other non-domestic sector energy users, i.e. industries, commercial, agricultural and forestry sector related activities, and government institutions. Only 2% of the household sector's energy consumption is met by commercial fuels of different kinds. Also, as much as 50% of the energy requirement of the non-domestic sectors is met by traditional fuels, particularly by fuelwood and charcoal. The provisional energy balance for 1988/89 showed shares of 87%, 12% and 1%, for wood energy, other conventional fuels, and residues respectively.

Except in large urban centres and towns, most fuelwood consumed in the domestic as well as non-domestic sectors is collected freely from supply sources, either by family members or using hired labour. Even the larger users of woodfuel, i.e. agro-processors, government institutions, commercial establishments, road construction agencies, monasteries, etc., rely heavily on public forests as free sources of fuelwood. This trend in energy consumption is not likely to change soon, despite the fact that Bhutan has become a net exporter of hydroelectricity.

Among the crucial factors which maintain the present heavy reliance on traditional fuel include: (a) the dispersed nature of the population and non-uniform distribution of the country's forest area; (b) the remote mountainous terrain which makes traditional energy sources necessary for space heating during winter months as well as for cooking; (c) the high investment cost associated with infrastructure development for commercial energy distribution and management; (d) the low earnings of the rural people in mountainous areas (where essentially a subsistence economy is the rule) does not allow them to switch-over to alternative commercial fuels for domestic uses, etc.

Despite such a picture, most development planners, particularly in the forestry and power sectors, have not yet duly acknowledged the important contribution made by wood energy in the national economy and in the energy balance of Bhutan. Unless wood energy gets due recognition and is fully integrated into relevant sectoral plans and programmes, a sustainable supply of wood energy cannot be guaranteed in the future and adverse impacts on the socio-economy as well as local environment are likely to result from unsustainable

fuelwood harvesting. The task of balancing woodfuel supply and demand in areas of localised scarcity and abundance, due to the skewed distribution of existing natural forests and population, will be a much harder task without advance planning and interventions. Further, the health impact of improper woodfuel utilization in open hearths, both for cooking and space heating at the household level, can be significant, particularly for women, children and the old, and need to be addressed.

Therefore, considering the importance of the wood energy system, the positive contribution of traditional woodfuel-based industrial and commercial activities in Bhutan, in terms of both employment and off-farm income generation in rural areas, including for women, and the threats to the sustainabilty of woodfuel, RWEDP invited the Forestry Services Division, Ministry of Agriculture, to organise the "National Training Course on Integrating Woodfuel Production and Marketing into Forest, Agriculture and Tree Production Systems in Bhutan" with the primary aim of disseminating information related to wood energy development to both governmental and non-governmental sectors at national as well as local level.

This training course was the first country level activity of RWEDP in Bhutan during its current third phase. RWEDP was, therefore, pleased to assist the Forestry Services Division in organizing this important in-country event on wood energy development. The course was a national follow-up of a RWEDP funded regional course on the same topic. During the three days of deliberations, field observations and group sessions, participants critically reviewed the factors that are currently affecting woodfuel production and marketing in Bhutan and identified issues that need to be addressed to promote the integration of wood energy into forestry, agriculture and rural development schemes. To guide the participants of the course, a number of presentations were made by selected resource persons. These, plus participants' own experiences and the findings from field observations were used to review the prevailing situation regarding wood fuel production, marketing and utilization. And based upon these findings, joint recommendations were drafted to address the critical issues identified in the group sessions. It was hoped that the course would enhance the participants' capabilities to design and implement future local level training courses, which would match the situation in participants' working areas.

There follows a statement of the critical issues related to woodfuel production and marketing confronting Bhutan which were identified by the training course participants and their recommendations for addressing the issues; the twenty papers which were presented to the participants; and a series of appendices consisting of the list of participants, the course programme, the opening and closing speeches and some background information related to the field trip which was undertaken on the final day of the course.

2. CRITICAL ISSUES AND RECOMMENDATIONS

At the end of the workshop all the participants were divided into 3 groups and each group was given a topic to focus its discussions. The groups were asked to identify critical issues related to their respective topics and to formulate recommendations. The results are presented below.

Production and Utilization (Group A)

1. *Current situation*

Rural Areas

- The production of fuelwood is not adequate for heating and cooking in the higher altitude regions
- Generally it is assumed that fuelwood production may not be adequate
- Fuelwood shortage foreseen in the near future due to population increase unless something is done now.

Urban Areas

- Fuelwood shortage for heating and cooking in the urban areas, especially in Thimphu Valley, is quite acute
- However, this cannot be generalised for all *dzongkhag* because a fuelwood surplus is produced in some *dzongkhag* like Monggar, Bumthang, Zhemgang etc.

Industries

- BCCL requires about 120,000 m^3 of fuelwood annually to produce 15,000 metric tons of charcoal. Actual fuelwood production is only about 25,000 m^3 – the balance is imported
- BBPL requires 45,000 metric tons of waste wood (equivalent to 75,000 m^3 of fuelwood) to run the plant at full capacity for production of particle board
- BFAL requires about 16,500 metric tons of fuelwood annually to produce wood chips
- Other industries also consume fuelwood which is in short supply.

2. *Constraints*

Rural Areas

- Natural location of forest cover
- Lack of proper network distribution
- Preference for hardwood species
- Lack of appreciation of fuelwood utility.

Urban Areas

- Species preference – shortage of hardwood fuelwood
- Lack of proper distribution network
- Heavy investment to build infrastructure
- Local contractors lack experience and therefore there is no established infrastructure
- Lack of management plan and reliable data on fuelwood
- Absence of pricing policy.

Industries

- Absence of management plan for industrial plantations
- Absence of forest resources inventory for *dzongkhag*
- Inadequate monitoring mechanism on silvicultural practices.

3. *Possible solutions*

Rural Areas

- Improve distribution network for fuelwood
- Restrict use of fuelwood other than by local population, especially in the high altitude areas and in the national parks
- Implement extension program on importance of fuelwood
- Improve traditional rural houses in terms of heat insulation
- Encourage use of fuelwood of conifer species through market mechanism and pricing policy.

Urban Areas

- Encourage use of fuelwood of conifer species through market mechanism and pricing policy
- Encourage use of saw dust heaters for cooking and heating
- Encourage use of electrical appliances for cooking and heating purposes
- Encourage the implementation of improved and appropriate building structural designs for heat insulation.

Industries

- Prepare and implement management plans which will be of advantage to both the government and the industries.

4. *Major recommendations*

Fuelwood supply from Chamgang – Helela and Gidakom FMUs must first go to the rural population, second to the urban population of Thimphu Valley, third to the development agencies (like PWD, Project Dantak etc.) and then the industries.

Marketing (Group B)

1. *Current situation*

Rural Areas

- Dry firewood supplied free of royalty but with permit – *dzongkhag*'s responsibility.
- Green firewood is also supplied free of royalty but with permit – FSD's responsibility.

Urban Areas

- *Armed Forces* - the demand far exceeds supply – also free of royalty but with permit
- *Monasteries* – free of royalty in cases where monasteries are located in rural areas; in urban areas they pay full schedule of royalty and obtain firewood through contractors
- *Govt. organizations* – they procure directly from FMUs and designated coupes and also from depots on full schedule of royalty
- *Town residents* – firewood is supplied door-to-door by contractors who are selected through the tender system.

Industries

- They get their raw materials/fuelwood from the leased areas especially the BBPL and BCCL
- People can also get off-cuts from saw mills after paying the cost – no formality is involved.

2. Constraints

Rural Areas

- Overlapping of implementation responsibilities – green firewood marked both by FSD and the DFEOs in some places

Urban Areas

- No compatibility between demand and resource base
- Users are reluctant to switch over to conifer species – heavy pressure on hardwood fuelwood
- Fuelwood users (domestic and commercial) in urban areas are not identified
- Wherever Forest Development Corporation is not involved, the contractors are reluctant to construct roads - thus affecting the delivery services
- Lack of fuelwood harvesting technology which also affects the delivery services.

3. Possible solutions

- Transfer fuelwood from surplus to deficit d*zongkhag*
- Switch over from hardwood to conifer uses
- Use appropriate fuelwood harvesting technology
- Improve efficiency in the use of fuelwood
- Ration fuelwood
- Encourage alternatives through private sector
- Switch over to solar energy for heating and lighting in rural areas
- Improve insulation and promote saw dust bukharis
- Identify and allocate degraded areas for bigger organizations like the RBA, RBP and RBG
- Establish nurseries for catering to the needs of these big organizations
- Identify domestic and commercial uses in urban areas and frame pricing policy accordingly
- DFEOs should be trained in promoting improved stoves
- Authority for allocating fuelwood to rural should rest with one agency only.

4. Major recommendations

- The recommendations on the supply of green firewood to the rural population of earlier workshops should be enforced to solve the confusion once and for all (see Technical Paper 21).
- Regarding mobilisation of fuelwood from surplus *dzongkhag* to the deficit d*zongkhag*, the first priority should be the rural population of fuelwood surplus *dzongkhag;* the second priority should be the urban consumers of fuelwood surplus *dzongkhag;* the third priority should be the rural plus urban consumers of the neighbouring *dzongkhag;* and the fourth priority should be industries or any other uses.

- Every *dzongkhag*/FMU should have its own pricing system. The fuelwood collected should be given to consumers or contractors at the rate leviable at the collection sites.
- Regarding appropriate harvesting technology, any other organisation replacing the Forest Development Corporation should be given the same kind of contract work as the Forest Development Corporation.

Extension and Support Services (Group C)

1. Current situation

- Fuelwood subsidy – supply of fuelwood free of royalty to different users
- Strict compliance with the prescribed annual allowable cut (AAC) or the management plan prescriptions
- Community and Social Forestry Program
- Duplication and overlapping of responsibilities
- Most of the forest areas do not have management plans
- Forestry extension network is limited
- Research on fuelwood is limited.

2. Constraints

- Species preference
- Overlapping of implementation policy
- Lack of proper research and database on fuelwood/biomas
- Conflict in the traditional/local rights on the fuelwood area
- Demand and supply gap due to high transportation cost
- Low royalty per truck load
- Lack of coordination between the line ministries.

3. Possible solutions

- Phasing out of subsidy (armed forces and revision of royalty)
- Research on fuelwood species
- Streamlining of implementation and extension policies
- Research on fuelwood consumption and build database
- Uniform pricing policy
- Promotion of lesser known fuelwood species
- Strengthening of extension network and awareness
- Appropriate hand tools and equipment to minimise wastage
- Improved housing insulation
- Environment project program fund to support energy saving schemes
- Monitoring/follow up on energy saving projects which are under implementation
- Inclusion of fuelwood energy awareness program into the curricula of schools/institutes

- Formation of a National Level Working Committee comprising members from the following line ministries :
    1. Forestry Services Division – should be the focal point
    2. Ministry of Trade & Industries (Division of Power, Trade, Improved Stove Project)
    3. Division of Education (Environment Education Unit)
    4. Ministry of Communication (Division of Roads, Works & Housing)
    5. Non Governmental Organizations (Royal Society for Protection of Nature, National Environment Commission, National Women's Association of Bhutan, Bhutan Chamber of Commerce and Industries)

4. Major recommendations

- At the time of tender it should be made explicit that the contractor should quote the same rate for fuelwood irrespective of the sources.
- Enforce the recommendation of earlier workshops regarding the levying of royalty to the armed forces.

Sales depot – subsidized fuelwood from soft wood species, Thimphu (TB)

Measured fuelwood for sale, Thimphu (TB)

Pollarded willow trees (Salix), planted for fuel and fodder in the city center of Thimphu (TB)

Pollarded willow trees (Salix), planted on private land for fuel and fodder, Thimphu (TB)

PART II: TECHNICAL PAPERS

1. ANALYSIS OF FUELWOOD USE IN THIMPHU VALLEY: A CASE STUDY

by

D.B.Dhital, Head, Forest Resources Development Section and
Namgay Wangchuk, Division of Forestry Office

1.1 BACKGROUND

1.1.1 Global perspective

At the global level, the production and consumption of forest products are dominated by fuelwood, charcoal, industrial roundwood, sawnwood, paper and paper-board etc. The production is basically influenced by many factors with population and the household income of the people the most important. The fuelwood and charcoal primarily originate from the roundwood produced from the forest. Fuelwood and charcoal occupy the most important position as far as utility and their requirement by the people are concerned. As per the FAO report 'State of the World Forests' 1997, the approximate consumption of fuelwood and charcoal per thousand people (in m^3) at the global level is given in Table 1.

Table 1: Approximate consumption of fuelwood and charcoal at global level

Countries	Years			
	1970	**1980**	**1990**	**1994**
World	320	332	337	336
Developed	178	207	196	156
Developing	377	376	380	386

From the table above it can be seen that the consumption of these two products is much higher in the developing countries than in the developed countries. The use of these two products in the developing region is basically for cooking and, in cold places, for space heating. Other sources of energy are used to a much smaller extent.

1.1.2 Local perspective

In Bhutan, fuelwood is used for various purposes, both in the domestic sector as well as in the commercial sector.

In the domestic sector, cooking and space heating are the most important uses. Various types of cooking stoves are available in Bhutan. Some are open type while others are closed types. The efficiency of the stoves is quite low, ranging from 5 percent to 16 percent (FAO 1991).

The space heating stoves, commonly known as *bukharis,* are widely prevalent in the colder region of the country. These *bukharis* are made locally as well as imported from the nearby Indian town. It is believed that the *bukharis* made locally, especially in Bumthang, are more efficient than the ones made elsewhere or imported from India.

Fuelwood is also widely used for the following purposes:

Cardamom drying

Cardamom is grown in the southern *Dzongkhag*. The fresh pods contain about 80 percent moisture and this has to be reduced to about 10 percent (FAO, 1991). Sun drying is not practiced in Bhutan. The bulk of the pods are dried using direct-fired furnaces. The amount of fuel consumed for this purpose in Bhutan is not known. However, in Nepal it takes about 12 kgs of firewood to dry one kg of fresh cardamom (FAO,1991). (1kg of firewood is approximately 0.0014 m^3).

Lemon grass oil distillation

Lemon grass *(Cymbopogon flexuosus Stapf.)* is a common ground vegetation found in the dry chir pine *(Pinus roxburghii)* forests of the eastern and central parts of the country. The oil extracted from this grass is used in manufacturing vitamin A, and in the flavouring, cosmetics and perfume industries. There are different types of containers used in the distillation process. The larger ones require about 1 kg of wood for 3 kgs of grass whereas the smaller ones require about 1 kg of wood for 1 kg of grass.

Yarn dying

The yarn is dyed in containers which are heated using fuelwood. However, the process seems to vary depending on the required colour. Yarn dyeing is a major activity in the Khaling Handloom Development Center and also in rural villages of the eastern *Dzongkhag*s. The Khaling Handloom Development Center uses around 100 to 150 m^3 of fuelwood annually for this activity.

Road construction and repair

Road construction and repair work is a major activity of the Public Works Division (PWD) and GREF. Besides using fuelwood for melting the tar, it is used for cooking purposes by laborers. The exact figure for this activity is quite difficult to obtain because much depends on the financial resources available and the length of the road to be constructed or resurfaced.

Rosin and turpentine

Rosin and turpentine are produced from the resin of chir pine *(Pinus roxburghii)* trees. The factory is located at Samdrup Jongkhar and is owned by Tashi Commercial Corporation. The annual requirement of fuelwood of this factory is about 1330 stacked m^3. (1 m^3 wood (solid) is equal to about 1.5 stacked m^3) (FAO, 1991).

Hand made paper

Hand made paper is widely used in Bhutan for writing religious books and packing important documents. The paper is made from the bark of *Daphne papyracea* and *Edgeworthia gardneri*. The paper making process involves boiling the barks of these species for several hours using fuelwood as the source of energy. It is estimated that about 7 kg of fuelwood is required per kg of bark (FAO, 1991).

Cremation

Cremation of dead bodies is a very important requirement in Bhutan. The exact size of the firewood requirement is not known at this time but a huge quantity of firewood is used annually for this activity. A rough estimate (FAO, 1991) indicates that about 500 to 600 kg of firewood is required for cremating one dead body.

1.2 LOCATION OF THE DZONGKHAG

Thimphu *Dzongkhag* lies in the western part of the country approximately between latitude 27° 8' north to 28° 0' north and longitude 89° 22'east to 89° 53' east. The total area of the *Dzongkhag* is about 1,935 square kilometers (LUPP, Atlas of Bhutan, MoA). The *Dzongkhag* receives an annual rainfall of about 500 mm to 800 mm. The summers are relatively warm while the winters are dry and very cold (LUPP, Atlas of Bhutan, MoA).

The *Dzongkhag* lies in the temperate zone. The altitude of the *Dzongkhag* ranges from 1200 metres to over 6000 metres above mean sea level. The percentage distribution of the area by altitude zones is given in Table 2.

Table 2: Percentage distribution of the area of the Dzongkhag by altitude zones

Altitude zones (in metres)	distribution of the area of the *Dzongkhag (%)*
1200 – 1800	1.0
1800 – 2400	5.0
2400 – 3000	16.3
3000 – 3600	18.8
3600 – 4200	18.6
4200 – 4800	27.3
4800 – 5400	10.9
5400 – 6000	1.4
6000 – 6600	0.5
> 6000	0.1

Source: Atlas of Bhutan. (LUPP) MoA.

Based on Table 2 above, it is seen that the major part of the area (1,780 sq. kilometers) falls between 2,400 metres to 5,400 metres altitude zones. These areas are very cold during the winter months.

1.3 CLIMATE

About 92 percent (1,780 square kilometers) of the area falls within the altitudinal range between 2,400 metres to 5,400 metres. The climate during winter is very severe with occasional snowfalls and space heating is necessary. The climatic data recorded at different stations of the *Dzongkhag* are given in Table 3.

Table 3: Meteorological data for Thimphu Dzongkhag, 1996

Stations	Altitude in metres	Av. max. temp. in °C	Av. min. temp. in °C	Total rainfall in mm	Max. temp during the year in °C	Min. temp. during the year in °C
Taba	2455	20.2	7.0	684.5	29.5	-7
Gidakom	2210	20.9	7.3	364.8	31.0	-6
Lumichawa	2210	21.4	14.4	744.1	30.5	-5
Kawajangsa	2375	21.5	6.5	673.9	31.0	-6.5

Source: Meteorological Section, Division of Power.

During 1996, the average maximum temperature remained moderate. However, during the winter months the lowest temperatures recorded in all the stations except Lumichawa were always below 0° C and the people living in and around Thimphu valley had to burn *bukharis* for heating their houses. The demand for firewood rises tremendously in the valley during winter. The Thimphu Territorial Division and Forestry Development Corporation (FDC) face a strong challenge to meet the demand for fuelwood during this period.

Table 4: Meteorological data for Thimphu Dzongkhag, 1997

Stations	Altitude in metres	Av. max temp.In °C	Av. min temp.in °C	Total rainfall in mm	Max temp during the year in °C	Min. temp. during the year in °C
Taba	2455	20.2	5.7	594.8	29.0	-5.0
Gidakom	2210	20.3	6.9	639.8	29.0	-6.0
Lumichawa	2210	22.0	15.8	858.1	26.0	12.0
Kawajangsa	2375	8.5	-1.2	7.7	14.6	-3.5

Source: Meteorological Section, Division of Power

A similar trend is seen in 1997 (see Table 4) with the winter months remaining very cold and creating a large demand for firewood .

1.4 FOREST TYPES

The different forest types in the *Dzongkhag* are basically due to the effects of altitude. A broad classification of the forest types found in the *Dzongkhag* is given in Table 5.

About 42 percent of the *Dzongkhag* forest area is covered with conifer forest comprising species like fir, hemlock, spruce, junipers, blue pine and small patches of chir pine. The broad-leaved forest in the *Dzongkhag* is very negligible (8,686 ha or approximately 5 percent of the total area).

1.5 SUSTAINABILITY OF THE HARDWOOD FORESTS

Based on the present trend of the demand for hardwood firewood in Thimphu valley, and the limited hardwood resources of the *Dzongkhag*, it will be very difficult to sustain the supply. A large chunk of the hardwood area (about 30 percent of the total) is very steep and some parts are also very fragile and environmentally sensitive. These parts will not be available for cutting operations as they will have to be conserved for environmental reasons. Furthermore, about 8 percent of the areas are ecologically very important. e.g. sources of water supply for major towns and villages, or are occupied by religious sites etc. A broad

view of such area classification is given in Table 6. Therefore, generally speaking, only about 5,000 ha, out of the total of 8,686 ha. is available for cutting operations.

Table 5: Broad classification of forest types of Thimphu, Dzongkhag

Forest types	Area in ha	%
Fir	13,384	6.9
Mixed conifer	42,404	21.9
Blue pine	24,187	12.5
Chir pine	1,591	0.8
Conifer forest	81,566	42.2
Broad-leaved + Conifer	427	0.2
Mixed broad-leaved forest	8,686	4.5
Conifer plantation	497	0.3
Scrub forest	17,222	8.9
Forest	108,398	56

Source: LUPP, MoA.

Table 6: Net hardwood forest area available for cutting operations

Total broad-leaved forest (ha)	Steep & sensitive sites (ha)	(%)	Ecologically important sites (ha)	(%)	Net area available (ha)
8686.00	2605.80	30	694.88	8	5385.32

Furthermore, only five *gewog* of the Thimphu *Dzongkhag* have hardwood forests, viz.: (i) Mewang (ii) Ge'nye (iii) Toebesa (iv) Chang and (v) Babesa. Toebesa *gewog* has the highest percent (about 80 percent) followed by Babesa *gewog* (10 percent) and Ge'nye (9 percent). Mewang and Chang *gewog* have very negligible amounts of hardwood forest, while the remaining *gewog* do not have hardwood forests at all.

There are two forest management units (FMU) under Thimphu *Dzongkhag*, namely Chamgang-Helela FMU and Gidakom FMU. Scientific management plans have been prepared for these two management units and are currently being implemented. Annual allowable cuts have been calculated based on the forest resources inventory and have been prescribed for strict compliance. Aerial photo interpretation reveals that the hardwood forests in these two management units are quite negligible. The distribution of hardwood forests in these two management units is given in Table 7.

Table 7: Distribution of hardwood forests by management unit

Management Unit	Area (ha)	%
Chamgang-Helela	351.00	18
Gidakom	1597.00	82
Total	1948.00	100

Gidakom management unit has 82 percent of the hardwood forest while Chamgang-Helela FMU has only 18 percent; but the demand for the hardwood firewood from Chamgang-Helela is much higher. The reason may be because of the proximity of the FMU to Thimphu town.

On the other hand, even though Gidakom FMU has a higher percentage of hardwood forest area, nearly 60 percent of the area mentioned above belongs to Paro *Dzongkhag*. However, since the area is under Gidakom FMU, this has really eased the problem of Thimphu valley.

Further, an area of 1,948 hectares (in Gidakom and Chamgang – Helela) can sustainably produce an annual yield of only 6,973 m^3. A detailed breakdown of the annual yield (hardwood) is given below:

Management unit	**Annual yield (m^3)**
Chamgang – Helela	3,750
Gidakom	3,223
Total	6,973

1.6 FIREWOOD SUPPLIED FROM VARIOUS SOURCES

1.6.1 Supplies to various organizations

The two management units are the main sources of firewood for the urban residents of Thimphu town and organizations like the Royal Bhutan Army, Royal Bhutan Police, Royal Bodyguards, monasteries, schools and hospitals etc. The rural people, however, get their firewood from the management units as well as from outside the management units. The quantities of firewood supplied to the residents of Thimphu town as well as to the above-mentioned organizations during 1996 and 1997 are given in Table 8.

Besides the above-mentioned two main management units, the residents in Thimphu valley also get their firewood from Begana and Chamina areas. The figures obtained from Langjophaka forest checkpost shows that a substantial quantity of firewood is being supplied to Thimphu town from these two areas.

Now, if we assume that 1 truck load of firewood is equivalent to 8 m^3, then the total quantities of firewood supplied from these four sources to the residents of Thimphu valley and other organizations would be as shown in Table 9.

Table 8: Quantities of firewood supplied to different destinations during 1996 and 1997

Year	Name of the FMU	Armed Forces		Urban People		Rural People		GREF/ IMTRAT	Monasteries		Other Supply	
		Hard wood	Conifer	Hard wood	Conifer	Hard wood	Conifer	Conifer	Hard Wood	Conifer	Hard Wood	Conifer
1996	Champing	879	161	1242	45	137	-	244	18	68	-	-
1997	Champing	679*	207	1035	254	286	25	244	8	36	-	-
1996	Mention	-	-	335	74	33	-	-	-	-	90	13
1997	Mention	-	135	-	-	-	-	-	-	-	39	14
1996	Gidakom	-	-	7	-	11	-	-		-	-	
1997	Gidakom	-	-	187	-	23	-	-		30	69	
1996	Begana /Chamina	-	-	6	-	-		-		-	-	
1997	Begana /Chamina	-	-	10	-	-		-		-	-	

** Mixture of hardwood and conifer*
Sources: (i) Simtokha, (ii) Chamgang, (iii) Jemina and (iv) Langjophakha Forest Checkposts.

Table 9 shows an increasing trend in the supply of the conifer firewood from Chamgang - Helela FMU and a decreasing trend in the supply of hardwood firewood. However, the hardwood firewood supply from Gidakom increased in 1997 compared to the previous year. A much stricter control, for allotment, has been exercised from Begana and Chamina areas.

Table 9: Quantities of firewood supplied from three sources during 1996 & 1997 (in m^3)

Year	Name of the FMU	Armed forces		Urban people		Rural people		GREF/ IMTRAT	Monasteries		Other supply	
		Hard wood	Conifer	Hard wood	Conifer	Hard wood	Conifer	Conifer	Hard Wood	Conifer	Hard wood	Conifer
1996	Chamgang	7032*	1288	9936	360	1096	-	1952	144	544	-	-
1997	Chamgang	5432	1656	8280	2032	2288	200	1952	64	288	-	-
1996	Menchuna	-	-	2680	592	264	-	-	-	-	720	104
1997	Menchuna	-	1080	-	-	-	-	-	-	-	312	112
1996	Gidakom	-	-	56	-	88	-	-		-	-	
1997	Gidakom	-	-	1496	-	184	-	-		240	552	
1996	Begana/ Chamina	-	-	48	-	-		-		-	-	
1997	Begana/ Chamina	-	-	80	-	-		-		-	-	

**This is a mixture of hardwood and conifer species.*
Sources*: (i) Simtokha, (ii) Chamgang, (iii) Jemina and (iv) Langjophakha Forest Checkposts.*

In future, the major share of the hardwood firewood should come from Gidakom and much stricter control needs to be exercised in Chamgang - Helela FMU, as well as in Begana/Chamina areas.

The total quantity of hardwood firewood supplied from the four sources in 1996 was 22,064 m^3 and in 1997 was 18,688 m^3. The supply figure is about three times more than the hardwood forests can sustain. Overall, the hardwood decreased in 1997 compared to 1996 whereas the conifer supply increased. This is a major achievement of the Forestry Services Division (FSD) in trying to encourage people to use conifer species (see Table 10).

Table 10: Annual supply of fuelwood by species, 1996 and 1997

Sources	Total quantity in m^3	
	Hardwood	**Conifer**
Chamgang (1996)	18, 208	4,144
Chamgang (1997)	16, 064	6,128
Menchuna (1996)	3,664	696
Menchuna (1997)	312	1,192
Gidakom (1996)	144	
Gidakom (1997)	2,232	240
Begana/Chamina (1996)	48	-
Begana/Chamina (1997)	80	-
Total for 1996	22,064	4,840
Total for 1997	18,688	7,560

Source: Thimphu Forest Division

Taking the 1996 supply figure from various forest checkposts, the urban areas accounted for about 58 percent of the total, followed by the Armed Forces (32 percent). The rural areas accounted for about 7 percent in the hardwood category. However, in the conifer category about 40 percent of the supply was to IMTRAT and GREF followed by the Armed Forces, which accounted for 27 percent, and urban people, 20 percent (see Table 11).

Table 11: Supply of firewood during 1996

Destinations	Quantity in m^3			
	Hardwood	**%**	**Conifer**	**%**
Armed Forces	7,032	32	1,288	27
Urban Areas	12,720	58	952	20
Rural Areas	1,448	7	0	0
Monasteries	144	1	544	11
GREF/IMTRAT	0	0	1,952	40
Other Areas	720	3	104	2
Total	22,064	100	4,840	100

** The quantity indicated here is not pure hardwood but it is a mixture of hardwood and conifer.*
Source: Thimphu Forest Division

A similar analysis was done for the supply during 1997. Table 12 shows that about 53 percent of the total supply of hardwood went to urban areas including schools, hospitals and other institutions, followed by 29 percent to the Armed Forces. However, in terms of conifer wood 36 percent went to the Armed Forces, followed by 27 percent to the urban areas and 26 percent to IMTRAT and GREF combined.

Table 12: Quantities of firewood supplied during 1997

Destinations	Quantity in m^3			
	Hardwood	**%**	**Conifer**	**%**
Armed Forces	5432*	29	2736	36
Urban Areas	9856	53	2032	27
Rural Areas	2472	13	200	3
Monasteries	64	0	528	7
GREF/IMTRAT		0	1952	26
Other areas	864	5	112	1
Total	18,688	100	7,560	100

**The quantity indicated here is not pure hardwood but it is a mixture of hardwood and conifer.*
Source: Thimphu Forest Division

From the analysis made in the previous sections it is seen that combined efforts need to be made to co-ordinate the supply of firewood. Since the *Dzongkhag* has only a small percentage of the country's hardwood forests, it is of great importance that the most representative chunk of it should be conserved as ecological reserves etc. Organizations and individuals should be encouraged to switch over to conifer firewood and, if possible, efforts should be made to use alternative sources of energy for cooking and space heating.

1.6.2 Industrial supply

Besides the above-mentioned supplies, firewood and charcoal are also supplied to industries like Bhutan Board Products Ltd. (BBPL, Tala) and Carbide and Chemicals Ltd. (BCCL, Pasakha) respectively. The details of the supply of charcoal made to BCCL Ltd. Pasakha from Chamgang- Helela and Gidakom management units during 1996 and 1997 are given in Table 13.

Table 13: Total quantity of charcoal supplied to BCCL, Pasakha, during 1996 and 1997

Year	FMU	Quantity in truck loads
1996	Chamgang-Helela	137
1997	Chamgang-Helela	97
1996	Gidakom	13
1997	Gidakom	132

During 1996, about 150 truckloads of charcoal were supplied and during 1997 about 229 truckloads were supplied. The overall demand of the industry has increased during 1997 compared to the previous year.

To supply 1 truckload of charcoal, 5 truckloads of firewood are required (1:5 ratio). Therefore, to supply 150 truckloads of charcoal (during 1996) about 750 truckloads of firewood was consumed. Similarly, during 1997, about 1145 truckloads of firewood were consumed.

Besides the firewood supply to the Thimphu residents and organizations, firewood was also supplied to BBPL, Tala from Chamgang-Helela and Gidakom management units. The details of the supply during 1996 and 1997 are given in Table 14.

Table 14: Total quantity of firewood supplied to BBPL, Tala, during 1996 and 1997

Year	FMU	Quantity in truck loads
1996	Chamgang-Helela	12
1997	Chamgang-Helela	21
1996	Gidakom	23
1997	Gidakom	6

During 1996, about 35 truckloads of firewood were supplied and during 1997 about 27 truckloads were supplied. The overall demand fell in 1997.

1.7 PROBLEMS AND CONSTRAINTS

- The high demand for hardwood firewood from Thimphu town and adjoining rural areas is causing a tremendous strain on the remaining hardwood forests which cover only about 5 percent of the total land area of the *Dzongkhag*.
- The annual yield of firewood prescribed from the forest management units (FMUs) is not sufficient to meet the demand, especially for hardwood firewood. The Thimphu DFO, which is mandated to meet all the demands, may be forced to exceed the prescriptions, at the cost of sustainability.
- The lops and tops generated from the normal Forestry Development Corporation's (FDC) logging operations/coupes are being used to meet a part of the demand; but there is less demand for such materials and the pressure is more on the hardwood firewood.
- There are general problems of co-ordinating road constructions by the FDC with the firewood coupes and regeneration of the harvested areas. When the FDC is not involved in the extraction and sale of firewood from areas outside the existing FMUs or other areas without any logging operations, it is not economical for the FDC (or for any other agencies) to construct forest roads or to build infrastructure and deploy expensive logging machinery, just to extract firewood materials only.
- Because of the existing unsustainable demand for hardwood firewood there is a danger that the existing forest composition will be altered by cutting down all the hardwood forests (especially *Quercus* species) and replacing them with conifer. Artificial regeneration of oak (*Quercus species*) has not been very successful. If the demand for hardwood firewood continue at this rate, then the existing oak forests will, eventually, be converted to coniferous forests.
- The six hectares annual hardwood firewood coupe(s) as prescribed in the Chamgang-Helela FMU plan is tiny compared to the huge demand for hardwood firewood, especially by the residents of Thimphu town.
- The local people are not willing to collect firewood from areas that are far away. There is a tendency to concentrate where there is a good access road, thereby leading to over-exploitation of certain pockets.
- Local contractors lack experience and proper equipment and this causes delay in the supply.

1.8 RECOMMENDATIONS

- The allotment of hardwood for firewood should be slowly phased out to discourage the over-exploitation of the existing and limited hardwood/broadleaved forests areas under Thimphu *Dzongkhag*.
- The extraction of hardwood firewood from Chamgang - Helela forest management unit should be limited to the quantity prescribed in the plan. In future the major part of the demand should be supplied from Gidakom forest management unit.
- Use of firewood of the conifer species should be encouraged and it should be made readily available to the people at an affordable price.
- The supply of firewood (both hardwood and conifer) will not be sustainable in the long run if it continues at the present rate. The possibility of switching over to other alternative sources of energy (other than wood energy) should be explored.
- Bhutan has sufficient hydro-electricity, therefore, people should be encouraged to switch over to this source of energy. The use of electrical appliances for heating and cooking needs to be considered a priority and encouraged.
- Multi-purpose and fast growing trees should be planted through community participation and under social forestry programs, to supplement the supply of domestic firewood.
- Attempts should be made to improve the traditional rural (as well as urban) houses in terms of heat insulation through better and more appropriate structural designs.
- Use of other materials like saw dust (from sawmills) and agricultural residues to supplement fuelwood should be explored and encouraged.

2. FUELWOOD RESOURCES, USES AND POTENTIALS IN GEDU FOREST DIVISION

by

Mr. Kuenga Dorji, Divisional Forest Officer,
Gedu Forest Division

2.1 BACKGROUND

Gedu Forest Division covers a total geographical area of 1,780 km^2 of which forest occupies 1,410 km^2 or 79 percent of the total. The Division falls under Chhukha *Dzongkhag* and has a total of 8,363 households in 11 *Gewog*. More than 90 percent of the households depend on fuelwood for cooking and heating.

2.2 USES

In urban areas about 20 percent of the people depend on timber for their cooking and heating needs. The following were the main users of fuelwood during 1996.

Users	**Quantity (T/L)/year**	**Purpose**
Institutions	48	cooking
Armed Forces	80/camp	cooking
Bhutan Wood Panel Industries	240	for boilers
Jari factories	73/factory	for boilers
Bakeries	96/factory	for boilers
Bhutan Board Product Ltd.	4675(Gedu area)	raw materials
Bhutan Ferro Alloys Ltd.	3600**	charcoal & firewood
Rural population	80***/household	cooking
PWD	55	road works

** *in metric tons*
*** *in head loads*

The fuelwood requirements of urban areas are increasing yearly. However, their requirements at present are, to a large extent, met from logging residues.

2.3 ALTERNATIVE ENERGY SOURCES

Since the forest resources are limited, the following alternatives can mitigate the problem:

- Community/Private forests
- Plantations of multipurpose trees in wasteland/barren land
- Silvo-pastoral systems
- Planting trees in farmlands and along contour bunds or farm boundary planting
- Pollarding and coppicing of willow trees near houses etc.

2.4 RECOMMENDATIONS

- Fuelwood used for cooking and heating in urban areas should be replaced by electricity.
- Substitute rural fuelwood by kerosene or more efficient smokeless gas stoves.
- Revise of royalty payments, especially for industries, to control exceptionally high demand and excessive use.
- Royalty should be levied on cubic metre basis rather than truckload basis for the industries.
- Research should be carried out to develop improved cooking and heating systems.
- Educate and train the people, especially the rural people, on fuelwood issues.
- Find better techniques for manufacturing charcoal.

3. FUELWOOD RESOURCES, USES, ISSUES AND POTENTIALS IN MONGAR FOREST DIVISION

by

Mr. K. B. Samal, Divisional Forest Officer,
Mongar Forest Division

3.1 BACKGROUND

The Forest Division of Mongar is located in the eastern part of the Kingdom, covering the jurisdiction of Mongar and Lhuntse *Dzongkhag* and encompasses a total area of 483,493 ha. Situated between 26 deg. 50 min. and 28 deg. 10 min. N latitudes and 90 deg. 46 min. and 91 deg. 10 min. E longitudes, the following broad forest types are found within the Division:

- Tropical broad leaved forests.
- Sub-tropical broad leaved and chir forests.
- Sub-temperate and temperate broad leaved and conifer forests.
- Alpine scrub and pastures.

The total population of the Division amounts to 60,500, made up as follows:

- Mongar: 4,800 households, 40,000 persons
- Lungtse: 2,513 households, 20,500 persons

The population is 90 percent agrarian and the people's dependence for their livelihood on natural resources is very high. The majority of the population practises subsistence farming and key supplement their household incomes through cottage industries, namely resin tapping, fruits, and cash crops like potatoes, oranges, chillies, etc.

3.2 FOREST RESOURCES

The forest areas of the Division cover about 81.9 percent of the total area of the two *Dzongkhag* of Mongar and Lhuntse combined. The detailed area statistics, as compiled by LUPP, MoA are shown in Tables 1 and 2.

Table 1: Forest resources in Mongar Dzongkhag

Type	Area in ha	As percentage of total area
Fir	5,679	1.42
Mixed Conifer	21,701	5.39
Blue Pine	133	0.03
Chir Pine	30,192	7.51
Conifer Forest	57,704	14.35
Broad leaved Conifer	20,612	5.12
Broad Leaved Forest	90,184	22.42
Scrub Forest	3,757	0.93
Forest	172,258	42.82
Total	420.220	100

Table 2: Forest resources in Lhuntse Dzongkhag

Type	Area in ha	As percentage of total area
Fir	45,983	8.85
Mixed Conifer	30,205	5.81
Blue Pine	0	0
Chir Pine	8,687	1.67
Conifer Forest	84,874	16.33
Broad leaved Conifer	12,078	2.34
Broad Leaved Forest	77,548	14.92
Scrub Forest	42,850	8.25
Forest	217,350	41.83
Total geographical	519,575	100

The total growing stock, annual increments and potential fuelwood as per the Forestry Master Plan document are:

Dzongkhag	Forest area (In ha)	G. Stock (In million m^3)	A. Increment (In million m^3)	Fuelwood (In m^3)
Mongar	172,258.00	16.06 (conifer) 22.67 (b. leaved) 5.53 (b.l + conifer)	0.27 (confer) 0.38 (b.leaved) 0.29 (b.l + conifer)	192,000
Total		44.25	0.94	
Lhuntse	172,258.00	24.19 (conifer) 19.50 (b. leaved) 3.24 (b.l + conifer)	0.40 (conifer) 0.32 (b. leaved) 0.05 (b.l + conifer)	315,000
Total		46.93	0.77	

3.3 WOOD ENERGY RESOURCES

Of the total annual increment from the forest, 507,000 m^3 of wood constitutes potential fuelwood after removing the prime timbers. Even considering the total population of the Division at 60,500 and per capita consumption at 1.92 m^3 and the total requirement for the whole population at 116.160 m^3, there is a fuelwood surplus of 390,840 m^3.

Alternative energy resources used are electricity and LPG which are used in the urban centres. However, their impact is insignificant.

3.4 FUELWOOD AS A MAJOR ENERGY SOURCE

Without fuelwood as an energy source, life in Bhutan is almost unthinkable. Whether it is in the rural village or the so-called urban centres, whether for cooking meals, boiling water, heating the rooms or for cremation purposes, the use of fuelwood is almost inseparable from the Bhutanese way of life. And its use will continue to predominate for the foreseeable future.

It would therefore be beneficial and timely to consider the fuelwood types presently in use, the demand and supply situation, alternative energy uses, fuelwood distribution, supply and pricing system etc. Taking Mongar Forest Division as a case study the following are some of the facts which might serve as an indication:

3.4.1 Fuelwood types

The types of fuelwood that are mainly used are dry trees, lops and tops from logging areas, fallen dead trees and green trees marked for the purpose in case lops and tops and fallen trees are scarce. Drift and waif woods are also used as fuelwood. Some local industries also resort to carbonisation so that they can use charcoal in their industries.

3.4.2 Fuelwood uses and category of consumers

The most important use of fuelwood is for cooking. The other uses are space heating, cremation etc. The major consumers are rural people whose only energy source is fuelwood. By the provisions of the Forest and Nature Conservation Act and the relevant decision of the National Assembly, people in the rural areas are entitled to collect dry firewood for domestic use. Green firewood is also allotted to them, after marking, where there is a scarcity of dry firewood.

In the urban area, fuelwood is used for space heating with stoves known as *bukharis*. Institutions like *dratshang,* schools, security forces, hotels, etc. consume substantial quantities of fuelwood in the urban areas.

3.4.3 Fuelwood preferences, supply and demand situation

There is a general preference for hardwood over softwood for fuelwood. This is mainly because the hardwood gives more lasting heat per unit volume and also emits less smoke. Also the consumers find it more economical.

In the foregoing discussion, it has been mentioned that there is substantial fuelwood surplus in Mongar Division. This is not to imply that there is no scarcity of fuelwood. Localised shortages of fuelwood are felt almost everywhere near the population centres whether it be in urban or rural areas.

In rural areas, where people have the option to collect dry firewood, their requirements are hardly documented. Although green firewood is allocated on a permit basis only, it is not surprising that forest areas are first receding from the population centres. Moreover, getting fuelwood to meet day-to-day needs is becoming costlier in many villages. This is an indication of over-use of the accessible forest resource and if the trend continues the fuelwood will be a very costly commodity for many rural farmers.

In urban areas, the demand for fuelwood can be more easily assessed and the supply affected accordingly. In practice, the major consumers like the Roads Department, security forces, school/institutions, hotels can afford to purchase the fuelwood from the approved agents/contractors. Even specialised needs like and split firewood are supplied by them.

In general there is no real scarcity of fuelwood at present in Mongar Division.

3.4.4 Alternative energy uses

As already stated, the only alternative energy partly available for the urban dwellers is hydropower. This is really negligible considering the overall energy needs of the population.

With commissioning of the hydropower plant at Kurichu, it is expected that power will be plentifully available for those willing to use it for cooking and heating and it should significantly reduce the dependence of urban dwellers and other major consumers on fuelwood energy.

Liquefied petroleum gas and kerosene continue to be convenient alternative energy sources or cooking for a small section of people in urban and other areas accessible by road.

3.4.5 Fuelwood distribution supply system and pricing

The rural population collects the dry firewood from the forest adjoining their villages without any permit whatsoever from the forest offices. Green trees are also allotted on a permit basis to the villagers where dry firewood is scarce.

The needs of the urban dwellers, hoteliers, government organisations and institutions like schools, *dratshang,* PWD/GREF, security forces are met by the firewood supplied by the approved firewood contractors.

The price of green firewood for the rural people consists of only the approved royalty since they undertake the collection themselves. However, the prices of the firewood supplied to the urban consumers and government organisations are fixed by the open competitive tender rate of fuelwood supply quoted by the contractors for specific locations and within a valid contract period, which is usually one year. The sale rate of fuelwood supplied by contractors includes the cost components such as royalty, collection charges, transport cost to identified depots and profit margin of the contractor, etc.

3.5 PERTINENT ISSUES

In view of the importance of woodfuel as the biggest energy source for the Bhutanese population, it is felt that there are two major issues that need to be addressed in Mongar Division:

- the rational use of available woodfuel under efficient management, distribution and pricing systems; and
- a long term national strategy for harnessing and using woodfuel energy with the emphasis on available alternative energy resources.

Considering that woodfuel energy is going to be the most important source of energy for the majority of Bhutanese people for the foreseeable future, a more standard system of woodfuel management and production, distribution and pricing needs to be worked out to deliver the goods and services to all categories of consumers efficiently.

The present practice is to allow the majority of the rural people to freely collect woodfuel and thus there is no information on its actual consumption in the country. The pricing of fuelwood is also erratic and many consumers still get fuelwood royalty-free. This must be streamlined and all categories of consumers must be made to pay for the fuelwood.

Where there is bulk demand for fuelwood near towns and other population centres, the system of granting permits to individual consumers should be a strictly avoided, and the supply should be routed through approved contractors or government depots. Collection of fuelwood must be from planned FMUs as far as possible and where there is no FMU, proper silvicultural marking has to be done in identified potential areas for extraction of fuelwood.

Because of a negligible difference in royalty and the sale price, many consumers prefer hardwood, thus creating a pseudo-shortage of fuelwood. This problem can be mitigated by raising the royalty and sale price of hardwood, which is in short supply or by reducing the price of softwood which is abundant in many FMUs. In any case, it is time to take a stand and say no to any demands for a specific preferred type of fuelwood if it can't be made available without compromising silvicultural principles and environmental conservation.

People have also to be made aware of the effective and economic use of briquettes wood energy by introducing improved energy saving devices like saw dust *bukhari*, saw dust briquettes, improved ovens/*chulhas*. This can be accomplished by conducting awareness campaigns, demonstrations etc. aimed at the target audience.

Notwithstanding the paramount importance of woodfuel for the livelihood of many Bhutanese today, the continuous removal of biomass from the forest at the present rate in pursuit of meeting the socio-economic needs of the people will have drastic negative impacts on the natural environment of the Kingdom.

We firmly believe that forests have many broader and significant functions to offer for sustaining human welfare than merely acting as a "woodfuel resource" reserve. Environment protection, bio-diversity conservation, soil protection and atmospheric climate ameliorisation are a few functions which readily spring to mind. The need to maintain a green vegetal cover is more pronounced in Bhutan than perhaps in many other countries because of the fact that Bhutan lies in a relatively fragile mountainous geological formation. Also, we have a very high potential for hydropower generation with big perennial rivers flowing through the Kingdom. Well-forested watersheds are a great boon to hydropower projects which can bring important positive changes to the socio-economic status of the Bhutanese people.

We must now take concrete steps to work out a long term national strategy for woodfuel energy use in Bhutan with the emphasis on diverting consumers to other available energy resources so as to gradually reduce the pressure on the forests which today supply the cheapest source of energy. Such a strategy will have to take into account all and any relevant government policy decisions and also give due regard to the socio-economic dimensions of fuelwood.

Operational and support programmes have to be designed and implemented to suit the strategy and must be pursued vigorously in the field. Such programmes should cover activities like extension services to create more awareness of alternative energies like electricity, biogas, LPG, kerosene, etc. in order to encourage consumers to use these. It may also be necessary to subsidise electricity and perhaps even heating and cooking appliances.

Advantage may be taken of social and agro-forestry programmers that are already in place to raise more fuelwood plantations in resource rich areas.

But the most important task will be to inculcate in the people a true love for the forests and obtain their willing participation and support to manage and protect them in the wider interests of the nation so that we can hand over this rich legacy of a 'common property resource' to future generations. If this is accomplished, we will have a complete new energy consumption scenario in the Kingdom (perhaps 2-3 decades down the line from now) based on a sustainable supply of hydro-power energy, and the dependence on woodfuel, and hence the country's forests, will be a thing of the past.

4. OVERVIEW OF FUELWOOD RESOURCES MANAGEMENT IN BUMTHANG FOREST DIVISION

by

Mr. Wangdi, Representative of the Divisional Forest Office,
Bumthang Forest Division

4.1 GENERAL INFORMATION

Bumthang Forest Division was established in 1983 and covers the three districts of Bumthang, Trongsa and Zhemgang. The total geographical area of the three districts is 664,686 ha with a total population of 41,129 as shown below:

Districts	Geographical Area (Ha)	Population
Bumthang	271,405	12,597
Trongsa	180,690	12,641
Zhemgang	212,591	15,891
Total :	**664,686**	**41,129**

Source : LUPP & Forestry Master Plan.

4.2 FOREST AREA

The Division has one of the largest areas of forest in the country with a total area of 523,815 ha or 80.36 percent of the Division's territory. It has a great variety of trees ranging from sub-tropical tree species at altitudes of around 300m to alpine forests at altitudes of 4,000m and above. The district-wise distribution of forests areas in the Division is shown below.

Districts	Forest Area	Percentage
Bumthang	181.135	66.75
Trongsa	155.249	87.68
Zhemgang	184.431	86.75
Total:	**520.815**	**80.35**

4.3 FOREST RESOURCE PLAN

The Forest Resource Division Section (FRDS) under the Forestry Services Division (FSD) has formulated management plans for the three districts with the basic objective of regulating the forest resources in accordance with the sustained yield concept and using an environmentally sound approach.

A management plan for Mangdichhu Management Unit in Zhemgang District will be revised in 1998 and the plan for Wangdigang Management Unit in the same district has been implemented since 1995. The Chendebji Management Plan in Trongsa District will commence implementation in 1997 whereas the Karshong Management Plan in Bumthang District is already in the third year of operation. The working plan for Dhur, developed by a

Swiss expatriate in the early 1980s, is in need of immediate revision. From the past experiences the new plans for these units would require realistic determination of potential yield on the basis of in-depth appraisals of the forest resource base.

The total area of 29.935 ha under the planned management units in three districts constitute 6 percent of the forest area of the Division. The figures on growing stock and annual allowable cuts from the existing units as per the management plans are given below.

Management Units	Area (Ha)	Growing Stock (m^3)	AAC (m^3)
ZHEMGANG			
Mangdechhu	5,000	1,089.00	3,700
Wangdigang	9,620	3,700.00	6,950
Sub-Total	14,620	10,659.00	10,600
TRONGSA			
Chendebji	9,700	8,140.00	7,000
Sub-Total	9,700	8,140.00	7.000
BUMTHANG			
Dhur	915	517.00	5,600
Karshong	4,700	5,347.67	5,300
Sub-Total	5,615	5,864.67	10,900
Grand Total	29,935	24,663.67	28,500

4.4 SOURCE OF FUELWOOD FOR URBAN AND RURAL HOUSEHOLDS

Both urban and rural households depend on the existing forest management units, the natural reserved forests outside the units, and private registered lands like *Tsheri* and *Pangshing* as potential fuelwood sources.

However, those households located in and around the forest units get their fuelwood from the units for free. A similar situation exists in Trongsa District where the Chendebji Management Unit is located far from the main population of rural households and the people still depend on *Tseri* and natural forests for fuelwood.

In most cases the urban households obtain fuelwood from the management units since they are able to pay the cost charged by the Forest Department. The Division, however, resorts to tree marking for urban fuelwood supply when there is insufficient fuelwood stock in the units. In places like Trongsa an ad hoc site selection of supply sources is made based on the growing stock tree composition and site feasibility.

There is a need to either increase the sizes of the existing units or further open up more units in the Division to meet the growing demand of the urban population for fuelwood. From the fuelwood collection operation carried out in the management units under the IFDP (Integrated Forestry Development Programme), Bumthang, it is estimated that only 14 percent of the total timber production is collected as fuelwood in the form of lops and tops, side branches, defective logs etc.

The share of fuelwood in the total roundwood produced from management units in Bumthang District is shown below.

Year	Timber Production in Roundwood ($m^{3)}$	Fuelwood Share (%)
1992	9,996.30	9
1993	3,922.18	22
1994	11,693.82	13
1995	10,849.19	9
1996	7,672.37	15
AVERAGE	**10,826.77**	**14 percent**

From the timber supply records covering 1993 to 1996 for Bumthang District, the shares of fuelwood produced from three main sources are estimated as shown below:

Year	Management Units	Reserved Forests ($m^{3)}$	Wood based Industries ($m^{3)}$
1992	859	13,088	58
1993	3,119	13,160	63
1994	1,565	13,512	104
1995	1,018	13,168	66
1996	1,140	11,744	131
Total	**7,701**	**64,672**	**422**
%	**10.58**	**88.84**	**0.58**

In Bumthang, therefore, the bulk of the fuelwood is derived from reserved forests (88.84 percent) and 10.58 percent is derived from the forest management units, while only 0.58 percent is derived from sawmills in the form of offcuts.

4.5 FUELWOOD CONSUMPTION BY DISTRICT

Among the three districts of the central region Bumthang, located in the sub-alpine zone at 3000 feet and higher, is found to be the largest consumer of fuelwood. The consumption pattern of fuelwood (in truckloads) is shown below:

Year	Bumthang (T/L)	Trongsa (T/L)	Zhemgang (T/L)
A. URBAN			
1992-1993	142	85	50
1993-1994	398	173	53
1994-1995	209	140	45
1995-1996	217	176	52
1996-1997	253	136	77
Sub-Total:	1,219	710	277
B. **RURAL**			
1992-1993	1,601	284	11
1993-1994	1,636	361	4
1994-1995	1,676	37	38
1995-1996	1,556	284	73
1996-1997	1,357	431	78
Sub-Total:	7,826	1,397	204
Grand Total (A+B):	9,045	2,107	481

A huge quantity of fuelwood supplied by Trongsa and Zhemgang is in the form of head loads (HL). For an approximate estimation of fuelwood consumption, 80 headloads is considered equal to 1 truckload (T/ L) or 8 cubic metres. The average fuelwood consumption per year in three districts is worked out below:

District	Urban Consumption per Year	Rural Consumption per Year
Bumthang	1,950m^3	12,522m^3
Trongsa	1,136m^3	2,235m^3
Zhemgang	443m^3	326m^3
Total :	**3,529m^3**	**15,083m^3**

From the above figures it is estimated that 19 percent of fuelwood is consumed by urban consumers like guest houses, hotels, shops, government institutions. Rural consumption constitutes the remaining 81percent.

4.6 USE OF FUELWOOD

Fuelwood is mainly used for cooking, space heating, preparation of animal feed, *Lochoe* (annual traditional offerings), cremation, hot water baths, *Tshechhu* (local religious festivals), and preparation of local alcoholic drinks.

In Bumthang, fuelwood use, by order of importance, is accounted for by cooking, animal feed preparation (cattle rearing is common in the locality and requires a large share of fuelwood for preparing animal feed) and space heating. A Rapid Rural Appraisal conducted in five *Gewog* in Trongsa revealed that feed preparation for 2 or 3 cattle alone consumes more fuelwood than cooking a meal for a family of 5.

More fuelwood is used by the local residents (both urban and rural households) in Bumthang due to the seasonal performance of local religious festivals (*Tsechhu* in almost all the *Gewog)*. This, along with other religious *puja* offerings in various temples, uses a huge quantity of fuelwood in cooking for the large number of people which attends these festivals. Sometimes the festivals last for months.

4.7 ASSESSMENT OF FUELWOOD RESOURCE MANAGEMENT AND RECOMMENDATIONS

4.7.1 Current fuelwood situation in the management units

The existing forest management units do not generate an adequate supply of fuelwood as the collection is mostly confined to logging waste such as defective logs, side branches etc. For economical reason the cable crane operators prefer to extract sound logs rather than undertake the cumbersome collection of fuelwood. Also, a considerable quantity of lops and tops fit for fuelwood is left in the forest after the trees are converted into *cham* (beam size blocks).

Suggestions

- Identify the potential sources of fuelwood within each management unit and incorporate such areas into operational plans.
- Increase the sizes of existing units and further create more management units to augment fuelwood supply in the district.
- Explore possibilities to utilize logging waste in the forest to meet the increasing consumption of fuelwood and to sustain the fuelwood energy base. An IFDP trial is already being initiated to minimize the logging waste and to utilize residual wood in the form of industrial *bukhari* size timber and fuelwood. The defective logs, branches and trees damaged by felling are all taken out by cable crane.

4.7.2 Preferred fuelwood trees

The preferred trees for fuelwood are blue pine in Bumthang and *Quercus* and *Castanopsis* species in Trongsa and Zhemgang. Local residents of Bumthang feel that blue pine emits less smoke and lights easily. If there is road enabling easy access the people prefer spruce or blue pine in Shingkhar and Ura. The spruce is known as a hardy fuelwood species in the conifer belt and lasts longer while burning. In other two districts the preference is more for hardwood because of its calorific value.

If the present trend of allotting standing trees for fuelwood continues there is a likelihood of depleting the potential genetic source of valuable timber species in the foreseeable future.

Suggestion

- Consistent marking operations for fuelwood supply as per the silvicultural guidelines should remain a primary goal to retain sound and healthy trees.

4.7.3 Sub-urban fuelwood consumption

A huge demand for subsidized fuelwood comes from the suburban population. These households, located in and around the municipal centres, accrue economic benefits through the use of other energy sources like electricity, cooking gas and kerosene.

Suggestions

- Review energy consumption situation in such areas and develop plans to reduce subsidy on fuelwood supply for the residents living in the sub-urban areas. This will also help to reduce constant monitoring over the use of subsidized fuelwood by the urban population.
- In co-ordination with other concerned agencies or responsible institutions, formulate action plans to seek appropriate alternative energy sources for sub-urban centres.

4.7.4 Fuelwood depot service

In the division there are two types of fuelwood delivery systems. The first is direct delivery from the stumps (road head) to the consumers through the involvement of contractors. The second is delivery from the unit road head to the consumers who make their own transport arrangements. These systems are applicable only to the urban and institutional consumers. For rural consumers, the marking of standing trees is still the prevailing practice. Under the fuelwood delivery arrangement for the urban population, the general opinion is in favour of having a central fuelwood depot from where the urban residents can obtain their fuelwood requirements.

Suggestion

- Create central depots for fuelwood supply wherever possible or contract out suitable sites to interested contractors.

4.7.5 List of improved stoves

Many households in Bumthang and Trongsa are using improved stoves manufactured by the Agro-Mechanical Workshop, Bumthang. The factory has produced sawdust *bukharis* which are not very popular at present. With the increase in the cost of fuelwood and depending on sawdust availability this improved *bukhari* would soon find a ready market in both urban and suburban centres.

Suggestion

- The improved stoves used for space heating and cooking may help to save fuelwood consumption as they are more energy-efficient than traditional mud stoves. There is a strong need for more substantive research to test the efficiency of such *bukharis* in the context of their usage in the traditional Bhutanese house.

5. FUELWOOD CONSUMPTION IN WANGDUE FOREST DIVISION

by

Mr. Abilal Baskota, Divisional Forest Officer
Wangdue Forest Division

5.1 INTRODUCTION

The total geographical area of the Division is about 9,424.7 km^2 of which 40,468 ha are under forest cover. The population within the Division area is about 40,000 of which 57 percent is in Wangdue District, 35 percent in Punakha District and the remaining 8 percent in Gasa. These figures exclude the urban population like the armed forces and high school students.

Almost all the vegetation types of Bhutan are found in this Division. The forested area dominates in Punakha with 84 percent (82,934 ha) of the area, Wangdue with 59.9 percent (264,167 ha) of the area and Gasa with 20.4 percent (82,516 ha). Information on the total geographical area, landuse types, etc. are given in Attachment 1.

5.2 FOREST TYPES IN WANGDUE FOREST DIVISION

(i) *Wet sub-tropical forest (lowland hardwood):* Up to 2000 – 3000 m in altitude and a mean rainfall of less than 2000 mm; the predominant species are *Schima wallichii*, *Castonopsis indica, Lithocarpus sp.* etc.

(ii) *Sub-tropical pine forest:* Up to 2000 m altitude and a mean rainfall of 1000 – 2000 mm; *Pinus roxburghii* is the dominant species.

(iii) *Temperate forest:* Between 2000 – 3000 m altitude and mean rainfall of 1000 – 2000 mm; the main species are *Quercus sp., Acer sp., Betula alnoides, Castonopsis sp., Arundinaria sp.* mixed with *Pinus wallichiana*, *Laryx griffithii* and *Tsuga dumosa* in the higher elevations.

(iv) *Sub-alpine forest :* Between 3000 – 4000 m. the main species are *Tsuga dumosa, Picea spinulosa, Pinus wallichiana, Laryx griffithii, Abies densa, Juniperu recurva, Betula utilis, Rhododendron sp. Bamboo sp*; the forest types are pure blue pine forest, mixed conifer forest with various species mixed, partly pure hemlock/spruce stands in the lower elevations and dominated by fir at the higher altitudes.

(v) *Alpine forest:* Above 4000 m with a long dry period and a very heavy frost during winter; sparse vegetation with rhododendron, juniper, birch, acer, salix and many shrubs with open grassland.

5.3 GROWING STOCK

The mixed conifer zone has a volume of 400 - 500 m^3 per ha with sustainable yield of 2 –5 m^3 per ha. The volume of the hardwood is about 200 - 300 m^3 per ha and the annual sustainable yield is estimated to be about 3 m^3 per ha.

5.4 USES OF WOOD

About 90 percent of the population within the division (rural and urban) depend on the forests for construction timber and fuelwood (for cooking and space heating). Among them the armed forces is the major consumer. Annually the RBA alone consumes about 408 truckloads (about 3,364 m^3) followed by RBP with about 384 truck loads (3,072 m^3). High schools, urban centres, and monasteries together consume about 95 truckloads (760 m^3). The wood based industries like the DIWC uses wood for manufacturing furniture, panels and other woodcrafts. These demands are met from both outside and inside the forest management units (FMUs). The largest share of the rural demand (firewood and local construction) is supplied from forests outside the FMUs but which are in the vicinity of settlements. Fuelwood consumption figures by *Gewog*/district are given in Table 1.

5.5 FUELWOOD SOURCES

Fuelwood comes from the following sources:

- Official allocation of trees by the Forest Division,
- Self supply (collection of branches etc),
- Collection of logging residual (lops and tops) by contractors for supply to urban market.

Only 27 percent of the total demand is met from the forests having approved scientific forest management plans (as per the fuelwood consumption assessment carried out by GTZ in 1995).

5.6 OFFICIAL SUPPLY

The official supply amounts to about 28,050 m^3 for all three districts which is equivalent to 0.67m^3 per capita (calculated 4 trees/year per household and the volume was calculated by GTZ at 1.37 m^3/tree).

5.7 SELF-COLLECTION

Besides the official supply, fuelwood comes from gathering of deadwood, branches and residuals from the trees used for construction timber. The self-supply of fuelwood most probably increases with the remoteness of the settlement from the forest and thus varies from district to district. Gasa has the highest share accounted for by self-supply with 64 percent followed by Wangdue with 60 percent and Punakha with 50 percent. The total amount, collected by the rural population is estimated at about 34,400 m^3 which is equivalent to 0.8 m^3 per capita.

Table 1: Wood consumption per Dzongkhag in Wangdue forest division

Dzongkhag/Gewog	**Firewood**			
	Self Collection		**Official Supply (m^3)**	**Total (m^3)**
	Genuine (m^3)	**Residuals (m^3)**		
Goen Khame	442	0	438	880
Goen Katoe	509	0	351	860
Laya	1,016	0	597	1,613
Lungnang	1,359	0	806	2,165
Urban	0	655	0	655
Total for Gasa	**3,326**	**655**	**2,192**	**6,173**
Bjemenang	403	0	718	1,121
Chubu	796	0	1,178	1,974
Guma	689	0	1,069	1,758
Goen Shari	416	0	433	849
Kabjisa	1,580	0	,263	3,843
Lingbukha	1,280	0	1,014	2,294
Shenganang	1,025	0	1,008	2,033
Talo	582	0	1,008	1,590
Toewang	1,203	0	1,107	2,310
Dzoma	734	0	1,134	1,868
Urban	0	2,423	0	2,423
Total for Punakha	**8,708**	**2,423**	**10,932**	**22,063**
Bapisa/Thimphu	**2,325**	**0**	**0**	**2,325**
Athang	1,463	0	997	2,460
Bjena	1,847	0	1,343	3,190
Daga	748	0	740	1,488
angchu	1,131	0	899	2,030
Gangtey	1,353	0	822	2,175
Gasey Tshogom	835	0	680	1,515
Gasey Tshowom	671	0	499	1,170
Kazhi	1,372	0	943	2,315
Nahi	464	0	564	1,028
Nisho	1,998	0	1,622	3,620
Phangyul	1,138	0	1,080	2,218
Phobji	2,223	0	1,255	3,478
Rubesa	1,915	0	1,310	3,225
Sephu	2,374	0	1,556	3,930
Tshetsho	514	0	619	1,133
Urban	0	2,083	0	2,083
Total for Wangdue	**20,046**	**2,083**	**14,929**	**37,058**
Grand Total	**34,405**	**5,161**	**28,053**	**67,619**
Grand Total %	**26**	**4**	**21**	**52**

5.8 SELF-COLLECTION (RESIDUALS)

The fuelwood for the urban population, mainly the armed forces, monasteries and schools, comes usually from logging residuals which are collected by contractors. For all three districts, the total amount of firewood from logging residuals is estimated at 5,100 m^3 or 0.1 m^3 per capita.

The total amount of firewood consumed in 1993 for all the three districts is estimated at about 67,000 m^3 or 1.6 m^3 per capita. Per district as follows:

Gasa	2.2 m^3 per capita
Punakha	1.5 m^3 per capita
Wangdue	1.6 m^3 per capita

5.9 FUELWOOD TYPES

The consumers prefer hardwood and the demand at present is met both from outside and inside the forest management units. About 80 percent of the urban demand is met from the Rimchu Working Scheme area.

5.10 PRICING SYSTEMS

For the distribution of firewood, in the urban area, tender is floated. Normally the lowest bidder wins the tender. At present Nu. 180 is charged as royalty on a per truckload basis. However, presently the armed forces are eligible for “royalty free” supply.

5.11 ALTERNATIVE ENERGY USES

In the urban area LPG, kerosene and electric heaters are used for cooking and space heating.

5.12 ISSUES

The following constraints are faced by the Division :

- The fuelwood supply at the moment, particularly in the urban areas, can be met from the Rimchu areas. If the Rimchu Working Scheme is not made into a full management unit, the Division could face serious fuelwood supply problems.
- The fuelwood from Khotokha FMU is not economical due to the absence of an access road.
- The consumers prefer hardwood (*Quercus spp*.) which is not easily available.
- The Division lacks social/community/private forestry.
- There is no access road to the Nahi FMU as well as to the area outside the FMU where fuelwood resources are available.

5.13 RECOMMENDATIONS

- Introduce alternatives to wood energy (electricity, gober gas, sawdust etc in the armed forces, monasteries, and schools).
- Road construction agencies like the PWD and Project Dantak should introduce modern technology for coal tar boiling instead of using firewood.
- Customs duty/tax should not be levied for imported electrical cooking and heating items.
- Designate a suitable area and plant with fast growing fuelwood species.
- Disseminate smokeless stoves to the villages.
- Prepare management plans even for forest areas outside FMUs.

Attachment 1

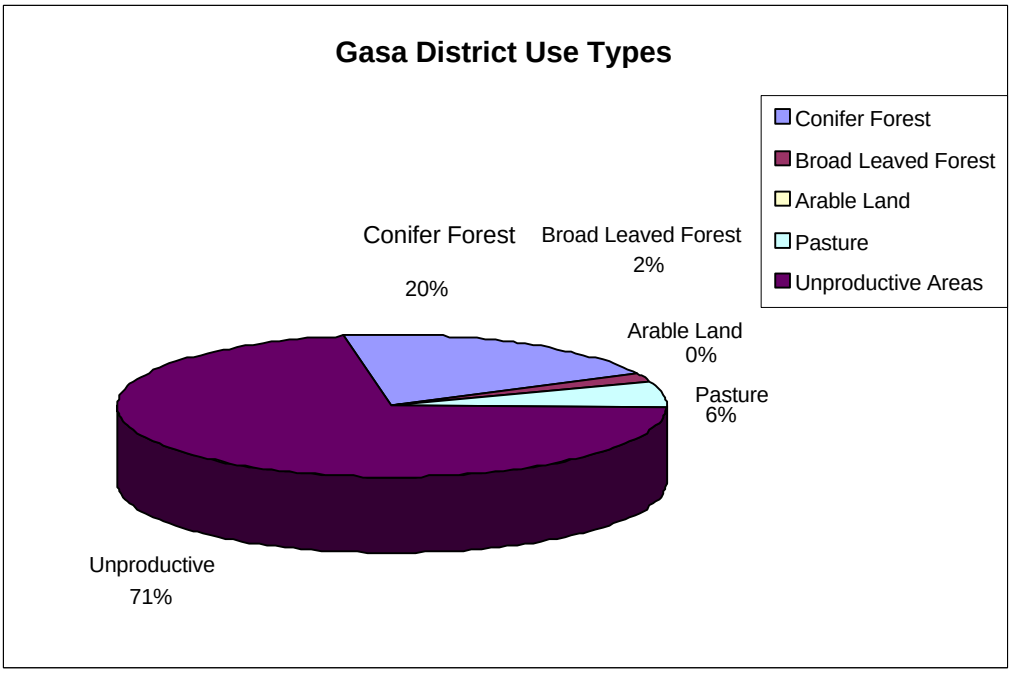
District Information

Gasa District

Total Area:	4412.3 km^2
Estimated Population:	2988
No. of Households	482
Estimated Population per km^2	1

Land Use Types

Conifer Forest	Broad Leaved Forest	Arable Land	Pasture	Unproductive Areas
74,676 ha	7,840 ha	755 ha	23,409 ha	266,767 ha



Attachment 2

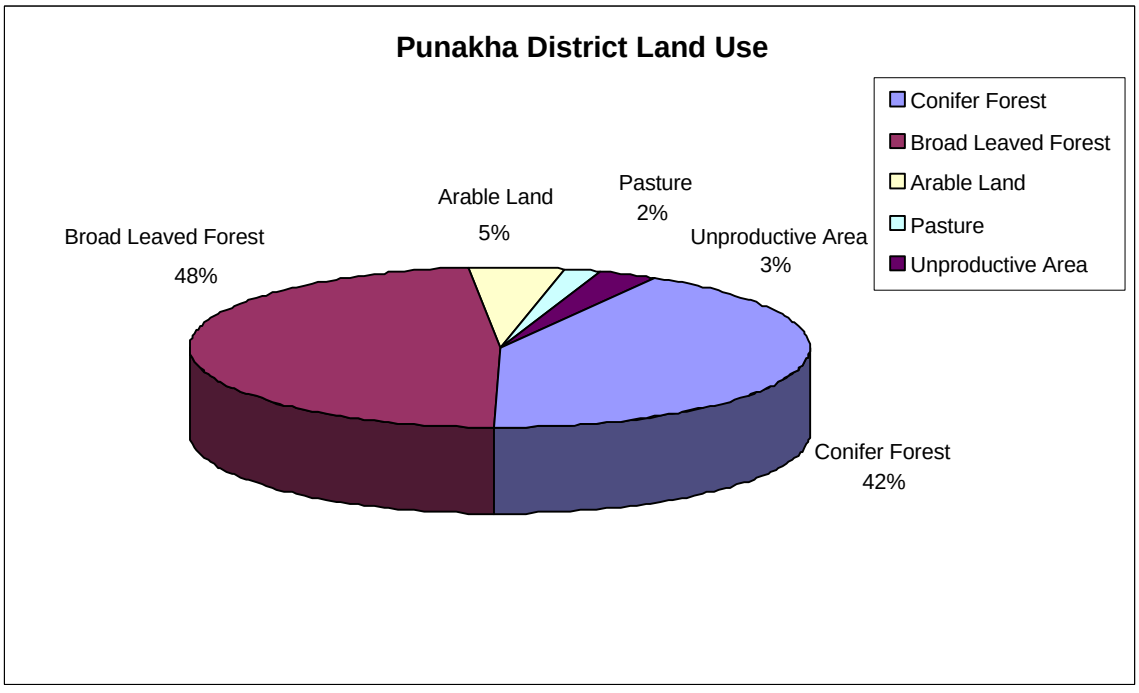
District Information

Punakha District

Total Area	:	974,7km^2
Estimated Population	:	14835
No. of Households	:	2280
Estimated Population pe km^2	:	15

Land Use Types

Conifer Forest	Broad Leaved Forest	Arable Land	Pasture	Unproductive Area
38,187 ha	43,747 ha	4,606 ha	1864 ha	3,000 ha



Attachment 3

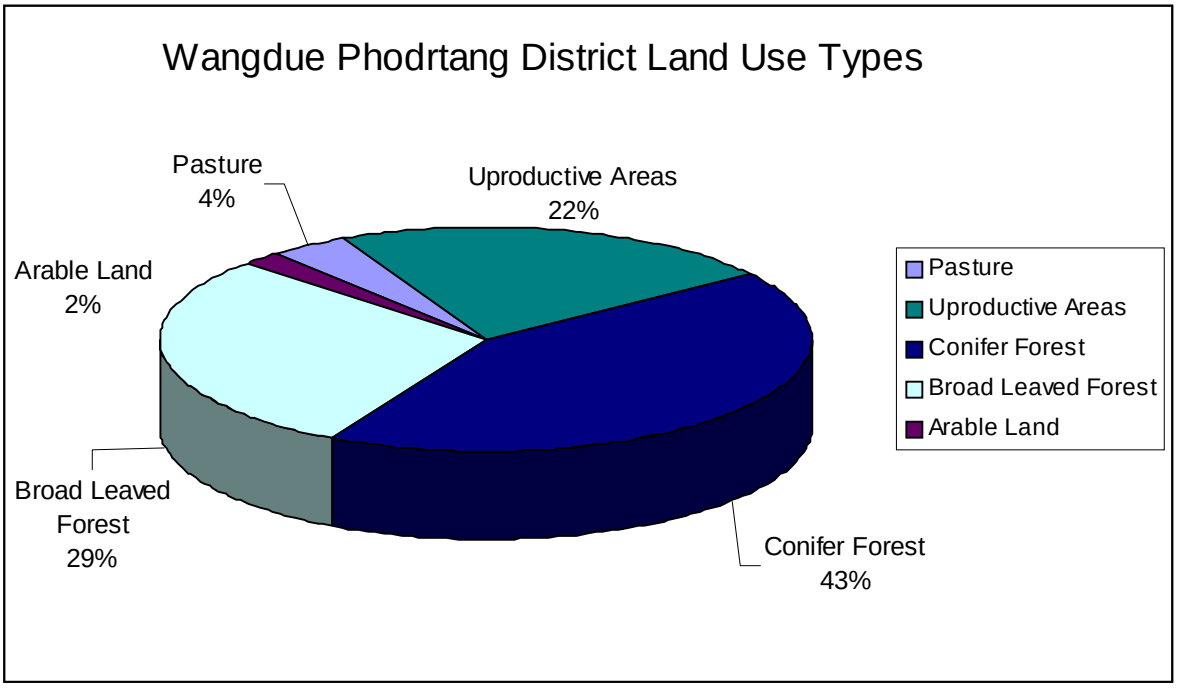
District Information

Wangdue District

Total Area	:	4038.2 km^2
Estimated Population	:	22345
No. of Households	:	2969
Estimated Population per km^2	:	4

Land Use Types

Conifer Cortest	Broad Leaved Forest	Arable Land	Pasture	Unproductive Areas
155,742 ha	107,819 ha	9,095 ha	14,201 ha	79,392 ha



6. FUELWOOD RESOURCES, USES AND ISSUES IN TRASHIGANG FOREST DIVISION

by

Mr. Kin Gyeltshen, Divisional Forest Officer
Trashigang Forest Division

6.1 TRASHIGANG FOREST DIVISION

Trashigang Forest Division is only 8 months old and its total geographical area is 3,721 km^2 with 24 *Gewog* and 3 *Dungkhag.*

The Forest Division covers Trashigang and Trashiyangtse *Dzongkhag*.

6.2 MAJOR USES OF FUELWOOD

Cooking, heating and industrial processes.

6.3 DEMAND

Rural

Place	1995 – 1996 (m^3/yr)	1996 – 1997 (m^3/yr)
Trashigang	4,832	5,043
Trashiyangtse	1,201	1,441
Total	**6,033**	**6,484**

Institutions(especially schools)

Place	Number	Fuelwood required (m^3/yr)
Trashigang	31	11,012
Trashiyangtse	5	1,458
Total	**36**	**12,470**

Urban
In Trashigang the fuelwood requirement is 2,280 m^3 per year

Government Organisations
The fuelwood demand is 9,303 m^3 per year.

6.4 DIFFERENT CATEGORIES OF CONSUMERS IN TRASHIGANG *DZONGKHAG*

Organizations/Institutions	Quantity of fuelwood (m^3/yr.)
RBA	4,500
IMTRAT	1,700
RBP	648
Project Dantak	500
Total	**7,348**

6.5 ALTERNATIVE ENERGY RESOURCES

Sources	% of the total
Cow dung	2
Gas stove	20
Electricity	3
Kerosene	5
Total	**30**

The remaining 70 percent of the energy consumption comprises fuelwood.

6.6 SUPPLY SOURCES

The annual allowable cut from the Khaling Kharungla Forest Management Unit is 3,140 m^3 per year, whereas the total demand within the Division is 30,311 m^3 per year. The remaining 27,127 m^3 per year is supplied from outside the FMU.

6.7 ISSUES AND CONSTRAINTS

There are numerous constraints, a few important ones are listed below:

- The degradation of forests (e.g. from Yonphula to Khaling nearby the road and from Radhi to Phongmi) is increasing due to heavy demand.
- Forest management institutions need to be strengthened.
- Ad hoc demands like those related to the National Day, 8th Five-Year Plan etc., for which timber and fuelwood have to be extracted without any proper planning, need to be controlled.

7. FUELWOOD USE IN SIMTOKHA RIGZHUNG INSTITUTE

by

Kinley Namgyel, Teacher, Simtokha Rigzhung Institute

7.1 IMPORTANCE OF FUELWOOD IN THE ORGANISATION

Fuelwood is a basic necessity of the Institute. It is used for cooking meals for about 300 students and 50 staff every day and for space heating. This is the only educational institute in Thimphu with boarding facilities .

7.2 REQUIREMENTS

If it is hardwood, especially Quercus sp, 200m^3, if it is softwood, 300m^3.

The wood is bought from contractors (who obtain it from Chamgang-Helena forest) and then split and cut into shorter pieces for use in a traditional Bhutanese oven which is used for most of the cooking. A traditional oven is also used for cooking dal and curry.

7.3 ALTERNATIVE ENERGY USES/SOURCES

Although no other energy source is used for cooking at present besides wood, a number of alternatives to wood energy are possible:

(i) Electricity

This could be a reliable source of energy for cooking, heating and lighting. As the country is rich in hydropower and there are several big hydro projects coming onstream this is the best alternative. However, the initial cost of installing electrical cooking ovens and appliances will be very high and therefore should be subsidized. The unit cost of electricity should also be reduced substantially.

(ii) LPG

LPG gas is another alternative, especially in institutes and organisations where there are a small number of beneficiaries. But the suppliers should ensure regular and adequate supply of the gas. It is suggested that some modifications should be made to the present gas cylinders (e.g. double the size) and the stoves should be big enough to hold bigger and heavier pots.

(iii) Solar energy

The possibility of using solar energy for cooking should also be explored.

(iv) Gobar gas

Research should be carried out to explore whether the gas could be used for cooking bigger quantities of food in institutes.

7.4 CONSTRAINTS

The following are the constraints faced by the Institute:

- wood is becoming scarce at the source;
- sometime the contractors are not efficient;
- often the roads are blocked due to rain in summer and snow in winter;
- limitation of budget;
- difficult to get “royalty free” firewood and a separate firewood coupe.

7.5 SUGGESTIONS TO IMPROVE THE PRESENT SITUATION

- Take steps to realise the energy alternatives mentioned above to supplement wood energy -this will lessen the cutting down of already scarce wood in the Thimphu region.
- Award contracts to more than one supplier to enable timely and adequate supply of wood to all organisations. Draw up a list of suppliers and make it available to consumer organisations.
- Supply wood at times which avoid bad weather conditions.
- Decide a uniform rate per m^3 and not per truckload basis (which is not reliable).
- Provide royalty and coupe to all contractors specified to supply wood to different organisations.

8. FUELWOOD USE BY TASHI CARBON AND CHEMICALS LTD.

by

Mr. D. N. Gyeltshen, Tashi Carbon and Chemicals Ltd.Pasakha, Phuentsholing

8.1 INTRODUCTION

Tashi Carbon and Chemicals Ltd., is one of the small-scale industrial undertakings of Tashi Group of Companies, established in 1987. Charcoal derived from wood is the basic raw material comprising nearly 98 percent of the total composition. Wood for the company is thus not fuel but a vital source of raw material. One hundred percent of our product is exported to India.

8.2 ANNUAL REQUIREMENT

Installed-capacity would require 5,280 MT of charcoal if the plant is operating at 80 percent capacity. With the resultant effect of short supplies in varied forms the actual average consumption is 2,900 MT per annum.

8.3 CHOICE OF SPECIES

Market demand in India currently calls for a higher grade of carbon. Proportionately, the charcoal requirement is 75 percent soft wood/coniferous and 25 percent hardwood species.

8.4 SOURCE

Current sources are Thimphu., Paro, Wangdue and Samtse Divisions. Volume collection from each area is determined by geographical condition and the amount of wastewood abandoned by prioritised and privileged institutions. Therefore, the company does not enjoy the benefit of coupes or quotas for its industrial raw materials.

8.5 ALTERNATIVE RAW MATERIALS

Due to the nature of its composition and its end utility, no other material can substitute vegetable carbon.

Activated carbon is widely used as a decolourising agent in the production of essential commodities such as pharmaceutical goods, essential oil, cosmetics, cold drinks, sugar, and in treatment of drinking water etc.

8.6 TASHI ROSIN AND TURPENTINE INDUSTRIES

Tashi Rosin and Turpentine Industries, Samdrup Jongkha, is a small scale industrial undertaking of the Tashi Group of Companies. Apart from the primary task of manufacturing rosin and turpentine oil, it is also engaged in the extraction and procurement of chir pine resin - a basic raw material.

8.7 IMPORTANCE OF FUELWOOD AND PURPOSE OF CONSUMPTION

Rosin and turpentine oil are essentially produced by steam. Fuelwood is used to fuel the boiler which generates the steam.

8.8 ANNUAL REQUIREMENT

The annual fuelwood requirement for the last 5 years has been 460 truckloads (TL), or 4,600m^3, among which 4000m^3 was for production, and 600m^3 was reserved for emergencies. It is expected that the company is unlikely to exceed this amount considering its operational limitations and production capabilities.

8.9 CHOICE OF SPECIES

The preferred choice is hardwood. Although it provides the same amount of energy as any other fuelwood it is slow burning and so helps cut down on excessive consumption. However, if there is no choice, any species can be used.

8.10 SOURCE AND CONSTRAINTS

The local Forestry Department is the source of fuelwood where, as is the norm, the annual requirement for the next year is placed in November or December of the year in session. They in turn allot the supply to the fuelwood contractors who bring the fuelwood from the designated forest areas.

To date the company has not faced any constraints in obtaining its fuelwood requirements.

8.11 ALTERNATIVE ENERGY

The only other alternative energy other than fuelwood is coal. But running purely on this type of energy is not feasible due to the following reasons:

a) The furnace is not suitable for coal. However, if need be this can be modified.

b) Price of coal is prohibitive - it costs around Rs. 3,000/- per M/Ton at Guwahati, our nearest point of procurement. This excludes other legal expenses such as taxes and transportation costs and illegal *goonda* taxes imposed in India.

c) Uncertainty of supplies - suppliers usually experience shortages for most of the year.

8.12 USING A FUEL MIX

As mentioned earlier, we have never faced any problems in the procurement of our fuelwood requirements. However, to reduce consumption of fuelwood if faced with a supply constraint, we could switch to the combined use of coal and fuelwood on a 50:50 basis. This would reduce the consumption rate by 50 percent. But switching totally to coal is not possible as this would cause the unit to run at a loss.

9. FUELWOOD USE BY BHUTAN CARBIDE AND CHEMICALS LTD.

by

Mr. Lungten Chojai, BCCL, S/Jongkha

9.1 BACKGROUND

Bhutan Carbide & Chemical Limited (BCCL) was conceived as a joint venture between the Royal Government of Bhutan (RGoB) and Tashi Commercial Corporation, keeping in mind the abundant availability of low cost hydel power, indigenous charcoal and limestone.

In 1990-91, the RGoB disinvested its shares and at present Tashi Group holds the major share and the balance is held by public and financial institutions like the Bank of Bhutan (BoB), Royal Insurance Corporation of Bhutan (RICB), Bhutan National Bank (BNB) etc.

BCCL is also involved in the mining of limestone and has two active mines, one at Hourikhola, Samtse and the other at Rongri, Gelephu. BCCL is also involved in a large-scale afforestation programme in Bhangtar, S/Jongkha, Eastern Bhutan.

BCCL requires 60,000 tons of chemical grade high quality limestone and around 15,000 tons of wood charcoal annually. The installed production capacity is 22,000 metric tons (MT) of calcium carbide per year.

9.2 REFORESTATION ACTIVITIES

9.2.1 Objectives

(i) To establish a fuelwood plantation and produce charcoal for the factory at Pasakha;
(ii) To ensure the sustainability of the factory's operations through a sustained supply of charcoal;
(iii) To minimize the dependency on imported charcoal.

9.2.2 Current status

The RGoB has leased out 1,000 ha in the form of degraded forest from Bhangtar Range of S/Jongkha Division and an agreement deed has been drawn up between RGoB and Ministry of Trade and Industries on behalf of BCCL for a 30 years period.

The project area is Malangetar in Bhangtar Range, S/Jongkha Division, located in the southeastern portion of Bakuli block under Bhangtar *Dungkhag*, about 65 km away from S/Jongkha town.

Being in the initial stage, the reforestation project can only produce up to 5 percent annually of the total charcoal requirement.

At present the BCCL obtains up to 15-20 percent of its annual charcoal requirement of 15,000 MT from other logging areas in the country. The balance is met from India and involves a heavy investment.

Efforts will be made to meet the total raw materials requirement from the project and within the country. This, however, will fully depend on the allotment of sufficient area by the Forest Services Division. At least 10,000 ha net area is required, as shown below:

Raw material requirement for BCCL factory at Pasakha

Particulars	Estimate
a. Annual requirement of firewood	100,000 MT
b. 1 ton of firewood	1.2 m^3 firewood
c. 100,000 tons of firewood	120,000 m^3 firewood
- Assuming growth rate	12 m^3 /ha/year
- Rotation period	8 years
- 1 ha plantation produces	96 m^3 firewood
d. For one year raw material requirement the plantation area required will be 120,000/96	1,250 ha
e. To meet 120,000 m^3 of firewood from plantation the area required is 1,250 x 8	10,000 ha

9.2.3 Target and achievement

The project target is 100 ha of fuelwood plantation annually but due to disturbance in the south and delay in area release, the project has raised only 690 ha of plantations during a 10 years period (1988-1997).

The Forestry Services Division has released 734 ha to date, against the allotment of 1,000 ha from Bhangtar of S/Jongkha Division.

9.2.4 Charcoal carbonization

Firewood obtained from the lops and tops of felled trees, rejected logs and poles are transported to specified depots from the areas connected with road links. Firewood from difficult areas are collected and made into charcoal at the source.

The firewood at the depot is used for manufacturing charcoal in permanent kilns.

9.2.5 Rotation

The plantation will be recycled through coppicing or replanting, whichever is suitable. Based on experience so far, the rotation period has been estimated as 8 years. The plantations established during 1988 and 1989 under BCCL have already been harvested and the average volume of outturn was 80 m^3 /ha of fuelwood. Efforts will be made to increase the outturn to 100 m^3 /ha within the same rotation period.

9.3 CONSTRAINTS AND POTENTIALS

Constraints

- Insufficient area for plantations.
- Species choice - limited choice of species due to damage by wild animals.
- Supervision - timely supervision hindered due to border problems.
- Location - project area too far from the factory.

Potentials

- Timely area allocation for raising the plantations.
- Proper species choice by trying to avoid fodder trees.
- Exploring the possibility of an area being allocated nearer to the factory.
- Adequate area for raising plantations under sustainable management system with rotation of 8 - 10 years. It has been estimated that, even if the project attempts to produce only 50 percent of the charcoal needs of the factory, about 5,000 ha land area have to be under fuelwood plantation. In case an additional area cannot be made available, the alternative is to raise not only fuelwood but also economically valuable species within the allocated 1,000 ha. By doing this, the production of charcoal can be multiplied manyfold through economic substitutions.
- Considering the need to maximize value production within the fixed rotation, we may also explore the possibilities of species spacing trials jointly with Forestry Research Centre.
- Training for skill development in charcoal carbonization and fuelwood plantation raising and management, especially for lower level staff.

10. FUELWOOD USE IN THE PUBLIC WORKS DIVISION

by

Mr. J. P. Sharma, Public Works Division

The Public Works Division under the Ministry of Communications is one of a number of government departments responsible for the construction and maintenance of roads in Bhutan. The total road network in Bhutan is 3,375.65 km. Of the total length, 2,275.15 km of road are black topped and the remaining 1,152.50 km are non - black topped. Tables 1, 2 and 3 give some details of the roads in Bhutan by type, district and category.

PWD is the major road construction agency in Bhutan and is therefore one of the major consumers of fuelwood in the country. The PWD uses fuelwood for:

- Resurfacing and sealing
- Bridge decking, centering and shuttering works
- Fuelwood for National Work Force (NWF) in the absence of other sources.

Most of the firewood is required for resurfacing and sealing works using 80/100 bitumen. PWD is aware that a huge volume of firewood is required for this work and is therefore changing the technology to minimise fuelwood consumption in order to conserve the country's valuable forest resources. PWD has stopped using the 80/100 bitumen for new road construction. It is now only used for minor pot holes and patch repair works. For road sealing and resealing works PWD has started using emulsion (cationic), which does not need any firewood, instead of 80/100 bitumen.

Even when 80/100 bitumen is used for technical reasons, improvements in the methodology - the boilers are mounted on trucks and a sprayer is used to spray the bitumen - minimise the amount of fuelwood used.

By introducing the changes described above, we have reduced the need for firewood by about 60 percent.

Table 1: Road network by type

Types of road	National Highway (km)	District Road (km)	Feeder Road (km)	Urban Road (km)	Total (km)
Black topped	1,562.44	293.00	289.71	78.00	2,223.15
Non-black topped	24.00	122.00	1,006.50	-	1,152.50
Total	1,586.44	415	1,296.21	78	3,375.65

Table 2: Table showing road network by Dzongkhag

Dzongkhag	National Highway (km)	District Road (km)	Feeder Road*(km)	Urban Road (km)	Total (km)
Thimphu	111.00	0	152.65	66.00	329.65
Chukha	213.00	0	158.67	12.00	383.67
Haa	16.00	25.60	47.67	0	89.27
Paro	103.00	36.40	88.26	0	227.66
Samtse	0	84.00	39.8	0	123.80
Tsirang	62.00	0	30.00	0	92.00
Dagana	0	87.00	13.00	0	100.00
Punakha	9.00	0	100.72	0	109.72
Wangdue	142.00	0	108.24	0	250.24
Bumthang	122.00	0	91.47	0	213.47
Sarpang	120.44	0	129.10	0	249.54
Zhemgang	144.00	0	56.40	0	200.40
Trongsa	167.00	0	16.00	0	183.00
Lhuntse	0	43.00	10.00	0	53.00
Mongar	177.00	21.00	51.70	0	249.70
Pema Gatshel	0	23.00	39.68	0	62.68
S/Jongkha	59.00	50.00	52.70	0	161.70
Trashigang	141.00	5.00	96.65	0	242.65
Gasa	0	0	1.50	0	1.50
Trashiyangtse	0	40.00	12.00	0	52.00
Total	1586.44	415.00	1296.21	78.00	3375.65

*** Feeder roads include roads under the Divisions of Forestry Services , Agriculture, Education, Power and Telecommunications.*

Table 3: Table showing road network by agency and by category

Agency	National Highway (km)	District Road (km)	Feeder Road (km)	Urban Road (km)	Total (km)
PWD	977.44	303.00	524.13	78.00	1,882.57
DANTAK	609.00	112.00	40.10	0	761.10
OTHERS * **	0	0	731.98	0	731.98
TOTAL	1,586.44	415.00	1,296.21	78.00	3,375.65

**** Others include feeder roads under various agencies like Forestry Services, Agriculture, Power, Education and Telecommunications Divisions.*

11. BHUTAN'S ENERGY POLICIES

by

Mr. Tempa Jurme and Ms Deki Yangzom, Division of Power

11.1 INTRODUCTION

A country's energy demand and supply situation, including the consumption and utilisation pattern, indicates its level of socioeconomic development. Since energy is the basic requirement for sustaining life, enhancing industrial growth and expanding commercial activities, the energy sector is recognized as the most important and highest priority sector for the socio-economic development of the Kingdom. The natural forest cover of 72 percent will continue to provide the basic energy requirement for the people of Bhutan, as well as sustain the country's biodiversity and the catchment basins which supply the perennial flow of water in the country's rivers and streams. The high mountain terrain and the swift flow of water from the densely covered forest catchment areas with varying drops of head ranging from 100m to 7000m will provide abundant opportunities for hydropower development. Thus, hydroelectricity, which is renewable and sustainable, will play a vital role in meeting the energy demands of industry, agriculture, commerce, institutions and households, as well as for export to neighboring countries. However, firewood will continue to meet the basic energy demand of rural people for whom alternative energy is impossible for techno-economic reasons.

11.2 BHUTAN : A STATISTICAL DIGEST

Area		:	46,500 km sq
Population		:	600,000 (1995)
Population density		:	12.9 per km sq
Urban population		:	15 percent
Population growth rate		:	3.1 percent (1995)
Life expectancy	Male	:	65.9 (1995)
	Female	:	66.1 (1995)
Health coverage		:	90 percent (1990)
Universal child immunization		:	84 percent (1990)
Literacy rate		:	54 percent
GDP per capita		:	US$ 470 (1995)
Economic growth rate		:	7.5 (1995)
Inflation rate		:	8.2 percent (1995)
Forest coverage		:	72 percent
Agriculture		:	8.8 percent
Non-forest		:	19.2 percent
Per capita fire wood consumption		:	3.0 m^3
Length of roads		:	3,216.97 km (1995)
Number of post offices		:	103 (1995)
Rural water supply schemes		:	1,753 (1995)
Major rivers		:	Amochu,Wangchu, Punatsangchu and Manas

11.3 ENERGY SOURCES

Despite its low level of economic development, Bhutan's per capita energy consumption is relatively high reflecting in part the fact that its immense forest resources provide an abundant and readily available source of energy. Per capita energy consumption amounts to about 0.8 ton of oil equivalent, which is about twice as high as Nepal's.

Firewood accounts for about 77 percent of total energy consumption and virtually all non-commercial energy consumption. As a percentage of the total consumption of firewood, the household sector uses 95 percent, government and commercial establishments 3 percent, the agriculture sector 0.9 percent and industry uses only 0.7 percent. Annual consumption of firewood for a typical household was estimated at 14m^3. Of this quantity, 7 to 9 m^3 is used in cooking and the rest for space heating.

11.3.1 Hydroelectricity

The electrification process started in 1966 with installation of a 256 kW diesel generator in Phuentsoling. Bhutan's first hydropower plant was commissioned in 1967 in Thimphu with an installed capacity of 360 kW. With the commissioning of Chukha Hydropower Project of 336MW capacity in 1986-88, Bhutan became a net exporter of electricity. The Power System Master Plan (1990-93) study identified and listed an inventory of 91 potential sites. The list is not exhaustive, for only the easily accessible and most promising sites were targeted. It is theoretically estimated that Bhutan has about 30,000 MW capacity of hydropower potential. The latest update (1996) on hydropower potential from the ongoing feasibility and pre-feasibility studies shows a techno-economical feasible potential of over 16,000MW. Presently, only three sites are being developed: Kurichu, Basochu and Tala totaling 1,125 MW. The development of the hydroelectric energy sector over the years has accelerated the growth of GNP, and accounts for 25 percent of the national revenue earning in the Seventh Five-Year Plan period (1992-1997). The consumption of power (electricity) has jumped from practically nil at the beginning of the Fifth Five-Year Plan period to 216 GWh in 1991 to 366.363 GWh in 1997.

Power Sector: A Statistical Digest

Total installed capacity	:	344.35 MW
Total energy generation (1997)	:	1,838 GWh
Total energy export (1997)	:	1,564.035 GWh
Total number of hydroplants	:	23 (20 kW-336 MW)
Total number of registered consumers (1997)	:	30,321
Number of towns electrified (1997)	:	39
Number of villages electrified (1997)	:	363
Energy consumption (1997)	:	366.363GWh

11.3.2 Solar energy

In keeping with the policy of equal distribution of development benefits, a solar power programme was launched to give electric lighting to institutions in the remote areas. Up to the end of the 7FYP, 1,157 photovoltaic panels were distributed and installed throughout the country to schools, monasteries, BHUs, and to remote animal husbandry farms and villages. With good sunshine hours available in the country, this new and renewable energy proved to be viable and cost-effective compared to establishing a grid transmission network for remote and isolated places.

11.3.3 Fuelwood

Fuelwood still continues to be a dominant source of energy for lighting and cooking in the rural and remote areas. The estimated per capita consumption of fuelwood is 3.0 cubic metres, one of the highest in the world. In order to reduce the consumption of fuelwood, the Division has continuously carried out extensive rural electrification programmes in the successive Five-Year Plans and shall continue to do so in the future Five-Year Plans. A quite substantial percentage of fuelwood is consumed for lighting. Therefore, an extensive rural electrification programme would alleviate the pressure on fuelwood collection. Other forms of biomass like sawdust are also used for cooking and heating but on a very small scale.

11.3.4 Fossil fuel

As the country reaped the fruits of the past five year development plans, communications, especially surface transport, also expanded rapidly during the 7FYP. This trend has increased the consumption of fossil fuel energy at an accelerated rate thereby increasing the import of petrol, diesel, kerosene and LPG. Table 1 shows the volume of petroleum products imported during 1991-95.

Table 1: Petroleum products imported (1991-1995)

Fuel imports	1991	1992	1993	1994	1995
LPG	-	720 tons	1,800 tons	1,741 tons	1,675 tons
Kerosene	6,253 kL	7,122 kL	8,078 kL	6,691 kL	7,961 kL
Diesel	16,173 kL	16,778 kL	16,461 kL	17,647 kL	20,035 kL
Petrol	3,574 kL	3,506 kL	3,469 kL	3,530 kL	3,690 kL

11.4. ENERGY POLICY TARGETS

To achieve economic self reliance by exporting hydroelectric energy and earning revenue

The Royal Government of Bhutan intends to harness the vast renewable hydropower potential endowed by nature to generate electric energy to supply and meet the increasing demand for energy in the country as well as to export it to the neighboring region. Major portions of the hydropower production from mega projects are planned for sale to neighboring countries for earning revenue which will be used to further the socio-economic development of the country as well as to expand the sector in general in a sustainable and environment-friendly manner.

To provide hydroelectricity to all the people as far as possible at an affordable price

As electricity has now become one of the basic necessities in our daily life, it is the national policy to provide hydroelectricity to all the people as far as possible in a safe and reliable manner, and at an affordable price.

To reduce pressure on fuelwood supply from the forest

Since the majority of the population live in rural areas consuming large quantities of fuelwood for cooking and lighting purposes, it has been a consistent policy of the Royal Government to extend electricity to the rural areas through the national transmission grid or local generation units like mini hydel plants. The rural electrification program aims to electrify rural houses and reduce the pressure on the forests for fuelwood supply. Preservation of

the forests is an equally important issue for sustaining the development of the hydropower industry, which will be the backbone of the national economy.

To enhance productivity and employment opportunities

The availability of electricity will bring many associated benefits: school children will be able to study longer hours in the evening, housewives and farmers will be able to do some extra productive work at home such as weaving and other handicrafts etc. Also, the supply of electricity will stimulate the establishment of many industrial developments like cottage industries, flour and rice mills, agro-based and heavy industries in all parts of the country. Thus, it will also create a good source of employment and income generation for the people and the fruit of development programmes like rural electrification will lead to the equitable distribution of development benefits.

To minimize the import of fossil fuel for the transport sector

There is no potential to produce hydrocarbon fuel in the country. All petroleum has to be imported. This drains foreign currency and adds to the imbalance in the balance of payments. Therefore, it is the desired policy of the government to import only for the transport sector and replace its use for other sectors like power generation and industry. Even in the urban transport sector, a pilot electric bus will be introduced. If successful, such public transport will reduce the consumption of imported fossil fuel and vehicle congestion in the urban areas.

11.5 ENERGY POLICY STRATEGIES

Hydropower development

Bhutan will continue to invest in mega hydropower projects to meet its energy demand as well as for export to earn revenue, which will be used for socio-economic development activities on a sustainable basis. This policy seems to be the best choice as hydropower resources are abundant, renewable and sustainable.

Rural electrification by grid extension and mini hydel development

To alleviate the problems of fuelwood shortages, to save the forest from depletion, and in the interests of the environment, rural electrification programmes, either in terms of grid extension or the isolated development of small hydropower plants, will be carried out to provide an alternative source of energy for lighting, cooking and heating to all the people as far as possible in a safe and reliable manner.

Solar energy programmes

In remote areas where grid extension or mini hydel development is techno-economically not feasible, alternatives such as solar energy will be harnessed to meet basic requirements such as for institutional lighting, especially for boarding schools, basic health units, monastic schools).

Fossil fuel reduction

As burning fossil fuel has harmful effects on the environment (greenhouse gas pollution) and as supplies are very much dependent on an imported supply, alternatives such as hydroelectricity and improving the efficiency of technology (appliances and vehicles), which can reduce fossil fuel consumption, have become necessary. Therefore, it is planned to carry out massive urban and rural electrification schemes to provide electricity to the

maximum number of consumers as well as find other alternative technologies such as cableways and electric buses/cars for the transport sector so that the import of fossil fuel can be minimised.

11.6 EIGHTH FIVE YEAR PLAN ACTIVITIES

Generation Programme

a) Investment Scheme Project - This involves constructing mega hydroelectric projects for revenue earning. Generation projects such as Kurichu-45 MW, Tala-1,020 MW and Basochu-60.8 MW hydroelectricity projects are classified under this scheme.

b) Development Scheme Project - This is generally a small hydropower project primarily meant to provide electricity for lighting, cooking or heating for domestic households in rural and urban areas. Kilungchu-200kW, Dongdichu-4MW both fall under this scheme.

Transmission Programme

This programme involves the development of the transmission grid for long distance transfer of electric power to various district load centres as well as the export of power using high voltage line from power stations viz. Kurichu, Basochu, Chukha and Tala to various areas.

Distribution Programme

This programme aims to distribute the power received from the transmission grid to various load centres. Sometimes power is supplied by isolated micro/mini/small hydels to these load centres. 5,000 rural consumers and 1,500 urban consumers are targeted in the 8FYP.

Hydropower Feasibility Studies

Besides the construction of three mega hydro projects, feasibility studies on the following major hydropower projects will be undertaken during the 8FYP: Mangdechu Hydropower Project-265 MW near Kunga Rabten, Trongsa (Feasibility work started under a grant from the Norwegian government); Wangdephodrang Hydropower projects stage-I-760 MW across Punatsangchu below Jala/Ula village (*Status - Not yet started);* Wangdiphodrang Hydropower projects stage-II-650 MW below Daga Uma village (*Status - Not yet started).*

Solar Energy Projects

This programme involves the electrification of remote and isolated areas where the extension of the electricity grid or the construction of micro hydel is uneconomical and not feasible. About 1,000 beneficiaries are targeted under this programme.

Energy Demand

A power market demand forecast was prepared for the DoP as part of the Bhutan Power System Master Plan Study, carried out in 1993. The demand forecast for domestic use covers districts that are currently supplied by the DoP and new districts which are assumed to be supplied during the forecast period. The forecast specified three categories: (a) households; industry and commerce; (b) government institutions; and (c) others. The district forecasts were added up to form a national forecast.

Table 2: Electricity figures (1990-2010)

Year	Total Sales -GWh	Total Requirement-GWh	System Peak Load -MW
1990	145	163	26
1995	354	436	77
2000	506	630	111
2005	574	714	126
2010	687	851	150

Total sales in the DoP system are forecasted to stand at 687 GWh in 2010, up from 145 GWh in 1990, i.e. an average annual increase of 8.1percent over the forecast period. The growth in sales is considerably lower in the latter part of the period than during the first years.

Although loss factors are assumed to gradually decrease in many districts, the total electricity requirement will increase by a slightly higher percentage than sales, due to a decrease in the industrial share of total sales. It is forecasted that the total requirement will increase from 163 GWh in 1990 to 851 GWh in 2010. The system peak load is forecasted to reach 150 MW in 2010.

Household sales are projected to increase by 11.9 percent over the forecast period, while industrial sales, and commerce and government institution sales are assumed to increase by 7.1 percent and 8.2 percent, respectively. This will result in an average annual growth rate in total sales of 8.1 percent during the period 1990-2010. Industry's share of total sales will decrease from 78 percent in 1990 to 65 percent in 2010, while the household sector's share will go up from 13 percent in 1990 to 21 percent in 2010. The share of commerce and government institutions will remain more or less unchanged at 10 percent.

11.7 ISSUES TO ADDRESS

- Intensive rural electrification.
- Improvement of a smokeless furnace with heat storage capacity for space heating and energy efficient ovens.
- Promotion of electricity for cooking.
- Improvement of insulation in buildings.
- Introduction of solar hot water system. Preheated water from solar energy may be used for cooking, drinking, washing, bathing etc., thus a substantial amount of fuelwood could be saved.
- Introduction of proper fuelwood outlet at the load centre.
- Adoption of cultivation of village wood lots and social forestry.
- Adoption of stronger institutional and intersectorial linkages on energy usage e.g. a committee on wood energy.

12. ALTERNATIVES TO FIREWOOD

by

Dr. Sangay Wangchuk, Head, Nature Conservation Section

12.1 INTRODUCTION

Traditionally firewood has been the major source of energy for cooking and heating in all parts of the world. Over the years many countries have switched over to other forms of energy such as liquefied petroleum gas, electricity, coal, etc. This trend was particularly prominent in the early 1970s when wood-burning cook stoves were replaced by gas or fuel oil. The pattern of shift from wood to other sources of energy, especially for cooking, has been influenced by new technology available for harnessing energy that is cheap and convenient. The Western world has gone through this process and most of the developing countries are moving in this direction.

An effort has been made in this paper to analyse the present trend of fuelwood use in Bhutan, explore some of the alternatives available, and discuss what ones may be feasible in the Bhutanese context. Some of the analysis is based on field research carried out on fuelwood use patterns and the emerging new trends in three regions of the country. The paper also endeavors to reflect some of the intricacies associated with resistance to accepting alternatives to fuelwood in the state-run institutions. Some suggestions that could have implications for future forest policy on fuelwood management are made.

12.2 PRESENT TREND IN THE USE OF FUELWOOD

More than 75 percent of the Bhutanese people depend on wood as a source of energy for cooking and heating (Ministry of Planning, 1996). A study carried out by FAO shows that Bhutan has one of the highest per capita firewood consumption figures (1.2 tons) in the world. While the use of firewood as a primary source of energy for cooking will change in the urban areas, it is most likely that firewood will continue to be used for many years to come in the rural areas. Limited studies carried out in the country have shown this trend. For instance, the demand in the urban areas for firewood will be influenced by the supply-demand equation. Most of the apartment owners either do not provide facilities for the use of firewood for cooking or heating or discourage the use of wood inside the rooms. On the other hand, in the rural areas there is no indication of a change in the source of fuel for cooking and wood still predominates. Electric or thermal power is not an acceptable substitute for cooking or heating both for social and technical reasons.

In-depth analysis is constrained by the lack of adequate and reliable data. However, an attempt has been made to analyse the trend in the use of firewood as a source of energy for cooking and heating in Bhutan. As there is a distinct pattern in the use and access to firewood resources, the discussion has been split into the rural and urban spheres. The discussion on the rural firewood use trend is based on research carried out by the author in three regions of the country.

Some of the research results from the three regions in the country show that in Radhi (Trashigang) 95 percent of the households still use firewood for cooking and 5 percent of the households have started using LPG and kerosene. Shaba *gewog* (Paro) seems to have already moved towards replacing firewood by LPG, kerosene and sawdust. While 40 percent of the households possess LPG gas stoves, 20 percent use saw dust for cooking. Only 40 percent depend entirely on firewood as a source of energy for cooking. However, in Chumey *gewog* (Bumthang) 100 percent of the households use firewood both for cooking and heating.

The research results should be taken only as indicative figures that convey the trend in the use of firewood. This seems to also reflect the transitional state of the socio-economic process as the ability to shift from firewood to other sources such as LPG is perceived as an upward movement in social status in the rural areas. The cost involved in installing an LPG stove is very high relative to the national per capita income. For instance, a household pays approximately Nu. 5,000 for an LPG stove, in addition to a deposit for the cylinder.

The existing gas stoves do not fulfil all the cooking requirements of the households in the rural areas. For instance, during the agricultural season or festivals, the energy from the gas stoves is not adequate for cooking for a large number of people nor are these stoves a suitable source of heating during the winter months. Therefore, the households have to fall back on using firewood at these times. However, almost all the households interviewed aspire to shift from firewood to other sources such as LPG and electric stoves. The reasons range from convenience of the LPG stoves to scarcity of firewood.

In the urban areas a distinct trend in the use of firewood and the shift to alternative sources of energy can be observed. For practical purposes, the discussion is based on two levels of firewood users – the institutes and armed forces, and urban residents. This approach separates the supply of firewood to government institutes and to private individuals.

Major institutes that continue to use firewood for cooking are the armed forces (Royal Bodyguards, Royal Bhutan Army and Royal Bhutan Police), schools and hospitals. Although consumption figures (Table 1) are not alarmingly high, the nature of preferred species, and the location of extraction sites make it a source of concern as far as sustainability of the forest stands is concerned. Field survey shows that firewood collection sites are limited to a few accessible areas in Chamgang, Gidakhom and Changaphu. These are areas where the felling cycle has been reduced to 4 from 30 years due to pressure from the consumers. What exacerbates the already precarious situation is that consumers accept only hard wood which generally comprises oak species. The slow growing nature of oak species and high water retention capability further aggravates the state of the environment within the vicinity of the firewood harvesting areas.

It is difficult to assume that these institutes will shift to other sources of energy such as electricity in the near future. Some of the institutes interviewed argue that the supply of electricity is not reliable enough to meet the need to serve food at specific times of the day. It is contended that relying on electricity for cooking is too risky. The use of LPG in institutes is not feasible at present due to the small size of cylinders which do not contain enough LPG to cook for a large number of people.

Another aspect which has a direct implication for the sustainable supply of firewood is the kitchen management system now in practice. Kitchen management involves three clear job responsibilities: annual budgeting and acquiring the funds for firewood; supplying the firewood; and using the firewood to cook the food. While these responsibilities are carried out effectively, one important aspect of kitchen management is missing – ensuring the efficient use of the firewood. Once the annual budget for the firewood requirement has been approved, the supplier is concerned only about the level of supply and the cooks are concerned only about getting the food cooked on time and do not give any thought to using the firewood efficiently and saving as much firewood as possible. Of course, in a private kitchen the picture painted here would be slightly different.

Lack of information on the state of hardwood forests in and around Thimphu *dzongkhag* has led to a disagreement between the suppliers (Forestry Services Division) and the consumers over how much is available and what can be supplied at a sustainable level. This is largely due to the fact that the FSD has no way of making their concerns known to the consumers. Occasional pleas are, however, made by the FSD in the Kuensel (the national newspaper) for the consumers to accept soft wood that is available in a large quantity.

Table 1: Firewood consumption (1992 – 1995) for Thimphu City and nearby villages (in cubic meters)

Consumers	**92-93**	**93-94**	**94-95**	**Total**
Government	-	560	910	1,470
RBG	1,421	861	1,337	3,619
RBA	3,444	3,024	994*	7,462
RBP	2,555	2,457	-	5,012
GREF/IMTRAT	1,708	2,520	273	4,501
Villagers	7,826	7,154	1,092	16,072
Urban	9,387	6,419	11,683	27,489
Total	26,341	22,995	16,289	65,625

Source: Progress Report of Divisional Forest Officer, Thimphu. FSD, 1995

*** Figure of RBA in 1994-95 not for complete year***

In urban areas market forces, access differentials and preferences of the landlords are shaping the trend of firewood use and the shift to other sources of energy. One truckload (8 cu m) of hard wood costs more than Nu 3000 by the time it is ready for use in the kitchen or *bukhari*. On average a household uses one truckload of hard wood for heating and three for cooking. For an average income family, this is quite expensive. Such a situation forces people to look for alternative sources. There is a general tendency to opt for electric stoves and heaters.

Hard wood is definitely in short supply in and around Thimphu which means that not every consumer can have direct access to it. It therefore demands a high capability to organise even one truckload of firewood. This process filters out many of the potential consumers thereby reducing the pressure on the forest officials. Furthermore, some of the rules are also directed at reducing consumption of forest products, including firewood.

One of the most effective agencies in directing the shift in the use of firewood to other sources of energy are the landlords in the urban areas. Most of the landlords either do not allow the tenants to use firewood for cooking or discourage them from using it in open

kitchen systems for fear that it will blacken the walls and other parts of the house. Some do not even allow the use of a *bukhari* which is fairly clean as the smoke can be directed safely outside. Since alternatives are available the transition appears smooth.

Table 2: Source of fuel for cooking

Gewog	Firewood (percent)	Kerosene/LPG (percent)	Other sources (percent)	Remarks
Radhi	95	5	None	
Shaba	40	40	20 (Saw dust)	Saw dust, locally called *buss*, is used for cooking
Chumey	100	-	None	Few houses use improved stoves

Source: Wangchuk, S. 1997

Table 3: Projection of fuelwood consumption in relation to population increase

Year/Commencement of 5 year Plan	VIII Plan 1997 –2002	IX Plan 2003 – 2007	X Plan 2008 - 2012	XI Plan 2013 –2017
Estimated Population in '000	620/2.92%**	742/2.3%**	808/1.8%**	881/1.42%**
Fuelwood Consumption in '000 cu m				
Domestic (Base Case)	1,351.1	1,513.8	1,696.1	1,900.3
Other Sectors	223.8	229.8	237.1	245.9
Total	1,574.9	1,743.6	1,933.2	2,146.2

Source: Adapted from Forestry Master Plan, 1991.(** = estimated growth rate)

Wood based industries also use large quantities of wood as firewood besides timber. For instance, Bhutan Carbide and Chemicals Limited uses charcoal as one of the main sources of energy for the production process. Some successful captive plantations have been carried out by the BCCL for making charcoal. However, the production from Bhutan is not adequate and the company has to import from India and also supplements this with high quality coal from Vietnam. Bhutan Board Products Limited also uses wood that could be potential firewood. As is the case with many of the wood based industries, the raw material available at present is far short of what is required to operate at full capacity. It is most likely that the industrial demand for firewood will increase even if no new industries are established.

12.3 TARGET GROUPS

Efforts at providing alternatives to firewood for cooking and heating should be directed at all levels of society – ranging from government institutions to individuals. However, for practical purposes, government-run institutes should be accorded priority as there seems to be some hope of success if proper measures are put in place. In urban areas the transitional socio-

economic process is doing the job of shifting consumers from firewood to other energy sources. In rural areas the use of wood as a source of energy for cooking will not change and there is not much that can be done to alter this. This is also reflected in the mode of firewood collection in the rural areas, especially in Radhi and Chumey *gewogs* (Table 4). However, what can be done is to reduce the consumption of firewood through extension activities and the supply of improved cook stoves. Therefore, any effort to encourage alternative use of wood for cooking and heating should be aimed at urban residents and large government establishments.

Table 4: Mode of collection of firewood

Gewog	Firewood (Self collection) – percent	Firewood (Contractual services) – percent	Remarks
Radhi	85	15	
Shaba	20	60	20 % from other sources
Chumey	70	30	

Source: Wangchuk, S. 1997

12.4 AVAILABLE ALTERNATIVES

Bhutan is one of the highest per capita producers of electric power in the world. There are at present 23 hydroelectric generating stations with 364 MW (megawatt) installed capacity plus 13 MW Diesel Generator sets (Ministry of Planning, 1996). 154 villages had been electrified by the end of the 7FYP. This programme will continue to receive priority during the 8FYP. Theoretically, Bhutan can produce sufficient electricity to a supply the whole country for lighting, cooking and heating. The Power Master Plan projected a substantial surplus of hydroelectric power once all potential rivers are tapped. It also contains lays the plan for the establishment of the National Power Grid which will cover all major parts of the country.

In the past one of the major constraints on using hydroelectric power for cooking was the frequent breakdowns at the generating source or transmission line. Over the years there has been great improvements and a continuous supply of power is now the norm, especially in the urban areas.

There is a steady increase in the use of Liquefied Petroleum Gas (LPG) and kerosene for cooking in the urban areas. Bhutan consumes 1,700 tonnes of LPG and 20,000 kl of kerosene every year. The government has increased the number of suppliers of LPG from one to three. It is estimated that many subscribers are on the waiting list for an LPG connection. With the increase in population, the demand for LPG connections will increase, especially in the urban areas such as Thimphu, Phuntsholing and Samdrup Jongkhar.

Saw dust is also increasingly used as a substitute for solid wood for cooking. However, this is limited to semi-urban areas. Briquettes made of waste wood have been tried in some areas. The primary source of raw material for the briquettes is sawmills. Recently the Ministry of Trade and Industries established a stove manufacturing unit in Thimphu that produces stoves that can use saw dust for cooking. Most of the urban areas have saw mills and if the new stoves take off, they may help to reduce firewood use in urban areas.

Biogas is being tried in the warmer parts of the country for cooking. The raw material for the generation of biogas is cow dung. Some of the international aid agencies have supported this programme. The inherent problem with this system of energy generation is that it has climatic constraints. Dung which is the main raw material will ferment only at a warm temperature. Moreover, this is a completely new concept in Bhutan.

12.5 SOME POLICY IMPLICATIONS

The efforts of the Forestry Services Division will continue to be directed at reducing firewood consumption and exploring alternatives to firewood for cooking and heating. It is expected that these efforts will eventually lead to the sustainable harvesting of forest resources. However, while it is important to explore alternative sources of energy for cooking and heating, one should not lose sight of the social, economic and technical feasibility of harnessing these alternative sources. Furthermore, the willingness of the target groups to change will constitute an important factor in the success of shifting from firewood to other sources of energy. The shift has to be either market driven or enhanced by the socio-economic trend prevalent at specific points in time and it can not be thrust upon the people.

The search for new alternatives and efforts to reduce the consumption of firewood will need to be matched by opening up presently inoperable areas. This will entail investment but in the long run will benefit the country as a whole since the presently over-harvested areas can be rehabilitated.

Large-scale fuelwood plantations could be established in and around the rural communities. This is not an alternative to fuelwood in the true sense but one way of reducing pressure on the existing forests from where firewood is traditionally harvested. People all over the developing countries have now accepted firewood simply as one of the major expenses of living.

The present system of supplying firewood to wood based industries has to be rationalised in the light of the fact that these industries are here to stay and have to be functional. To avoid conflict between the rural firewood requirements and wood based industries, a clear-cut strategy needs to be put in place. One option could be that the wood based industries meet their firewood requirement from captive plantations rather than compete with the rural people at free collection sites.

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13. FUELWOOD ENERGY: RESEARCH AND DEVELOPMENT NEEDS IN BHUTAN

by

Mr. Phuntsho Namgyel, RNR-RC, Yusipang

13.1 INTRODUCTION

Some 400,000 years ago our ancestors discovered and used fire to keep themselves warm and to roast meat. It also provided them with protection from wild animals. This was a revolution in human development. Fire, generated from burning wood, remains a reliable source of energy for cooking and heating and is preferred by a great majority of the present 5 billion plus world population. Fire from burning wood is a time tested technology and it will undoubtedly be used for many thousands of years into the future.

However, the long and continued use of wood as a source of energy for cooking and heating by an exploding world population, and for many industrial processes, had by the 1970s and the 1980s caused alarm in the public mind about its negative impact on the environment. Fuelwood collection was held responsible for the high rate of deforestation (disappearance of forest cover) which was taking place all over the world. It was also believed that the fuelwood stock had declined to such a low level that an “energy crisis” was just around the corner, and that this would be catastrophic for the world’s poor people.

While a fuelwood scarcity in a large part of the world is real and causes considerable physical and emotional distress to millions of poor people in terms of increasing collection distances and times, undercooked food and rising fuelwood costs, it is now understood that fuelwood collection is not the sole agent of deforestation. The voiceless and powerless have been the scapegoat for the powerful and rich. Large scale deforestation is mainly caused by commercial logging, clearance for large scale ranching, in-migration following road construction, urbanization and other development projects.

Bhutan, with 2.3 million ha of forest and just 600,000 people, is in a very favourable situation compared to other countries, and fuelwood offers tremendous potential for the well being of the people. The country's forests yield an annual allowable cut of over 7-8 million tons of wood.

Bhutan's is in fact immersed in a sea of fuelwood. Bhutan’s concern for and interest in fuelwood should not be for crisis management but to understand the conditions that determine fuelwood potential, use, and flow, and to formulate appropriate wood energy policies and strategies and programmes for sustainable use and affordable access to this renewable source of energy.

13.2 THE GREAT PARADOX

Despite the positive fuelwood situation and the great potential of fuelwood as a renewable energy source in Bhutan, fuelwood use, supply and distribution remain a matter of great concern to Bhutanese resource planners, managers and citizens. There are still some strongly held concepts prevailing in Bhutan which convey a somewhat negative picture of wood as a source of energy. They include:

- Fuelwood use and collection result in the degradation of forests, therefore should be discouraged and alternative fuels should be promoted
- The fuelwood consumption level is very high, therefore it should be controlled.
- Fuelwood is not a clean energy source; smoky rooms cause respiratory illnesses.
- Bhutan has a large hydropower reserve and electricity is cheap, therefore efforts should be made to substitute fuelwood with electricity.
- Fuelwood should be phased out; other alternative sources of energy should replace it.
- Fuelwood is a traditional commodity only, therefore it has no place in urban and industrial societies.
- Fuelwood collection involves a great deal of inconvenience to get the fuelwood through state controls and to overcome bureaucratic and physical limitations.

The great paradox for Bhutan is that there is a plentiful supply of fuelwood, yet planners, managers and citizens are unable to respond adequately to the tremendous opportunity offered by renewable wood fuel as an important source of domestic energy. This is due to the inadequate understanding of the complexity of fuelwood production, use, and distribution, and the interplay of a host of policy, social and economic factors.

13.3 FUELWOOD ENERGY: THE POSSIBLE RESEARCH AND DEVELOPMENT AREAS

Biomass energy, mainly fuelwood, accounts for about 88 percent of the total energy consumed in the country. Conventional energy sources (coal, oil, gas and electricity) account for the remaining 12 percent. Fuelwood energy, therefore, deserves much better treatment and respect. The possible fuelwood research and development areas could include:

13.3.1 Database development

Prior to demonstrating the importance of fuelwood and its role in the overall national energy budget, an adequate and reliable data base system should be developed. Such an information system will enhance understanding and make apparently complex problems into simple problems. It could also lead to more informed policy formulation and more appropriate programmes.

13.3.2 Biomass inventory

Frankly, to a forest planner and manager, fuelwood is secondary to timber. Accordingly, forest measurement is designed for accounting timber volume which is generally the stem volume above a certain minimum height and diameter. In the case of hardwood, branch wood constitutes upto 40 percent of the total tree biomass and thus the conventional inventory greatly underestimates the true total wood available in the forest. A biomass inventory needs to be incorporated into the conventional inventory.

13.3.3 Alternative fuels

The alternative fuels such as electricity, kerosene, liquefied petroleum gas etc. can never substitute fuelwood. To 86 percent of the people living in the rural areas, fuelwood is a “free”, reliable, convenient and renewable source of energy for cooking and heating.

Kerosene and LPG are imported goods, and the supply is at times unpredictable and unreliable. We are said to be very rich in hydro electricity but there are many physical limitations which place it beyond the reach of the rural people. The scattered settlement patterns found in Bhutanese villages, the high costs of constructing distribution lines, the absence of load centres, and losses incurred en route are some of the most serious constraints. Micro hydropower technology has also high establishment costs for Bhutan and it will be difficult to continue with the technology unless grant aid is received. Moreover, the electricity from micro hydro is limited to lighting applications in most cases and cannot meet the demand for cooking and heating.

13.3.4 Housing insulation

Except for settlements along the Indian border, Bhutanese houses need to be heated in winter. It is estimated that a considerable percentage of total fuelwood is used for space heating.

A recording of both inside and outside room temperatures of a concrete building in Thimphu showed a mean temperature difference of just 4 degrees Celsius. Improvements in housing insulation could save fuelwood.

13.3.5 Improved cooking stoves

On average, a typical village home has a fire burning for 10 hours each day. There has been an improved cooking stove programme since 1985, with the objectives of preventing respiratory diseases, and saving cooking time and fuelwood consumption. However, an evaluation carried out at the end of phase one showed that only 34 percent of the improved stoves distributed in the villages were working, 35 percent were malfunctioning while 31 percent had either been converted to the traditional type by adding the three lumps around the pot seats or had been abandoned for various reasons. There is plenty of scope for further improvement in stove design.

13.3.6 Wood properties

It is important to understand wood properties. The Table below shows their significance.

Condition of Wood	Calorific Value (kJ/kg)
1. Freshly Cut Wood	8,200
2. Air Dried Wood	15,500
3. Oven Dried Wood	18,800

One important application of this knowledge is to supply wood well in advance, and to air dry it.

13.3.7 Lesser known species

Bhutan is a biodiversity rich country with hundreds of tree species. Yet, the country depends on a few selected species to meet our fuelwood requirement, thus exerting tremendous pressure on them. The selection base needs to be expanded and many lesser known species should be utilized.

13.3.8 Fast growing species

Through species selection and improvement programmes, fast growing species like willow can offer a tremendous opportunity to meet the increasing demand for fuelwood.

14. SOCIO-CULTURAL ASPECTS OF FIREWOOD CONSUMPTION IN BHUTAN

by

Durga Devi Sharma, DFO, NCS

14.1 INTRODUCTION

Local communities in rural areas are largely dependent on firewood for all or most of their energy needs. The major source of energy in Bhutan is biomass in the form of wood, which is used by a majority of the rural and semi-urban population. In urban areas, electricity, cooking gas, kerosene, and fuelwood are also used.

Coal, fuel oil and electricity are the dominant sources of energy for the industrial sector. Bhutan's energy reserves include coal deposits in the southeastern part of the country, a considerable hydropower potential and biomass in the form of fuelwood. It has been estimated that approximately 98 percent (Master Plan for Forestry Development in Bhutan: Wood Energy Sectoral Analysis, 1991) of the domestic energy consumption is derived from biomass, mainly fuelwood, and to a limited extent residues, such as straw, stalks, and dung. The industrial and agricultural sectors, together with the government sector (e.g. armed forces, monasteries, road construction) use considerable amounts of firewood.

Most of the fuelwood use in Bhutan originates from government owned forests, with a very small amount from private lands. In the rural areas almost all the fuelwood used is collected by the villagers themselves. In the non-domestic sector fuelwood is obtained through the Forestry Services Division. Fuelwood used for construction is most often cut along the roadsides.

In southern Bhutan no dyeing of yarn and almost no preparation of alcoholic drinks take place. The number of domestic animals is on average less than five per household. Cooking times are comparatively shorter than in the north and central parts of the country. In the eastern part of Bhutan, the preparation of alcoholic drinks is common and 30 percent of the grain is used for this (MoA,1991). The average number of domestic animals is about ten per household. Weaving is common but only a little yarn dyeing takes place, as dyed yarn is brought from the distribution centres in Khaling and other places. The northern, central and western parts of the country are similar in these respects. Cooking takes about six to eight hours per day, but it is the custom to have a pot of hot water ready at all times. In the central part of the country, space heating is needed, depending on location, climate and altitude. In the northern parts, heating is required for more than six months of the year; in the central part for three-four months, while in the south no heating is necessary. Most often only one room, usually the kitchen, is heated by using the heat from the stove,

The present low consumption of alternative energy sources is largely due to their limited availability, but also because of a lack of cash income in rural areas where barter trade is still common. For instance, cooking gas is still not readily available in most towns, while fuelwood is cheaper and available almost everywhere. For these reasons, it is not likely that commercial energy sources will replace fuelwood to any large extent. But a shift may take

place, as indicated by the fall in the consumption of kerosene and the rise in electricity use (for lighting) whenever electricity becomes available, and survey results indicate that in quite a significant number of villages people have to walk further each year to collect fuelwood - a clear indication that fuelwood is becoming scarce. Fuelwood consumption in the future may be affected by the fact that once fuelwood becomes scarce, people will start to economise in an effort to save it.

Surveys carried out in Black Mountain National Park show the following results:

District	*Gewog*	No. of Respondents	Consumption per household : Manloads of fuelwood per day	Time spent on fuelwood collection per day (hrs)	% of fuelwood collected from the forest
Wangdue Phodrang	Athang	112	1.12	0.58	98
	Phobji	8	1		98
	Gangtey	13	1.04		99
Trongsa	Tangsibi	145	1.3	1.91	81
	Lanthel	43	1.19	1.07	82
	Korphu	130	1.33	1.43	75
	Trong	3	0.83		70
Total		454	1.24	1.5	84

District	*Gewog*	respondents stating that it is harder now to collect fuelwood than in the past (%)	respondents stating that it is not harder now to collect fuelwood than in the past. (%)	respondents by reason for the increased difficulty (%).		
				Control by Forestry Staff	Population Increase	Longer Distance
Wangdue Phodrang	Athang	83	17	77	20	3
	Phobji	88	12	58	17	25
	Gangtey	90	10	79	14	7
Trongsa	Tnagsibi	65	35	73	24	3
	Langthel	59	41	33	67	0
	Korphu	78	22	68	27	5
	Trong	67	33	100	0	0
	Zhemgang	74	26	70	26	5

14.2 FUELWOOD CONSUMPTION IN OTHER SECTORS

The non-domestic sector, e.g. industry, agriculture, forestry, commerce and government, have a 23 percent share of the total energy consumption. Agriculture, forest industries and related activities (including plywood and particle board factories) account for a major share. Boarding schools, especially secondary schools, monasteries, RSP, RBA, IMTRAT also use a lot of fuelwood. On the basis of the number of students in the school, a rough estimate was made of the amount of fuel used by assuming that 1.2 kg of fuelwood per person per day is used. Fuelwood requirements of the armed forces (RBP, RBA, IMTRAT) are difficult

to estimate as there is no accurate information on the size of the forces or on where they are stationed. Monasteries also require a lot of fuelwood. Religious ceremonies like funerals require about 500 kg each time.

14.3 ENERGY USE PATTERNS IN BHUTAN

Fire in the form of fuelwood is the most important need of a farmer from the forest. This is apparent from the number of hours a fire is burnt at home for cooking meals and brewing local alcoholic drinks etc. On a normal day there is a fire burning from 10 to 12 hours. On special occasions such as social functions, religious ceremonies etc., the fire hours extend to almost 15 hours. During such times a second kitchen is normally maintained outside. *Zaw* (puffed rice) frying is either a normal activity or done for long hours in the outside kitchen. Brewing local spirit (*ara*) is also a common household activity.

Most of the rural areas in Bhutan do not have electricity. A few high altitude areas such as Merak–Sakten in the east and Gasa–Laya in the west have solar panels for lighting. The majority of the rural residents use kerosene lamps for lighting. With regard to alternative energy sources, people in high elevations prefer solar power, whereas hydropower is preferred in the lower elevations.

All cooking is done over a fire burning from wood, dung or crop residues. The stoves are of two types: three stones placed in a triangular pattern, the traditional mud stove, and the metal tripod stove. The metal stove is an "open fire ". The legs are set to keep the pot at a certain distance from the floor. This type of stove is beneficial as it heats the home, the smoke it produces helps to keep away insects and preserve the timber with which the house is made (Balla et al, 1991). According to Gujral (1991), the efficiency of these stoves in Bhutan ranges between 5 percent and 16 percent with an average efficiency of about 12 percent while in use. Some of these metal tripod stoves have a metal basin welded to the legs to keep the fire and the ashes off the floor.

Open fire types of stoves are popular in the high altitude regions where heating is a must for seven to nine months of the year. Other types of open fire stoves include two or three-sided mud packed stoves, and the three stone stove without sides. Respondents living in areas above 3000 meters stated that the only other type of stove they are interested in is a *bhukhari*, which can be used for heating and cooking.

In the lower elevation, people use the traditional mud stove. These stoves are made by the villagers themselves out of stones and mud. They normally have two potholes rimmed with three lumps of clay for holding the pot over the fire. The surveys conducted in the high altitude region of the Jigme Dorji National Park indicated the following results:

(i) Villages in the vicinity of the forest where the houses are more scattered stated that it was not difficult to collect fuelwood.

(ii) Clustered villages situated at a distance from the existing forest complained that it was more difficult to collect fuelwood now than it was ten years ago. According to the respondents they needed to travel 4-5 hours to collect a head load of firewood.

(iii) Walking distances for collection of fuel wood range between 1.5 to 3 km in these areas.

In Chebesa, it is necessary to walk 3 km to find a suitable firewood collection spot. Even then all the firewood is generally wet and therefore everyone burns yak or cow dung.

For religious reasons, the residents of Laya and Lunana in the Gasa *Dzongkhag* do not burn dung as an energy source. Burning the dung in the hearth is considered to offend the local deities guarding their villages. In the Lingshi area the burning of dung as fuel is customary. This is probably because it is closer to the Tibetan border and the customs in Lingshi have been more influenced by those in Tibet where the practice is routine.

Migratory yak herders bring fuelwood with them when they travel to the alpine meadows in the summer. The number of bundles that a herder brings depends on the number of people accompanying him/her, the availability of firewood in the summer grazing site, and the number of yaks in the herd. The amount of firewood transported ranges between 40 and 60 bundles or 10-20 yak loads.

Dry wood is used for cooking and wet wood for making cheese. If the cheese is not made over a fire burning from wet wood (usually Rhododendron or Juniper spp) the cheese will stick to the bottom of the pot and burn.

There is no quantitative measure of energy consumption in any of the areas. The calorific value of and the number of dung cakes burned per day is unknown. The volume of the fuelwood consumed everyday is also unknown.

The only indication that fuelwood use may be higher in the lower elevation is based on the number of bundles of fuelwood a family uses per day. Since the size of the bundle is unknown, this information does not tell us anything about the amount of firewood burnt per day. It only suggests that people in the lower elevation may burn more.

14.4 FUELWOOD SPECIES IN DIFFERENT REGIONS OF THE COUNTRY

Western region
Blue pine, oak (*Quercus* and *Castanopsis*), mixed conifer, etc. The preferred species is the *Quercus.*

Central region
All soft wood species and *Castanopsis, Quercus griffithii, Quercus semicarpifolia, Schima wallichii.*

The soft wood species, especially blue pine, are easy to split, they are easily accessible, and most convenient for burning in *bukharis*.

Fuelwood is allotted according to household size and effective utilisation is ensured. In some areas, there is a ban on commercial marking, and the supply is made only from the FMU.

Eastern region
Bechinangshing (*Castonopsis* spp), renangshing (chirpine), tongpashing (blue pine), etoshing (Rhododendron spp),etc.

Firewood is generally very scarce in most of the areas in Eastern Bhutan. This is associated firstly, with a smaller range of trees available and, secondly with heavy pressure from local users. Lops and tops of *Pinus roxburghii* provide the main source of firewood in most of these areas.

Firewood is one of the most essential forest products. It is used daily for cooking food and often for *ara* distillation and to cook animal food. On average, each household consumes around one back load (about 20 kg dry) of firewood per day, which works out to about 7.3 MT/yr/hh. With the total number of rural households around 27,369 in Eastern Bhutan, about 200,000 MT of firewood is probably consumed per year by the rural people. This is met by cutting a few marked trees and, in addition, lops and tops, dead trees and shrubs are collected from the nearby forests free of royalty.

Sub-alpine zone

Survey results in Jigme Dorje National Park (JDNP) have indicated that the depletion of fuelwood around settlements is perceived as a major problem by the villagers. The sub – alpine forests are especially vulnerable to deforestation since these forests are a source of fuelwood for the yak herder camps. Much of the fuelwood is used for cheese making and for processing other dairy products.

It is illegal for the Bhutanese to cut living trees for firewood, construction timber, or any other purpose. This policy even applies to privately registered land. Trees cannot be cut without a permit from the local forest officer. Even with a permit trees cannot be cut indiscriminately. These principles are based scientifically on regeneration rates and floristic composition of the forest and the management objectives advocated by the forest department. Permits are also required for collecting down branches and trees from government owned forests.

14.5 COLLECTION OF FIREWOOD (CASE STUDY OF RADHI, CHUMI AND PAM SHABA)

Firewood collection used to be carried out in groups, based on mutual labour exchange. However, this seems to be changing rapidly, which is characteristic of a society in transition. While for some households the organisational effort required for the collection of firewood has, with time, become more demanding, for others this is no longer an important activity as it is replaced either by contractual collection or by other forms of fuel. This seems to be a reflection of the new system of social stratification that is taking place based on access to economic resources. The old system of social relations based on mutuality and reciprocity is fast disappealing. Such change has made it even more difficult for the households with less manpower and cash income to be able to afford to have a fire in the village. The field survey carried out in three *gewogs* confirmed this trend. For instance, only 32 percent in Shaba and 28 percent in Chumey felt that forests were an important source of firewood. However, in Radhi 56 percent felt that forests were important because they provided firewood. For most of the households in Radhi, the organisational effort required to collect firewood is, over time, becoming more demanding. This is likely to continue as firewood is the only source of energy for the households in the *gewog*. In Chumey, firewood is also the main source of energy, collecting it may not be so demanding as the forests are close to their houses. But forest resources have diminished with the increase in population.

The Forest Act of 1969, and subsequently the Forest and Nature Conservation Act 1995, have made it mandatory for people to have a government issued permit before using any tree, irrespective of whether it is on one's own land or on government land. Chapter III, section 12, *Taking forest produce from Government Reserved Forests for own domestic use* - states under (b) *"An authorized Forest Officer may issue a permit in accordance with rules issued by the Ministry for a person to take forest produce from nearby areas of Government Reserved Forests if all the following conditions are satisfied :*

i the taking will not increase the danger of landslides, soil erosion or other environmental damage

ii anything taken is for a person's own domestlc use in rural areas

iii the taking is not restricted by other sections of this Act or any other law or rule, and

iv. the prescribed royalties have been collected."

Furthermore, alI trees must be marked by a forest official before they are felled. The bureaucratic procedures include obtaining a letter of recommendation from the *gup* endorsement by the *Dzongda,* approval and granting of a permit by the Divisional Forest Officer, and marking of the trees by the Range Officer. These procedures as well as the transportation of the tree to his home, can make the whole process a long and tedious one for the villager. For instance, the forest official concerned may be engaged in carrying out a similar activity in another location so that a person may have to wait for days before his trees are marked for felling. Furthermore, trees available silviculturally have to be identified to avoid overharvesting. Such trees may be located only in remote areas, making it impossible for an individual to transport them manually. All this makes it extremely difficult for a villager to acquire firewood.

A growing number of households have completely moved away from the old system of collecting firewood towards a contractual system or use other sources of energy. For instance, in Shaba 49 percent of the households use liquefied petroleum gas for cooking, while firewood is only a supplementary source and even this is acquired through a contractor. About 15 percent of the households use sawmill waste supplemented by firewood. Only 36 percent rely on firewood as a source of energy.

In Chumey, more than 40 percent of the households interviewed said that their firewood was transported by trucks and much of it consisted of sawmill waste.

14.6 RECOMMENDATIONS TO DEAL WITH THE FUELWOOD SHORTAGE

(i) A detailed and comparative energy use study is vital to the conservation of biodiversity in Bhutan. To accurately assess the fuelwood problem, all firewood collection sites should be mapped and vegetation sampled. Then, if any type of energy saving device is introduced its ecological effects on the environment can be addressed; dung consumption must also be measured.

(ii) *A stove* feasibility study must be conducted in the regions that burn firewood and, to a limited extent, crop residues. There are a few organisations in Bhutan already that specialise in improved stoves, such as the Agricultural and Mechanical Organisation

in Bumthang and the Department of Works and Housing under the Ministry of Social Services. The National Women's Association of Bhutan (NWAB) has had much experience with promoting improved stoves. The improved stove model in Bhutan has a chimney which reduces the problems of eye infections and respiratory irritation caused by smoke, but it does not provide space heating. Therefore, these stoves are not compatible with the needs of residents living in high altitude areas.

(iii) Establish social/community/ and private forests which will replenish fuelwood and timber supplies.

(iv) Provide solar energy as a substitute, especially for processing milk and milk products, and for heating water, especially at high altitudes.

(v) Construct mini/micro hydels and thus provide hydropower as an alternative.

14.7 RECOMMENDATIONS FOR A FUTURE PLAN OF ACTION

(i) At least 30 percent of the species in plantations should be fuelwood species.

(ii) Improved stoves should be highly encouraged to reduce fuelwood collection. Improved stoves will also alleviate the smoke problem and improve women's health.

(iii) Raise awareness of the firewood problem.

(iv) Establish community forest plantations with the simple aim of increasing firewood supplies.

(v) Establish agroforestry projects which aim for multi-products (fuel, fodder, fruit, etc) intended primarily for home consumption and not for the market**.**

(vi) Projects should involve women (most cooking is done by women) directly in stove design and in tree planting because men may not understand their needs. Men use trees for purposes other than fuelwood which is often the reason that fuelwood projects fail.

(vii) Empower women to manage natural resources. This will result in clear implementation strategies to improve the fuelwood situation.

(viii) Increase rural electrification.

(ix) Improve the kitchen environment by disseminating chimney stoves.

(x) Develop stoves with high fuel efficiency.

(xi) Develop a socially acceptable stove.

(xii) Minimise deforestation and its ill effects.

(xiii) Increase the availability of firewood by training users to use firewood more efficiently, thus reducing pressure on existing resources.

(xiv) Develop a built-in mechanism in the village infrastructure for a self-sustaining programme for dissemination of fuelwood efficient stoves.

(xv) Enable households to reduce their expenditure on wood fuel and generate employment opportunities

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15. WOODFUEL UTILISATION AND DISTRIBUTION IN BHUTAN

by

Mr. Til Bahadur Mongar, Deputy Director,
Forestry Services Division

15.1 POLICY PRIORITIES

The policy priorities of the Royal Government of Bhutan on the utilisation of forest products, including timber and firewood, are :

- domestic rural use;
- domestic urban/government agency use; and
- domestic industrial use.

The export of forest products is permissible only after the domestic requirement/demand for fuelwood has been met.

15.2 MODE OF ALLOCATION

(i) Dry firewood for the rural population is supplied free of royalty but requires a permit.

(ii) Green firewood for the rural population is supplied free of royalty but requires a permit.

(iii) Firewood for urban use is obtained through designated private contractors from the Forest Management Units or firewood coupes identified for that purpose.

(iv) Until now firewood has been supplied to the armed forces free of royalty but has required a permit. But if the proposal of royalty revision which has been put forward to the government is approved, the armed forces will also be required to pay royalty.

(v) Project Dantak pays a 25 percent royalty and requires a permit. The PWD and the monasteries also pay royalty.

15.3 THE EMERGING PROBLEMS

(i) Normally fuelwood is supplied from coupes designated for the purpose. But in some *dzongkhag*, the quantity of fuelwood from the coupes is far less than the actual requirements. For example, Thimphu requires approximately 20,000 m^3 of fuelwood per year but the sources at Chamgang, Helela and Gidakom are limited and are becoming depleted at an alarming rate.

(ii) When it comes to species choice, hardwood is preferred.

(iii) Mobilisation of firewood from one *dzongkhag* to another involves extra cost (in terms of labour mobilisation and transportation).

(iv) One of the main questions is can one *dzongkhag* meet the demand/need of another *dzongkhag* (after meeting its own internal demand)?

(iv) Fuelwood is used lavishly and is one of the factors accounting for the shortage.

15.4 THE SUGGESTED SOLUTIONS

(i) Switch over to alternative sources of heating and cooking, particularly in urban areas where electricity and other facilities are easily available.

(ii) Establish plantations of fast growing fuelwood species under community plantation schemes or social forestry programmes to replenish the natural stock.

(iii) Selected *dzongkhag* should be encouraged to raise fuelwood plantations and supply to needy *dzongkhag* for payment.

(iv) A project should be launched to promote alternatives to fuelwood by introducing appropriate and affordable cooking and heating appliances.

(v) An import tax should not be levied on imported cooking and heating appliances.

(vi) Rationalise fuelwood pricing.

16. SMOKELESS STOVES AND BIOGAS PROJECT

by

Ms. Kinley Wangmo, Assistant Programme Officer, Ministry of Trade and Industries

16.1 INTRODUCTION AND OBJECTIVE

The Smokeless Stove & Biogas Project was first launched as the National Stove Project on May 1985.

The prime objective of the project is to reduce the incidence of smoke related diseases and to reinforce the government's policy of preserving the country's forests. The activities of the project listed below will directly reduce deforestation both in the short term and, more significantly, in the long term.

The project initially began with the dissemination of one type of stove i.e the mud type. Soon after, the metallic type of stove was introduced. So far, 17,700 mud stoves have been installed in rural households and enhanced the living condition of many rural people within the Kingdom. While the mud type only takes care of cooking, the metallic type of stove serves both cooking and space heating purposes.

A training course on mud stove construction, installation, maintenance and operation for both men and women in all the *dzongkhag* was organised. A fee of Nu. 60/per stove was generally charged to have a stove installed. But as some of the villages could not even afford to pay Nu. 60, it was decided that the trainees would subsequently train village housewives in mud stove construction, installation, maintenance and operation under the guidance of the project supervisors so that they could do the installation themselves and avoid incurring an installation cost.

An evaluation on the already installed stoves was made in 1995 and the stove accessories were found to be in good condition.

16.2 ADVANTAGES OF SMOKELESS STOVES

Both the mud and the metallic stoves have the following advantages over the traditional stoves:

- Absolutely smoke-free and pollution-free
- More time efficient
- Cost effective
- Save woodfuel by 35 percent
- Prevent eye and respiratory diseases.

16.3 GOBAR GAS PLANTS

Another activity of the project is the recent introduction of the gobar gas plants. A few of these plants have been installed in Punakha on an experimental basis and have, so far, proved successful. A community toilet which fuels the gobar gas plant currently under construction in Loub Auikha in Punakha is almost near completion. However, it does not have the latest technology, i.e fuxi swastic bag plant (the insulated type meant for colder regions). One complete plant costs Nu.5000. The project plans to use this latest technology for all future installations.

16.4 SAWDUST AS A FUEL

Further, the project plans to encourage the use of the saw dust heaters/cookers/boilers in place of woodfuel stoves beginning with Thimphu in September 1998. This is to be duplicated all over the country. According to the latest compilation (1996 Forest Report), in Thimphu town itself there was a total consumption of 1,053 truckloads of hardwood and 304 truck loads of soft wood. The use of wood can be reduced significantly if sawdust heaters/cookers/boilers are used by individual households. This would not only protect the forests but would economically benefit the users, especially the middle and the lower classes. For example, one bag of sawdust is Nu. 6 and this would last about a day for a family of eight's cooking purposes. The sawdust is easily available from sawmills that are found all over Bhutan. Thimphu town itself has 9 sawmills. The saw dust from these saw mills can be better utilised by such equipment, instead of being disposed of into rivers and the surrounding areas and thereby causing water pollution and other environmental hazards.

The project is targeted at installing 7000 saw dust stoves in 1998, depending on the availability of funds. We plan to collect the sawdust and sell it to the users on a non-profit basis.

16.5 ALTERNATIVES FOR WOODFUEL

One way of reducing the consumption of woodfuel, is to use solar water heaters for institutes, armed forces, monasteries, hospitals, GREF, IMTRAT. Free solar energy is abundant.

For health and hygenic reasons, we have solar driers for drying vegetables and meat. The project will be working in collaboration with the TATA BP Solar India Ltd., Banglore to ensure genuine and high quality products.

Wood that is used by the institutes, armed forces, monasteries and hospitals can be utilised by wood based industries and other industries. This would mean an increase in revenue for the government.

One alternative is to use electrically operated cookers/boilers. This is the institutional type meant especially for the institutions, hospitals, armed forces, and the monasteries as they are the largest consumers of wood fuel. This type of rice cooker has a capacity for 25 kgs of rice, enough for about 200 people. During the first phase 50 cookers and 50 boilers will be procured from Calcutta.

In addition, a simple electrical water boiler with a capacity of 50 to 70 litres will be designed for shower and drinking purposes in households.

We have procured most of the metallic stoves from local fabrication units in Bumthang and Thimphu. This also helps to promote the fabrication units within the country. Some metallic stoves and electrically operated cookers/boilers are procured from Calcutta but the designs are based on Bhutanese needs and habits.

An exhibition has been held to orient the people in the use of the above-mentioned equipment and to get positive feedback from the users in order to upgrade the quality of the products.

One further alternative which would help to protect the forests is the planting of trees in the degraded areas. This work could be undertaken by project volunteers in all the *dzongkhag*.

17. THE USE AND CONSERVATION OF FUELWOOD IN BHUTAN

by

Major Sunil Kumar, Indian Military Training Team, Haa

17.1 INTRODUCTION

Environmental concerns have been on the global agenda for the last few decades. Pious pledges of eco intent made at Rio de Janeiro in 1992 and reiterated more recently at New York, have come to little or nothing, perhaps unsurprisingly given the global track record in translating lofty ideals regarding conservation, sustainable development or fossil energy substitution into concrete action. From this environmental impasse, two important lessons emerge for Bhutan:

(a) Ecological degradation is a near irreversible process. In hindsight**,** globally it would have perhaps been easier and more cost effective to prevent the rot from setting in. In shaping its environmental policy therefore, Bhutan would do well to adopt a pro-active, preventive stance.

(b) The costs of ecological degradation are high. Some estimates with regard to India state that the current degradation costs far outweigh the GDP growth. India could therefore well be de-developing even as it continues to degrade ecologically. Long term environmental benefits, must therefore, rank equal to, if not higher than the impulse for revenue generation.

In addressing the issue of sustainable development, the central challenge before Bhutan is not environmental, for in this matter it enjoys a comfortable headstart; the challenge lies in its ability to successfully interface its developmental aspirations with ecological safeguards. The Bhutan of tomorrow should not be - in the manner of numerous industrial economies - a picture of industrial bloom but ecological ruin; nor should it aspire to reject the fruits of economic development for the sake of retaining its pristine environment. The resolve should be to suitably integrate its developmental urges with environmental objectives and thus create a model environmental state, an 'Asian Switzerland' of sorts.

In the formulation of this paper, widespread reference to relevant statistics and factual data has been made and the arguments presented here have been constructed on this factual base. To avoid copious annexures and since the data are widely available in numerous related publications the data per se have not been included in the paper.

17.2 WOODFUEL SUSTAINABILITY

A perusal of the regional forestry register, deforestation and afforestation rates, and the per capita forest cover, reveals that Bhutan is rather favorably placed. With a forest crown cover approximating 64 percent, the position is one of strength and optimism. Forestry, in Bhutan must be viewed as a wealth to be exploited for the well being of the people and the furtherance of its developmental objectives. Environmental concerns may temper the pace and direction of the developmental thrust but care should be taken to ensure that these

concerns do not enlarge unduly, acquire political overtones and in the end, promote economic “status quoism” and inaction. The approach philosophy must be development led and not merely environmentally constrained.

It is 50,000 years since man learned to use fire and thus utilise the energy stored in plants and only a few hundred years since he made the transition to other fossil fuels like coal and oil. In our view, what is dangerous is not man's dependence on wood fuel per se, for nature itself ensures that even as its resources are denuded they are constantly renewed; but nature works slowly while human exploitation quickly tends to assume threatening proportions. As long as the exploitation levels of woodfuel remain contained within the renewal capabilities of region specific ecosystems, there is little cause for worry. Controlling exploitation levels constitutes the basis of wood fuel sustainability. The problems of localized scarcities and resulting ecosystem imbalance can be tackled by the fine-tuning of our micromanagement responses.

17.3 WOODFUEL STRATEGY

Suggested components of a purposeful Wood Fuel Management Strategy, as conceived by IMTRAT**,** are outlined in the succeeding paragraphs.

Institutionalised Planning

Even though biomass (wood fuel) accounts for 90 percent of the domestic energy consumption while conventional energy sources (fuel, LPG and oil) make up a bare 10 percent of the consumption, the latter has received the benefit of institutionalized planning while the former has not. It Is only logical that the dichotomy be urgently redressed. Institutionalized planning while obviating adhoc responses will ensure that a holistic view of wood fuel management is taken and viable options are thrown up for evaluation.

Forestry Focus

A related issue is that of focus. Currently, Wood Energy is the responsibility of the Rural Energy Division (RED),in the Department of Power. The focus that the subject consequently acquires is that of power and energy, while more appropriately the focus should be that of forestry. It is therefore advocated that either a separate department for Wood Energy Planning be set up within the Ministry of Agriculture, Forestry Services Division, or increased participation of Forestry Division officials take place in the wood energy planning process of the Rural Energy Division. This will provide for better coordination and give the subject the focus that it deserves.

Expansion of the Woodfuel Agenda

An examination of Bhutan's consumption pattern reveals that woodfuel has been used primarily for the subsistence needs of the people. Ways and means need to be devised to expand the agenda to include subsistence, growth, development and selective woodfuel marketing. This would give woodfuel as a commodity a viability and sustainability that is currently lacking. Harmonising the demands of woodfuel between the market and the rural poor, commercial undertakings and social programmes will be a major policy challenge.

Facilitating Agent

The role of the forester should graduate from mere policing to that of an extension and facilitating agent in the developmental process. Duties like granting permits, checking thefts and pilferage, establishment of check posts etc, while important, are restrictive. Foresters should chalk out pragmatic programmes in social forestry and marketing to ensure more effective utilisation of wood. Training capsules to actualise this role will need to be formalised and executed.

People's Participation

For years, the rural Bhutanese has secured for himself unrestricted access to forest wealth: woodfuel, shrubs, twigs, timber and other forest residues. Any redefinition in role or emphasis, has to be with the agreement and participation of the people. Unilateral imposition of decisions in any case are counter productive. The famous Chipko movement of the 1970s was more a protest against the withdrawal of the people's traditional access to forest wealth and did not arise out of any great concern for the environment.

Region Specific Databases

(a) Even In a small country like Bhutan, there are widespread disparities in the woodfuel demand and supply patterns, cooking and utilisation practices, areas of surplus and deficiencies etc. Strategies to sustain woodfuel in different regions need different tenors. This can only be possible if a region specific database is available in the first place.

(b) Whenever and wherever social forestry plans have been conceived on an inadequate understanding of the local needs they have met with dismal failure. The more they are based on an understanding of local needs, edaphic and socio cultural backgrounds, technical suitability, market situations, support services etc, the higher the rate of success is likely to be. Social forestry successes in the districts of Midnapore, Bankura, Birbhum and Purulia in West Bengal as also in various district of Orissa are the result of an intimate understanding of local needs.

(c) A perusal of numerous FAO reports on Wood Energy Development reveals a similar paucity of data. Wherever the forestry services division has not been able to provide the data, the report has said so, gone on to make reasonable assumptions and proceeded to finalise the report. The validity of such reports therefore becomes questionable.

(d) The importance of region/place specificity is best illustrated with examples. In Geylegphug, a town in South East Bhutan, of the various fuel alternatives available to the consumer, Indian fuelwood is cheaper by 30 percent. Attempting to market Bhutanese fuelwood here might prove to be a wasteful proposition. In a place like Haa, the bulk of the woodfuel supply is from diseased/segregated/matured species. While the apparent woodfuel pressure here might seem to be high, the actual pressure is not.

(e) Establishing region specific data bases and strategies that are alive to Bhutanese practices, genius and ethos are therefore most vital to the success of wood fuel sustainability.

17.4 SUSTAINABILITY: RESPONDING TO CHALLENGES AND PROBLEMS

Sustainability Tools

In order to assess the sustainability of a resource the following tools could be considered :

(a) *Forest Cover.* If Bhutan continues to maintain its forest crown cover at 64 percent in the years to come, it would be a fair indication of the fact that woodfuel as a resource is being sustained.

(b) *Per Capita. Forestage* the country's ability to maintain the per capita forestage at the current figure would give a similar indication.

(c) *Annual Allowable Cut (AAC).* The AAC is a fair measure of the sustainability of a resource or the supply surplus. As long as the annual extraction figures are contained within the AAC there should be no cause for worry. With regard to the AAC, however, a poor database once again is a cause for concern. A 1981 survey pegged the AAC at 13 million cubic metres, a 1991 Satellite Imaging survey estimated it to be 11 million cubic metres, while a recent FAO report contests both the figures stating that factors like accessibility and existence of forest and wild life reserves had not been taken into account. The FAO realistically estimates the figure at around 1 million cubic metres. Yet again, this reinforces the importance of establishing accurate databases.

Consensus

The above notwithstanding, their is broad consensus that fuelwood supply in Bhutan, on the whole, exceeds demand, except for certain areas in South and East Bhutan where localised scarcities prevail.

Sustainabilitv Objectives

A realistic assessment of sustainability objectives could be the ability to sustain the prevailing forest cover, Per capita forest cover and AAC to extractability ratio. Cumulatively, they could constitute the benchmarks of the sustainability drive.

Supply and Demand Management

The solutions at the macro level have to be sought primarily in increasing the supply of forest products, rather than on demand management. It would be more profitable for the policy maker and the planner to focus on the low productivity of forest products of the type needed by the people, and measures to enhance the same, rather than issues like biotic pressures and increased demand of the people. Demand patterns are difficult to regulate in any case, while effecting a switch to alternate sources of energy, especially in rural areas, is not easy due to lack of purchasing power. Savings can be achieved through better conversion technologies like improved stoves, but these are likely to be marginal. It is estimated that once the improved cooking stoves program becomes fully operational, a savings of a mere 1 percent in the fuelwood consumption will be achieved. The hope therefore lies in improved supply management through better forestry techniques, marketing strategies, people's participation, careful choice of species and technologies and improved management techniques.

The Scarcity Hoax

Not more than 10-12 percent of woodfuel, moving out of forests in Bhutan is registered through permits. By implication, foresters (like their counterparts in other parts of the world) would argue that the remaining 88-90 percent disappears due to the insatiable demand of the people. Here, there is a need for caution. The actual pressure on the forests may not be so severe. A considerable amount of fuel wood is obviously being diverted to traders and other sources, indicators both of loss of revenue and the market potential of woodfuel as a product.

Rationalising Forest Management

(a) The concept of reserved, protected and village or community forests, perhaps needs to be actualised. Reserve Forests are fully under the control of the Forest Department and managed under various silvicultural systems. In protected forests, only the forest crop (trees) is managed by the Forest Department, the land is owned and controlled by the Revenue Department, while, the village forests are generally created on degraded land. The rights and privileges of the local community vary with type of forest, restricted in the reserve forests and more liberal in the protected variety. Having created these forests, numerous options for their management exist.

(b) One option is for community forests to be utilised exclusively to meet the woodfuel needs of the people, while the reserved and protected forests are used to meet the demands for timber and the broader purpose of biodiversity and ecological conservation.

(c) Another conceivable option is to make a certain portion of reserved forests accessible to the fringe communities for woodfuel marketing. Woodfuel is grown, harvested and marketed with a percentage of the produce being made available to the locals by way of incentive.

(d) Mixed Lot Farming. Concurrently, mixed lot farming in the community forests is proposed. Commercial trees like the Sal and Eucalyptus are grown along with woodfuel. While woodfuel takes care of the subsistence needs, the commercial trees boost revenue and by way of percentage commission contribute to the cash income of the local community and generate rural employment.

Balancing the Inequalities

Despite boasting of an overall forest cover of 64percent, the forestry scenario in Bhutan, is characterised by numerous peculiarities :

(a) Inequalities in access and consumption patterns have led to areas of surplus and scarcities. Afforestation and community forestry schemes, perhaps, need to be activated in the areas of scarcity. Scarcities are more often caused by dishonest contractual systems in league with the timber mafia, rather than due to burdensome pressure of the people. In areas of scarcity, therefore, the woodfuel flow patterns need close and careful monitoring.

(b) There are other areas (the proximity of Haa is one such area) where trees tend to get diseased due to overmaturing. These need review and pragmatic harvesting cycles need to be worked out.

(c) An aggregated approach needs to be examined whereby the transportation and social costs of moving wood from areas of surplus to areas of scarcity could be thought out. While alleviating scarcities, it should be a cost-effective proposition, since in most rural areas the cost of woodfuel is still substantially below that of other sources of energy.

Monetization of Wood Fuel and Pricing Mechanisms

(a) Currently, the bulk of woodfuel in rural Bhutan is free. If it is to be made a viable and marketable commodity some sort of pricing mechanism must be devised. Pricing will help to generate revenue for the government, income for the rural poor, and make woodfuel more competitive vis-a-vis other commercial species. Having said that however, it must be emphasised that the bulk of the rural poor have no surplus cash income and have also regarded woodfuel as a free and traditional right. Monetisation initiatives in rural areas can be actualized only by effecting attitudinal changes and by ensuring peoples' participation and giving them a stake in the marketing process.

(b) Initial Grants. Having identified suitable areas for the launch of the social forestry schemes, grants/loans will have to be given for ensuring a smooth take off. Trees could be used as collateral with loan returns built in at the end of the first harvest.

(c) Percentage commission and buy back guarantees could be built in to make the projects sustainable.

(d) Two Tiered-Pricing Mechanism. A two tiered pricing mechanism could be conceived, according to the paying capacities of the target groups. Where cash incomes are virtually non-existent, participatory income generating schemes are the only answer. In other areas (around towns and cities) administered pricing could be introduced. The typically Bhutanese enterprises of cardamom drying and lemongrass extraction are heavy consumers of fuelwood. Since they are also income generators and foreign exchange earners, the prices of fuelwood used in these processes could be suitably administered. There are yet other categories of consumers viz bakeries, restaurants etc where woodfuel could be made available at market prices. Introduction of a price mechanism will help in making woodfuel a marketable commodity. It will help to divert woodfuel, in a regulated manner, to market outlets and thus assist in the drive from subsistence to marketing.

Miscellaneous Initiatives

(a) Commodity and Target-group Matching. Woodfuel, when managed scientifically, has numerous commodities to offer: small logs, branch wood, billets, twigs, leaves, split wood, planks and root stock, each possessing an importance of its own in the energy ladder, and attracting different target groups. Proper target group identification and making available the right commodity for the right target group will help in improving woodfuel flow and strengthening the marketing initiative.

(b) Technical Support. In supporting social forestry/ community forest schemes, the forester can offer important technical support :

  (i) Advice on appropriate genotype. Certain species like the Siddha (popularised in Orissa) and woody shrubs can be harvested frequently, making them popular.

  (ii) Advice on aspects like proper spacing of trees.

(iii) Advice on aspects like concerted exploitation in certain areas where trees have over-matured, biomass in the form of fallen leaves has accumulated and fire lanes have disappeared contributing to forest fires.

(iv) Once the community forests acquire momentum, through periodic planning, ensure that overexploited ecosystems get adequate rest by suitably timeframing the harvesting cycles.

(v) Ensure that the wood is of utilisable, commercial dimensions before it is harvested. Often, due to ignorance or commercial compulsion woodfuel is harvested in its prime, making it uneconomical.

Controlled Access

This, is yet another important issue in the sustainability drive. The demands of marketing are deregulation and ease of entry/exit to assist in smooth wood fuel flows within marketing territories. Yet, uncontrolled access can play havoc, aiding and abetting the growth of timber mafias. Access to forests needs to be coordinated with other developmental plans especially road building activity. Much of the ecological plunder in the Garhwal and North East forestry regions has been the result of feverish road building activity consequent to the 1962 border crisis. In the reserved forest areas especially, the construction of roads needs to be curbed.

Natural Vs Commercial Forestry

Elsewhere in this paper, the cause of commercial forestry has been propagated. A note of caution needs to be added. Relentless pursuit of commercial forestry (Eucalyptus plantations in Kodaikanal) has had a pronounced adverse effect on the rain absorption capacity of soil and consequently the ability of natural regeneration . A balance between the growth of natural and commercial forestry needs to be maintained.

Blanket Bans

Moved by the callous timber exploitation in North East India, the government recently imposed a blanket ban on timber trade fueling problems of another kind :loss of jobs and income opportunities to elephant owners, tea shop owners, fellers, labour etc. Bhutan must exploit the strength of its administrative structure and a system with a demonstrated ability to enforce laws, positively and judiciously after carefully assessing the social impact. Preventive measures must be taken in time, to avoid the need for avoidable extreme measures at a later date.

HRD Concerns

The sustainability strategy for woodfuel that we have discussed can only be relapsed by suitably and concurrently mobilising the HRD resources too. If we are to move from a subsistence approach to a more meaningful developmental and market oriented approach the forestry staff, especially at the middle and grassroots level, will need necessary reorientation training. Similarly, if people's participation is to be ensured, joint management committees at the *Gewog*/*Dzonkha* level need to be instituted. HRD, by itself therefore, will be a major player in the sustainability drive.

17.5 THE ENERGY SITUATION IN BHUTAN AND THE PROBLEMS OF ENERGY SUBSTITUTION

Bhutan's per capita energy consumption of conventional energy sources, e.g. oil and hydroelectric power, is estimated to be amongst the lowest in the world. In statistical terms the consumption profile is as follows:

(a) Wood Energy: 87 percent.

(b) Residues: 1 percent.

(c) Conventional Energy (CE) Sources : 12 percent.

Important attributes of the sectoral demand are as follows:

(a) Domestic Sector: 77 percent with biomass (wood) accounting for 98 percent of this demand.

(b) Industrial and other sectors: 3 percent with biomass accounting for 50 percent of the demand

(c) With regard to other sectors, the two traditional Bhutanese enterprises, namely lemongrass extraction and cardamom drying, while being notable foreign exchange earners and generators of cash income for the rural population, are also notorious fuelwood guzzlers.

Consumption Patterns

(a) Rural and Semi -Urban Areas

  (i) Biomass (wood) is the predominant source.

  (ii) People collect fuelwood directly from forests, bypassing official channels.

  (iii) Fuelwood trade is non existent in rural Bhutan.

  (iv) Traditionally, people have considered wood to be a free commodity.

  (v) Lack of cash incomes, makes energy substitution (kerosene, electricity) difficult, even in instances where the latter is locally available.

(b) Urban Areas

  (i) The Utilisation Index consists of both, biomass and CE sources like electricity, LPG and kerosene.

  (ii) As we move from rural to urban centres, the availability of substitutes and cash incomes makes energy substitution easier. The consumption ratio of biomass and CE sources, while being 50 : 50 (in percentage terms) in larger towns like Thimphu and Pheuntsholing, alters to 80 20 in smaller towns like Somdrup Jhankar and Geylephug.

  (iii) While in households around Thimphu the per capita consumption of fuelwood was 2.31 cubic meters, in Thimphu town itself it dropped to 1.23 cubic meters per capita.

(c) Other surveys have revealed that as altitude increases, the consumption of fuelwood also increases. At extremely high altitudes, wood consumption was supplemented by shrubs, twigs and dung.

(d) When compared with other regions with similar climatic conditions (e.g. in Nepal), the fuelwood consumption per capita is substantially higher. While the annual per capita consumption in Nepal varies from 700-900 kgs, in Bhutan it ranges from 800-3,200 kgs. This is attributed to cooking timings and methods, religious practices and other factors like drying of agro products which are peculiar to the Bhutanese way of life.

Evaluation of Other Sources of Energy In Bhutan

(a) Coal
- Found in SE Bhutan, in Samdrup Jongkhar District.
- Reserves estimated at 2 million tons.
- Low grade, unsuitable for industrial purposes, mainly exported to Bangladesh for brick burning and tea drying
- For industrial purposes, high grade coal is imported from India and Vietnam.

(b) Oil
- Kerosene, petrol, diesel and LPG are imported and distributed through a private network.
- All these products consume valuable foreign exchange.
- LPG, while preferred by users as an easy to use and relatively cheap source of energy, is available only in six towns in Bhutan.
- Kerosene is used mainly for lighting.

(c) Electricity
- While the estimated potential is in the region of 20,000 MW, a bare 2 percent has been harnessed so far for economic development. Chukha remains the principal provider of electricity.
- Micro power projects have been set up with Japanese investments at Chirang and Daga. Other projects like the ones at Tala, Mangdechu and Punatsangchu are, in the offing.
- Increase in hydropower generation would require heavy infrastructural investment and the availability of skilled manpower. Both are not easy to come by.
- A switch to cooking with electricity is possible only if there is sufficient spare capacity and consumer purchasing power.
- Lack of spare capacity and frequent power cuts in areas outside the Chukha grid are a severely inhibiting factor.
- Lack of purchasing power is an all pervasive factor in rural areas.

Energy Substitution: A Desirability/Feasibility Study

A prominent factor in inducing the switch will be the pricing mechanism. The FAO carried out a study of various sources of energy in terms of their energy value, cost and end use efficiency and evolved an 'effective pricing' mechanism.

The Thimphu Survey revealed the following :

(a) Wood	0.31 Ngultrum (Nu)
(b) LPG	0.33 Nu
(c) Kerosene	0.16 Nu
(d) Electricity	0.19 Nu

At Geylephug, the findings were:

(a) Wood	0.31 Nu
(b) Indian Wood	0.12 Nu
(c) LPG	0.32 Nu
(d) Kerosene	0.17 Nu
(e) Electricity	0.19 Nu

From the above it is evident that, in urban areas, while LPG prices are competitive, kerosene and electricity are cheaper. Availability of these substitutes, however, remains a major constraining factor. Only in Geylephug, where inexpensive fuelwood from India is available, would such wood be the cheapest energy source for cooking.

In rural areas however, even if the opportunity costs of collecting wood fuel were taken into account, it remains the cheapest source.

(a) Biogas Alternative

- A sole initiative has been made at Geylephug.
- Results were not very encouraging due to high procurement and maintenance costs.

(b) Improved Stoves

- A programme to introduce 'improved stoves' was recently started in six districts.
- The improved stoves have a higher efficiency of 22-24 percent as against 15-20 percent in the case of traditional stoves.
- The improved stove has a high procurement cost of 63 US$ as against 0.5 US$ in the case of traditional stoves.
- The programme has found only limited acceptability.
- It is estimated that if the improved stove programme is met with greater acceptability a 1percent savings on fuel wood consumption would accrue.

(c) Solar Energy

- Solar insulation is latitude dependent, the favourable belt lying between 15 and 35 degrees N.
- Bhutan lies well within this belt.
- Prima facia, the potential for solar energy exists.
- A detailed project study will have to be carried out to assess the technology availability, infrastructural costs, cost effectiveness and options for low/high grade thermal energy applications.
- Only then can specific options emerge. While examining the option, the success story of solar energy projects in Himachal Pradesh could be studied. Reasonably successful initiatives have been made to switch to solar based energy applications in that state. Owing to the cold and hostile weather conditions prevailing, Himachal Pradesh is one of the biggest consumers of woodfuel. In order to conserve woodfuel, a Solar Energy Action Plan was launched in 1994. In response, to date, approximately 24,049 solar cookers and 2,238 solar water heating systems have been sold. Also, solar lanterns and solar domestic lighting systems have been introduced.

(d) Wind Energy

- Location specific.
- Potential sites include passes and steep smooth hills for smooth wind flow.
- Empirical studies postulate that wind electricity is more cost effective than hydro electricity,
- A detailed study of the characteristics of the wind regime at potential wind conversion sites is imperative, before specific proposals emerge.

Effecting a Switch from Biomass to other Substitutes : Options

(a) Expansion of the Hydroelectric Grid: Hydroelectricity is a viable substitute. At current generation level spare capacity is insufficient. While the potential to create additional capacity exists, the means to galvanise that potential capacity in terms of investment and skilled manpower are not easily forthcoming.

(b) LPG and Kerosene: Both are viable substitutes, but increasing their availability would mean a larger import bill and a consequent drain on meagre foreign exchange resources. Fiscal balancing would be a prerequisite and an inhibiting factor.

(c) Focus. It would be sensible to focus the substitution drive in terms of electricity, LPG and kerosene towards urban centres and smaller towns. In rural areas, substitution would only be possible when development permits the emergence of cash incomes.

(d) Non Conventional Energy Sources. This is an eminently viable route, though not without large upfront costs. As discussed earlier, Bhutan would do well to invest in these substitutes in terms of R & D and pilot projects.

(e) Target Consumption. In sum, it might be a realistic proposition, to seek to alter , say by 2005, the current consumption profile (paragraph 27) to the one enunciated below:

Wood : 75 percent.

Conventional Energy Sources : 20 percent.

Non convential Energy Sources : 5 percent.

(f) Megawatt Concept. Concurrently, thoughtful initiatives like this, need to be examined. This is a new concept that marks a major change from the manner in which energy has been viewed traditionally. It offers energy saving solutions by saving energy that might otherwise have been used unnecessarily. The scope of the concept is vast: from simple things like use of energy saving lamps to construction of computer controlled heating systems. The concept is gaining popularity in the West. It could be selectively adapted to Bhutanese conditions. Hotels and public places could be impelled by law, to install computer controlled heating systems. A rational energy saving audit could be launched to identity areas to actualise the Megawatt Concept.

17.6 WOOD CONSUMPTION IN IMTRAT

Pattern of wood utilisation

Season	Purpose
Summer (April – September)	Cooking, boiling of drinking water, washing of hospital linen
Winter (October – March)	Warming and drying purposes in addition to above.
Throughout the year	Construction and Maintenance.

Monthly consumption (in kgs)

Posts	Summer	Winter	Total
Haa	39,523	226,835	266,358
Thimphu	9,620	34,225	43,845
East	4,560	21,760	26,320
Paro	5,411	14,746	20,157
Grand Total	59,114	297,566	356,680

(e) The Engineers Cell, annually consumes 3,200 cubic feet of mixed conifer and 340 cubic feet of blue pine for construction and maintenance activity.

Species

Purposes	Types	Commercial rates (Rs/37 kgs)
Cooking, boiling, washing drying and warming	Mixed Pine	Region specific (i) Haa - RS 22 (ii) East - Rs 46 (iii) Paro - Rs 31 (iv) Thimphu - Rs 20
For general construction and maintenance	Mixed conifer	Rs 76 per cu ft
For door panel, special carvings etc.	Blue Pine	Rs 90 per cu ft

Procurement :

(a) Through annual contracts.
(b) Rates promulgated by the RGoB
(c) Wood procured from logging areas situated approximately 15-25 kms away eg. the logging areas for Haa are at Chapey, Damthang and Chele La.
(d) Government transport is used.

Financial Implications (In Rupees)

	Summer	Winter	Net
Haa	23,500	134,874	158,374
Thimphu	5,200	18,500	23,700
East	5,700	27,200	32,900
Paro	4,599	12,533	17,132
Engineering cell Mixed conifer Blue pine	 Rs 243,200 Rs 30,600		
Annual Gross Expenditure	Rs 505,906		

Cost Benefit Analysis

(a) In IMTRAT, the dependence on wood fuel as an energy source is near total.

(b) The precipitating factors are easy and cheap availability of the source.

(c) Transportation costs are nil.

(d) The only other sources of energy in use are:

- Electric boilers for bathing and washing.
- Kerosene oil authorised to posts for cooking and powering of generators.

(e) Given the low price of wood, a shift to even LPG does not seem cost effective.

(f) The non-availability of LPG locally is another inhibiting factor.

(g) In so far as timber for construction is concerned, a shift to alternatives like mud, steel and cement would have the following implications:

- The steel and cement alternative would be costlier at source. Transportation would add to the cost.
- Wood is more cold resistant and therefore better suited climatically.
- The current skills of the work force are timber based. A shift to other forms would entail reorientation training.

17.7 IMTRAT AS AN ECO-FRIENDLY ORGANISATION: CURRENT AND FUTURE INITIATIVES

Meaningful afforestation plans in various areas have already been conceived and are being executed. It is proposed to give the plans a more scientific dimension by interacting with the forestry services, identifying appropriate species and planting short rotation plants in potential areas of scarcity like Paro, Yongphula, Thimphu and Pheuntsholing.

A strict ban on unlawful access to timber is being enforced, organisationally.

Numerous awareness raising measures have been introduced for sustaining wood fuel supply.

Effecting in-house savings on woodfuel consumption. Budgetary ceilings ensure that allocations are considerably lower than authorisation.

Since the greater pressure is on hardwood (for warming and heating) electric boilers have been introduced for washing and bathing purposes.

In the next financial year, selectively, a greater number of room heaters will be introduced to ease the pressure on space heating stoves (*bukharis*).

An exercise is being undertaken to explore the possibility of a switch to LPG to effect savings in fuelwood consumption.

Undertake Pilot projects on the use of solar appliances and improved stoves in selected border posts, will be undertaken.

Awaiting region specific recommendations of the Rural Energy Division for sustainability measures, notably in Thimphu, Haa, Yongphula and Pheuntsholing. They will be implemented in toto.

17.8 CONCLUSION

At 72 percent, the forest cover in Bhutan is a source of strength. While formulating its developmental strategies, care must be taken to gainfully exploit that strength. Principally, that would entail ensuring that exploitation levels remain within renewal capabilities, adopting an institutionalised and holistic approach towards woodfuel management, formulating people friendly and area specific woodfuel strategies and expanding the role of non conventional energy sources. Such a course, if pursued vigorously and imaginatively, would provide the desired results.

18. PROJECT DANTAK: TOWARDS FOREST CONSERVATION IN BHUTAN

by

Captain Loknath, HQ CE (P) Dantak, c/o 99 APO, Simtokha

18.1 INTRODUCTION

DANTAK is renowned for its commitment to Bhutan's socio-economic development. Its contribution has so far included the construction of a network of over 1,500 km of roads, Paro and Yonphula air fields, helipads, various prestigious buildings, a microwave station, a bulk petroleum storage, infrastructure and approach roads for Chhukha and Kurichhu hydel projects etc. Project Dantak's team of dedicated officers and personnel has accomplished this with quality and speed since its inception in May 1961. The list of achievements in the field of development in Bhutan is a long one and Project Dantak hopes to add to this by completing the Paro International Air Field and other assignments in the coming years. Construction of roads in hilly areas unavoidably necessitates clearing forests to some extent. But, though unavoidable, this can be minimised by judicious planning and improved methods.

Until last year, Project Dantak was in need of about 5,000 metric tons of wood annually, mainly for the construction and maintenance of roads, staff cooking purposes, water heating for washing and bathing and maintaining the temperature in offices and residences during extreme cold winters.

This has been reduced by 40-45 percent and requirements are now 2,500 to 3,000 metric tons per year. This has been achieved by using the following improved methods and systems in the field of road construction and domestic purposes.

18.2 FOREST CONSERVATION MEASURES ADOPTED BY PROJECT DANTAK

a. Effective planning during pre-construction stage

A detailed ground reconnaissance survey is carried out to finalise the alignment of the proposed road after a thorough study of the master plan using topographical sheets. The best suited alignment is thus selected based on various factors such as obligatory points, minimum length, minimum soil erosion, less cross drainage work, minimum forest clearing etc.

b. Slope stabilisation

Wherever natural slope is disturbed by formation/slope cutting, Project Dantak has been adopting various slope stabilisation steps such as construction of breast walls, retaining walls etc. ,as well as planting grass and other vegetation on the exposed soils.

c. Protection works against soil erosion

Generally, flowing water tends to scour the clayey strata met in the alignment of roads and its effect in soil erosion sometimes is of such a magnitude that it devastates the forest cover of the area. It is taken care of by providing/constructing various protective measures such as sausage walls, toe walls, wing walls etc.

d. Saving firewood by using cationic emulsion in place of bitumen for 30 percent resurfacing targets for 1998 - 99.

Cationic emulsion is a binder which is being used as an alternative to bitumen for 30 percent resurfacing targets during 1998 - 99. It will lead to saving of firewood to the tune of 1,500 metric tons for this financial year since cationic emulsion does not need any heating.

e. *Saving in firewood by using central gas/stove cooking system for troops*

Earlier, a great deal of firewood was being consumed for cooking purposes. Using a central gas/stove cooking system can save about 500 metric tons of firewood a year.

f. *Central electric water heating system*

Water needs to be heated in all cold climatic regions for washing and bathing purposes. Replacing the old manual firewood heating system by a central water heating system will save about 400 metric tons of firewood annually.

g. *Using hot mix plant and tar boilers for roadside BT works*

HMP and tar boilers are used wherever possible for BT works to further ensure minimum requirement of firewood by Dantak. This can save about 500 metric tons which otherwise would be consumed for BT works.

h. *Use of kerosene bukharis*

The use of firewood *bukharis* is to be curtailed by 30 percent and kerosene *bukharis* used instead.

19. FUELWOOD USE BY BHUTAN BOARD PRODUCT (BBP) LTD.

by

Mr. Phub Dorji, Deputy Manager (F), BBPL, Samtse

19.1 INTRODUCTION

Fuelwood is used in BBP as an organic fuel substitute for burning the boilers in the plant. The boilers are used to heat the thermal oil which passes through the drier and dries the wood flakes before they are mixed with the glue resin and processed further. Since Bhutan has an abundance of fuelwood, it is considered more economical (due to its easy access and the low cost of extraction) than finished L.D.O. from India.

In addition to fuelwood, waste wood is used as the main raw material for the particle board manufacturing plant.

So far wood energy has remained the cheapest and most environmentally friendly source of energy for industries in Bhutan.

19.2 ANNUAL REQUIREMENT IN METRIC TONNES

BBP's requirement for fuelwood is about 25 percent of the total wood raw material requirement for the production of particle board. At 100 percent plant capacity, based on the production of 19mm particle board, the fuelwood requirement is approximately 10,000 MT per annum.

The annual requirement of waste wood is about 45,000 metric tons, i.e. equivalent to 75,000 cu m, of which about 10,000 metric tons is used as fuelwood. The remainder is used for the manufacturing of particle boards.

19.3 CHOICE OF SPECIES

Normally mixed wood is used for production activities. Although hardwood is preferred over soft wood because of its high calorific value, no specific species is preferred as fuelwood so long as an adequate quantity is readily available.

19.4 AN ALTERNATIVE ENERGY USE/SOURCE

As an alternative to the wood-fired boiler we could have used an oil-fired boiler but the fuelwood boiler was found to be the most economical. If the wood is to be substituted by any organic fuel material a substantial investment will be required for the procurement of either a new boiler or to modify the existing boiler.

19.5 CONSTRAINTS IN OBTAINING FUELWOOD

Although BBP has its own mechanized logging equipment bought with the finance made available by Bhutan Development Finance Corporation there are certain difficulties in obtaining the fuelwood to meet the regular requirement. The difficulties are due to the high costs of road transport and nursery maintenance.

19.6 SUGGESTIONS

The present constraints could be improved if the government would provide BBP with royalty and tax concessions equal to the amount spent on the fuelwood plantation and its regular maintenance program year after year. This could be treated as an incentive for maintaining a well-planned forest resource on a long-term sustainable basis.

In addition to this, if some portion of commercially low value species adjacent to the presently allocated degraded forest area is also allowed to be used, it will help the company economize its operation costs.

19.7 SOURCES OF WOOD ENERGY

Fuelwood is procured mostly from Tala, Gedu, and Dungna. In addition to these sources fuelwood is also obtained from FDC's working areas in Thimphu, Paro, Haa and Wangdue, and Tsirang road.

19.8 RELATED ISSUES

Some fuelwood is used by the factory staff for room heating during cold weather.

19.9 BACKGROUND INFORMATION OF PEOPLE DEPENDENT ON WOOD FUEL

All the people involved in extraction of wood from the contractors to the labourers are paid a services charge and wages for their services. Therefore, these classes of people are dependent on the operations related to wood fuel extraction for the company.

The BBP manufacturing plant is located at Tala which is about 5 kilometres from Gedu at Phuentsholing-Thimphu National Highway, whereas the corporate office is located in the Industrial Estate at Phuentsholing.

20. AN OVERVIEW OF THE WOODFUEL SITUATION IN SOUTH ASIA

by

Mr. Tara Bhattarai, Wood Energy Resources Specialist, FAO, Bangkok

20.1 WOOD ENERGY IN ASIA

20.1.1 Wood energy consumption

Woodfuels are still an important energy source in many developing countries of Asia, and the household sector is the largest consumer of traditional fuel. In the 16 member countries of RWEDP (Figure 1) about 10,000 PJ of woodfuel is consumed each year. This corresponds to about 30 percent of their total energy consumption (excluding China). But one should be careful while interpreting these data about country specific wood energy consumption since large variations exist between data sources, e.g., FAO, WRI, UN, IEA, AEEMTRC, HESS. Besides, a large number of traditional industries and commercial establishments also rely heavily on woodfuel for energy (Tables 1 & 2).

It is also interesting to note that most country level energy balances have shown a declining share of traditional fuels in their annual energy consumption in recent years. This clearly hides the fact that, in absolute terms, woodfuel consumption in Asia is not decreasing but increasing at an annual rate of 1.6 percent. Based upon the findings of some country level studies it now appears evident that woodfuel consumption will not decrease within the foreseeable future (Table 3).

20.1.2 Wood fuel procurement methods

Only a limited amount of woodfuel consumed today (about 30 percent) enters into the commercial marketing channels. And the woodfuel market is also run exclusively as an informal sector activity. The principal consumers of traded woodfuels are the inhabitants of large cities and urban centres, where even the poor have to buy the woodfuel they need for cooking at the going market price. The other important consumers of the traded woodfuels are the traditional industrial commercial activities. Although some of these establishments may be managing their woodfuel supply from freely accessible sources, they do have to spend a minimum amount of money to pay for the labour they hire for its collection, and for its conversion and transportation. Many others may be buying their total requirement from local public or private supply sources. Whatever the amount of woodfuel that forms the traded share in total consumption, its contribution to local level income and employment generation in rural areas is considered quite significant. The economic value of woodfuel consumed in RWEDP member countries (excluding Cambodia) amounts to about US$ 30 billion, using an average woodfuel price of $ 40 per ton. (Table 4 and Figure 2).

Figure 1: Sixteen member countries of RWEDP

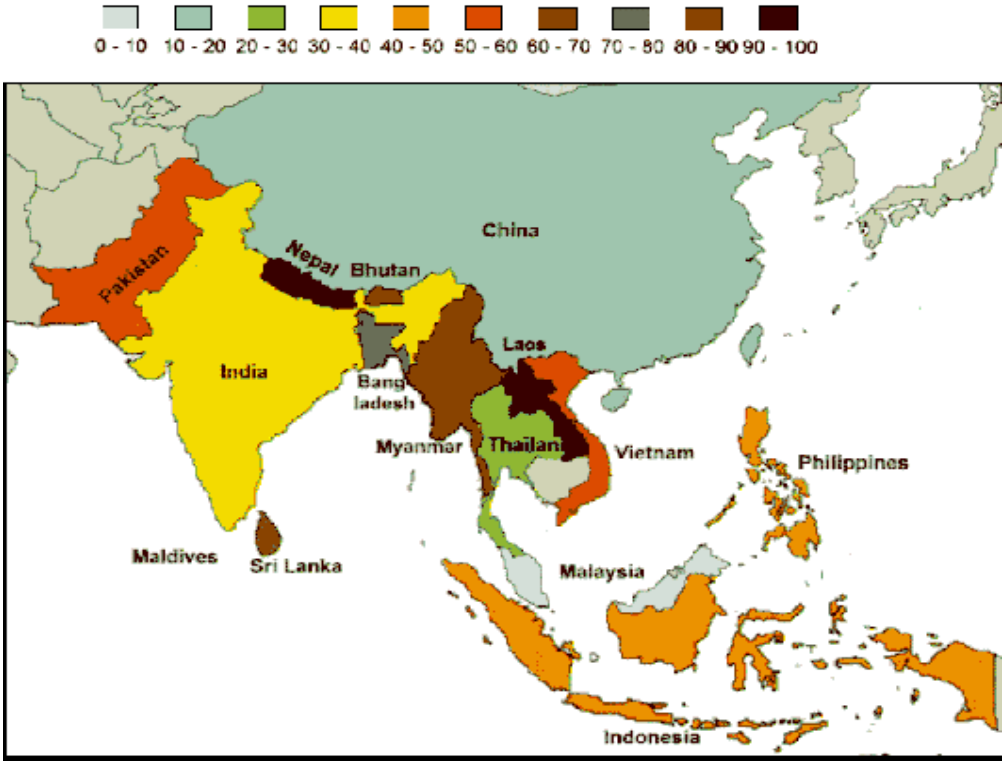


Figure 2: Woodfuel values in million US$ per year

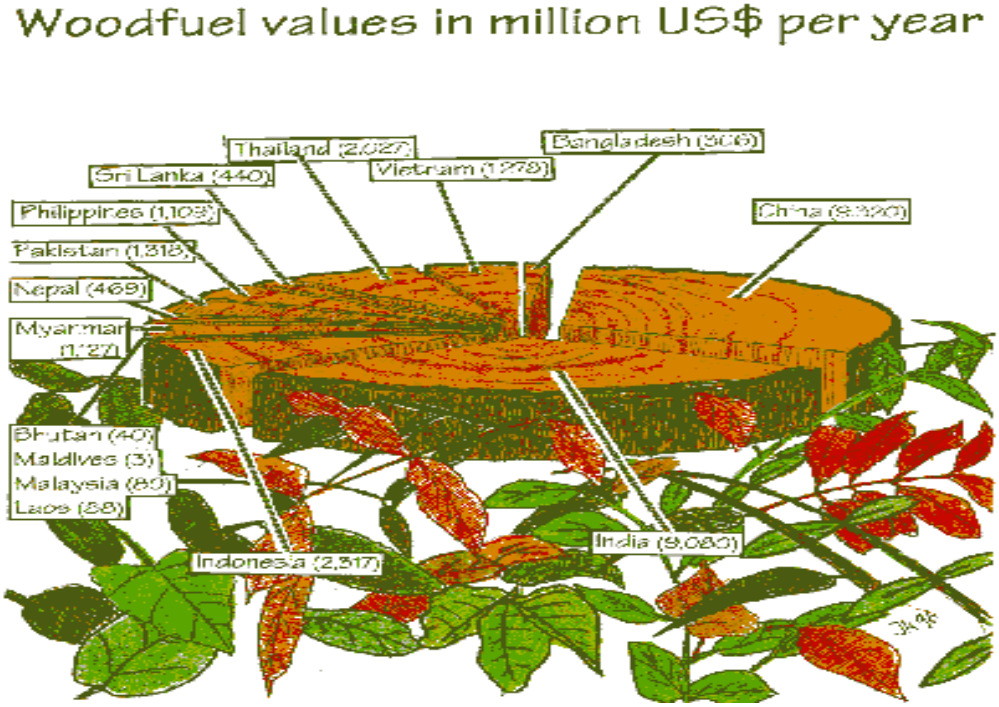


Table 1: Energy consumption in RWEDP member countries calculated in Peta Joules (PJ) from information contained in Energy Balances etc.

	Fuelwood			Charcoal			Year
Country	**Domestic**	**Industries**	**Total**	**Domestic**	**Industries**	**Total**	
Bangladesh[1]	95.76	18.93	114.69	0	0	0	1989/90
Bhutan[2]	12.25	0.99	13.80	0	0.37	0.37	1988/89
China[3]	3,495.00	0	3,495.00	0	0	0	1990
India[4]	3,165.00	240.00	3,405.00	0	0	0	1991
Indonesia[5]	868.76	0	868.76	0	0	0	1992
Laos[6]	32.83	0	32.83	0	0	0	1990
Malaysia[7]	11.79	0	11.79	05.69	0	5.69	1992
Maldives[8]	1.05	0	1.05	0	0	0	1987
Myanmar[9]	342.87	0	342.87	24.65	0	24.65	1990
Nepal[10]	169.30	6.43	175.73	0	0	0	1994/95
Pakistan[11]	493.85	0	494.10	0	0	0	1993/94
Philippines[12]	231.74	0	231.74	56.98	0	56.98	1992
Sri Lanka[13]	136.12	0	163.34	0	0	0.54	1992
Thaialnd[14]	161.93	0	161.93	185.01	0	185.01	1994
Vietnam[15]	395.54	0	427.12	15.44	0.08	16.10	1990
RWEDP	9,613.78	266.35	9,939.75	287.76	0.45	289.33	
% of Total	93.98	2.60	97.17	2.81	0.00	2.83	

[1]Rural Energy and Environment Planning for Sustainable Rural Development Bangladesh, Ahsan Habib, 1994
[2]Wood Energy Sectoral Analysis, FAO-RWEDP, Field Document 32
[3]ESCAP – Executive Seminar and Study Tour, 1991
[4]Biomass, Energy and Environment N.H. Ravindranath and D.O. Hall 1995 (Table 2.2 Low Est.),
[5]ASEAN Energy Review. Vol. 3, AEEMTRC, 1994
[6]Sectoral Energy Demand in Laos, REDP, 1989, [7]ASEAN Energy Review, Vol. 3 AEEMTRC, 1994
[8]Sectoral Energy Demand in the Maldives, REDP, 1989
[9]Myanmar Energy Sector Investment and Policy Review Study, WB 1991 (Annex 1.2b)
[10]Energy Synopsis Report. Water and Energy Commission, April, 1996
[11]Asian Energy News, No. 95
[12]ASEAN Energy Review Vol. 3, AEEMTRC, 1994
[13]Sri Lanka Energy Balance. Ministry of Power and Energy, September 1995
[14]Thailand Energy Situation, 1994. Department of Energy Development and Promotion, 1995
[15]Vietnam Rural and Household Energy Issues and Options, WB-ESMAP, 1994

Table 2: Share of biomass and wood energy consumption

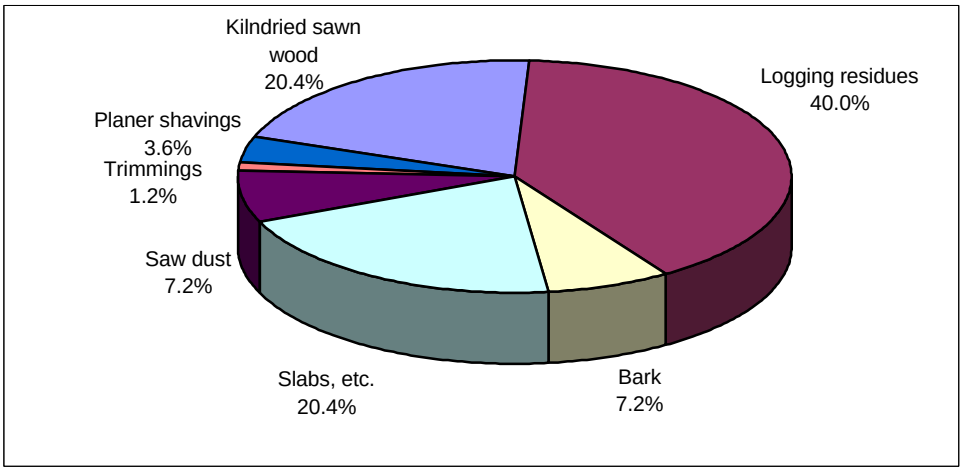
Country	Year	Share of Biomass (%)	Share of Wood (%)	Share of Biomass in Domestic sector (%)
Bangladesh	1992	73	13	89
Bhutan	1991	82	-	-
China	1992	10	-	25
India	1992	33	-	78
Indonesia	1992	39	31	73[2]
Laos	1991	88	-	-
Malaysia	1992	7	2	15[2]
Myanmar	1991	74	-	-
Nepal	1992-93	92	68	97
Pakistan	1993-94	47	27	83
Philippines	1992	44	26	66[2]
Sri Lanka	1990	77	-	93
Thailand	1994	26	9	65[2]
Vietnam	1991	50	-	-

1- No data available, [2]Domestic and commercial sector, [3]National energy balance
[4]World Resource Institute, [5]United Nations, [6]AEEMTRC

Table 3: Biomass energy consumption in member countries (PJ)

Country	1981	1986	1991
Bangladesh	243	262	277
Bhutan	7	9	12
China	1,541	1,820	2,018
India	2,165	2,441	2,824
Indonesia	1,181	1,320	1,465
Lao PDR	29	33	39
Malaysia	69	78	90
Myanmar	156	175	193
Nepal	113	197	206
Pakistan	192	233	296
Philippines	308	327	382
Sri Lanka	70	78	89
Thailand	484	546	526
Vietnam	197	222	251
Total	6,755	7,741	8,666 (1.6%)

Figure 3: From tree in the forest to kilndried sawn wood



Source: RWEDP estimate using various information published by different agencies

Figure 4: Share of woodfuel in total roundwood production

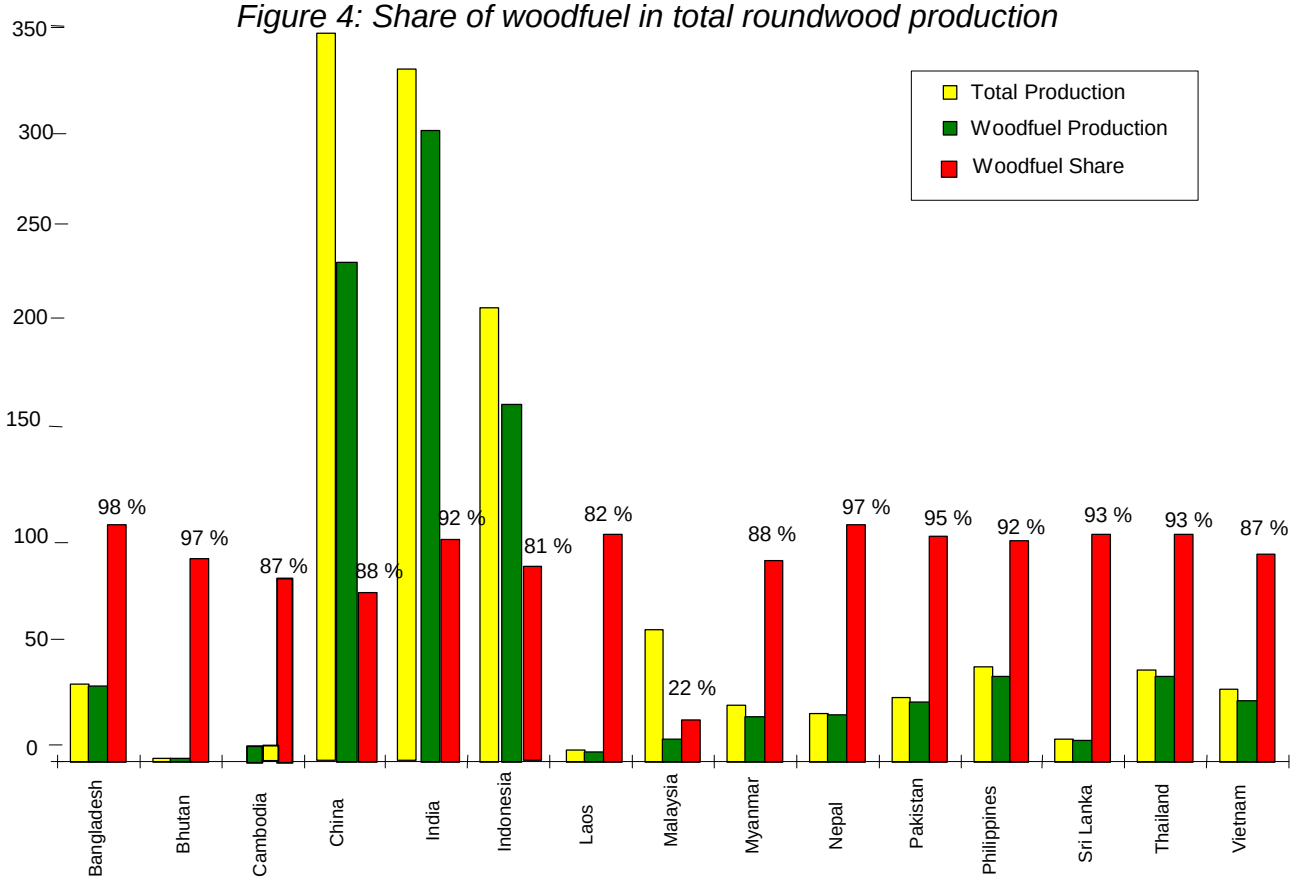


Table 4: Woodfuel values in million US$ using average woodfuel prices

Country	Fuelwood	Charcoal	Dom FW	Dom Char	Ind. FW	Ind. Char	Total
Bangladesh	306	-	255	-	50	-	306
Bhutan	37	3	33	-	3	3	40
China	9,320	-	9,320	-	-	-	9,320
India	9,080	-	8,440	-	640	-	9.080
Indonesia	2,317	-	2,317	-	-	-	2,317
Laos	88	-	88	-	-	-	88
Malaysia	31	49	31	49	-	-	80
Maldives	3	-	3	-	-	-	3
Myanmar	914	213	914	213	-	-	1,127
Nepal	469	-	451	-	17	-	469
Pakistan	1,318	-	1,317	-	-	-	1,318
Philippines	618	491	618	491	-	-	1,109
Sri Lanka	436	5	363	-	-	-	440
Thailand	432	1,595	432	1,595	-	-	2,027
Vietnam	1,139	139	1,055	133	-	1	1,278
RWEDP	26,506	2,494	25,637	2,481	710	4	29,000
Fuel prices	US$/Ton	US$/GJ	End-use efficien-cies of stoves		Fuel heating value GJ/Ton		
Fuelwood	40	2.67	Fuelwood	20%	Fuel-wood		15
Charcoal	250	8.62	Charcoal	30%	Charcoal		29

20.1.3 Socio-economic contribution of woodfuel

Country specific information related to the socio-economic impact of wood energy is not yet fully known, but studies conducted in a number of RWEDP member countries show it makes a significant contribution to employment and income generation. Woodfuel supply implies labour for growing, harvesting, processing, wholesaling, transporting and retailing the product. On a per unit of energy basis, the labour involved in these activities is about 20 times that for kerosene. It is believed that woodfuel business in Asia is the main source of income for 10 percent of the rural households and for about 40 percent of their cash earnings (Table 5).

20.1.4 Woodfuel as a by-product

Woodfuels are often produced/procured from within close proximity of the end-users. Most consumers in the household sector have a tendency to freely collect or self-gather the woodfuel they need from nearby accessible supply sources, e.g., from trees on private and farm lands, from community waste and scrub-lands, from public forests and plantations, etc. Studies of the share of forest and non-forest area based supply in total woodfuel consumption in 7 RWEDP member countries suggest a ratio of 1:3 and 2:3, respectively (Table 6). It is also stated that, typically, non-commercial sources are within a 100 km radius from the market.

Table 5: Estimated employment per fuel type

Fuel type	Tons of Fuel per Tera Joule	Estimated Employment per TJ Energy Consumed in Person Days
Kerosene2	29 Kilo Litre	10
LPG2	22 Tons	10-20
Coal	43 Tons	20-40
Eletricity	228 MWh	80-110
Fuelwood	62 Tons	110-170
Charcoal	33 Tons	200-350

Source: Estimated by the World Bank mission members for the Philippines Household Energy Study.
1Where applicable employment covers growing, extraction, production, transmission, maintenance, distribution and sales, including reading meters. It excludes employment generated outside the country for fuels that are important in semi-finished or finished state
2 This assumes that crude oil (for refining), kerosene and LPG are imported.
3 Varying according to capital intensity of the mine, seam thickness, energy value of the coal as well as the distance from demand centres.
4 Varies according to production method ranging from hydro to traditional oil/coal fired units and the efficiency of eletricity generation, transmission and distribution.
5 Depending on productivity of the site, efficiency of producers and distance from the market.

The other supply sources of woodfuel include residues from logging and wood processing industries, recovered wood from old construction sites, packing crates, pallets, driftwood, and the by-wood which is a product of other land and tree based production systems, including farm and agroforestry schemes as well as other non-industrial tree supply sources, and may account for as much as 20 percent of the total logging and milling residues; only about 20 percent of the trees harvested may be available as kiln dried sawn wood after passing the multiple stages of wood processing (Table 7 & Figure 3).

Table 6: Indicative sources of fuelwood used in various RWEDP member countries

Country	Year & Sector	million tons	forest land[1]	Other land[2]	Public land[3]	Unknown
Bangladesh	1981, HH and Ind.	5.5	13	87	-	-
India[5]	1996, HH	162	51	49	-	-
Indonesia[6]	1989, Urban HH	0.5-1.0	6	65	-	29
Nepal[7]	1995/96, HH	6.9	73	27	-	-
Pakistan[8]	1991, HH	29.4	12.6	84.1	-	3.3
Philippines	1989, HH	18.3	13.7	86.3	-	-
Sri Lanka[10]	1993, HH and Ind.	9.2	11	75	-	14
Thailand[11]	1992, Rural HH	5.74	-	56	37	7

Sources:
1 Forest land includes forest plantations as well
2 Other land is mainly own land, neighbours land, common land
3 Public land may include forest
4 Government of Bangladesh, 1987
5 Ministry of Environment & Forests, 1996
6 World Bank/ESMAP, 1990
7 WECS, 1997
8 World Bank/ESMAP and UNDP, 1991
9 World Bank/ESMAP, 1991
10 Ministry of Agriculture, Lands adn Forestry, 1995
11 RFD, 1993

20.1.5 Woodfuel use and deforestation

The other important message that is revealed by recent studies is the disqualification of the traditional perception that woodfuel collection was the root cause of deforestation in Asia. Instead, it has been found that clearing of natural forests for agricultural expansion, open animal grazing and frequent forest fires have been the most crucial causes of deforestation globally. Similarly, the projected woodfuel supply/demand imbalances in most countries in the region, as conceived in the mid 1970s, based on the “gap theory”, now seem completely outdated. The projected imbalances completely ignored the people's potential to produce additional woodfuel on non-forest land to overcome the woodfuel supply gap. Moreover, they failed to take into account the inter-fuel transformation potential within biomass sources.

20.1.6 Share of woodfuel in total round-wood production

Despite the fact that woodfuel receives no priority or only a limited priority in terms of commercial forest management objectives in comparison to saw-log and industrial round-wood production, and it is often considered only a by-product of commercial forest harvesting, its share in the total round wood production in most developing countries in Asia is still very high. Only one country, Malaysia, has a low share (about 17 percent) and the other member countries have shares of between 70 percent to 97 percent. This is a clear manifestation of their heavy reliance on woodfuel for energy (Table 7 & Figure 4).

Table 7: Forest area, plantation, wooded land, roundwood and woodfuel production in member countries

RWEDP Member Countries	Forest Area[1] Million ha	%	Plantation Million ha	%	Wooded Land Million ha	%	Total Roundwood Production in 1992 (million cum)[3]	Total Woodfuel Production in 1992 (million cum) [2]	Share of Woodfuel in Total Round Wood Production (%)
Bangladesh	0.769	6.0	0.335	2.6	1.121	8.6	31.907	31.014	97
Bhutan	2.809	60.0	0.005	0.1	n.a.	0.00	1.610	1.332	83
China	115.050	12.0	33.310	3.6	27.730	2.97	296.560	203.800	69
India	51.729	17.0	18.900	6.4	16.771	5.60	282.359	257.789	91
Indonesia	109.550	60.5	8.750	5	0	0.00	185.630	146.300	79
Laos	13.170	57.0	0.006	0.02	0	0.00	4.400	4.100	93
Malaysia	17.580	54.0	0.116	0.35	0	0.00	54.010	9.200	17
Maldives	0.001	3.3	n.a.	n.a.	0	0.00	n.a.	n.a.	n.a.
Myanmar	28.860	44.0	0.335	0.51	0	0.00	22.730	18.600	82
Nepal	5.023	37.0	0.080	0.6	0.327	2.39	19.591	18.971	97
Pakistan	1.855	2.4	0.240	0.31	3.195	4.14	26.567	24.379	92
Philippines	7.830	26.0	0.290	0.97	0	0.00	38.650	35.000	90
Sri Lanka	1.746	27.0	0.198	3.06	0.354	5.64	9.229	8.566	93
Thailand	12.730	25.0	0.756	1.48	0	0	37.590	34.800	93
Vietnam	8.310	25.5	2.100	6.45	0	0	29.620	25.200	85
Total	377.012	21.4	65.421	3.71	49.498		1040.453	819.051	79

1 Source: FAO Forestry Paper 112, Forest Resources Assessment 1990, Tropical Countries, FAO 1993
2 Source: FAO Yearbook Forest Products 1981-1992, FAO 1994
3 Source: World Resources 1994-1995

20.1.7 Woodfuel supply sustainability

Sustainable production and use of woodfuel can be socially, economically and environmentally feasible, provided the impediments to the expanded participation of the private sector are removed. Apart from wood, different types of biomass produced mostly in the agriculture sector as residue are used for energy and their sustainable use can also be feasible economically, socially and environmentally. Environmentally sensitive areas (i.e. watershed, catchment and biodiversity conservation areas) should of course be avoided. Sustainable woodfuel utilization can contribute positively to both the local and global environments as it is a CO_2 neutral renewable form of energy under a "harvest equals re-growth" management regime.

The prime area of concern is not the availability of woodfuels as such, but their distribution to people in need. And the weaker groups in society, particularly women and children, are the ones who suffer most, both physically and in terms of health, from localized supply problems. Timely intervention with appropriate corrective measures to match the local situation is thus desirable. While such localized supply shortages may be prominent in many places, woodfuel supply shortages may not be very prominent at the aggregate level, except in a few member countries.

20.1.8 Need for integration

The need for integrated rural energy development which duly recognizes the role, importance and productive potential of different sources of energy should be clearly recognized in the national development policy of every member country, and should be supported with inter-sectoral cooperation and coordination in the implementation of a specific programme that may fall under the jurisdiction of different sectoral agencies, (i.e. agriculture, forestry, energy, rural development, etc.).

20.2 THE REGIONAL WOOD ENERGY DEVELOPMENT PROGRAMME IN ASIA

20.2.1 Introduction

The FAO Regional Wood energy Development programme in Asia (RWEDP) is now in its third phase. The activities under the current phase started in the middle of 1994 and will continue until December 1999. Over the past 15 years RWEDP's participating member countries have expanded from 8 to 11 to 15, and now to 16 (i.e., Bangladesh, Bhutan, Cambodia, China, India, Indonesia, Laos, Malaysia, Maldives, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka, Thailand and Vietnam). Since its start in 1985, the Programme has been funded by the Government of The Netherlands. The budget for the current phase of the project is about US$ 8.8 million.

The long-term support to wood energy development in the region is based on the acknowledgment that woodfuel is the basic source of energy for 30 to 80 percent of the population, mostly rural, in the developing countries of Asia. And, it is being increasingly felt that the problem of woodfuel supplies are worsening in most areas as a result of growing populations and diminishing forest resources. Many factors such as widespread poverty, land and tenure systems, weak access to existing resource bases, patterns of economic and technological development, etc. have contributed to woodfuel related problems, either

individually or collectively. For example, the dwindling resources, the limited/reduced access to existing resource bases, the poor economic status of woodfuel users, etc. have influenced the availability and market price of woodfuels. As a consequence, there is (a) an increased dependence on the free collection of fuelwood from community wastelands, government owned natural forests and plantations; (b) greater hardship for women, children and elderly people, and decreased opportunities to work in other productive activities; (c) a static or declining consumption of fuelwood and a forced switch-over to other inferior biomass fuels --- this switch-over has affected the general nutrition level, kitchen hygiene and the health of the rural people, primarily by exposing them to fire and smoke related health hazards.

The initial thrust of the programme was on transferring high impact technology in selected areas of social/community forestry, energy conservation, and tree planting for increased wood and woodfuel production. Later on, the thrust was shifted towards enhancement of improved wood energy practices, networking, development of capabilities, strategies and skills in member countries. A number of studies commissioned during the second phase of the Programme revealed important information related to improved stoves, private and community woodlots, woodfuel flows, wood energy planning. The objectives of the current phase emphasise wood energy data, planning, policies and strategies. And the larger part of the RWEDP's resources and activities are being allocated to human resource development.

20.2.2 Objectives

(a) Long term development objective

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

(b) Immediate objectives

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

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

20.3 PLANNED ACTIVITIES

A number of regional, sub-regional and national level training courses/workshops, expert consultations, observation tours, area specific research and case studies, etc. have been already commissioned over the past three years of the current phase of the project. These activities have contributed significantly to enhancing the capacity in member countries to plan and implement the wood energy development related policy, strategies plans and programmes at the national level. People have been trained in both the forestry and energy/power sectors. Two national focal points per country, one in forestry and the other in energy sector, have been identified and brought together to address the wood energy development issues. A number of training institutions and women's organizations, including NGOs have benefited from the programmes sponsored by RWEDP in the region.

REFERENCES

FAO/GON, 1993 — Project Document 1993-1998, Regional Wood Energy Development Programme in Asia (GCP/RAS/154/NET), FAO/Government of the Netherlands Cooperative Programme, 1993

FAO/RWEDP, 1997 — Regional Study on Wood Energy Today and Tomorrow in Asia, Field Document No. 50, FAO Regional Wood Energy Development Programme in Asia (GCP/RAS/154/NET), Bangkok, October 1997

21. SUMMARY OF THE OUTCOME OF THE FUELWOOD WORKSHOP HELD IN BHUTAN IN JUNE 1995

by

S. R. Gurung, Planning Officer, Policy and Planning Division, MoA

21.1 LEGAL ASPECTS

Issues identified

- No specific legislation to regulate over-consumption
- Absence of comprehensive policy (subsidy and pricing structure)
- Under old Forest Act of 1969, no popular stake in protecting and managing forests.

Recommendations

- Review and enact legislation
- Frame a comprehensive national energy policy
- Give more authority and control over forests the users.

21.2 TECHNOLOGICAL ASPECTS

Issues identified

- Energy inefficient devices viz. stoves, utensils etc
- Poor insulation in traditional/existing houses
- Waste during extraction
- Wood based industries.

Recommendations

- Increase efficiency in construction of houses and cooking systems
- Improve extraction technique to minimise wastage
- Further wood intensive industrialisation should be decided only after careful resources survey and use conflict analysis.

21.3 ECONOMIC ASPECTS

Issues identified

- Absence of cheaper alternatives
- Social/environmental costs of fuelwood not considered
- Complacency due to abundance of and accessibility to forest biomas.

Recommendations

- Supply either free/subsidised electrical appliances
- Include social/environmental costs in value of wood.
- Adopt a pricing policy to make alternate energy sources more attractive/economical.

21.4 SOCIAL ASPECTS

Issues identified

- Attachment to fire for warmth and the visible comfort it affords
- Emergence of tourism
- Physical factors – climate, topography
- Negative perceptions of alternatives.

Recommendations

- Create/raise awareness built on tradition
- Persuade tourism/trekking agencies to use other energy
- Encourage the use of alternate in sources of energy in areas with well developed infrastructure.

21.5 EDUCATIONAL ASPECTS

Issues identified

- School curriculum does not focus on fuelwood usage
- Lack of awareness among both students and teachers
- Poor extension services
- Inadequate institutional set up
- Lack of role models.

Recommendations

- Incorporate fuelwood issue in school curriculum
- Create enhanced awareness among school teachers
- Improve educational and extension programmes
- Enhance role model activities.

21.6 INSTITUTIONAL ASPECTS

Issues identified

- Lack of institutionalisation and coordination (inter-sectoral linkages in energy usage).

Recommendations

- Institutionalise and coordinate inter-sectoral linkages on every usage (revitalise the National Committee on wood energy development.

21.7 ALTERNATIVES ASPECTS

Issues identified

- Lack of availability, affordability and reliability of alternatives

Recommendations

- Explore, taking into consideration cost analysis, availability, accessibility etc. alternative sources of energy to fuelwood.
- Lack of plantations oriented to fuelwood production.

21.8 AFFORESTATION ASPECTS

Issues identified

- Lack of plantations oriented to fuelwood production.

Recommendations

- Strengthen social forestry programmes; increase people's participation in afforestation programmes through agro-forestry/social forestry approaches.

APPENDICES

APPENDIX 1: LIST OF PARTICIPANTS

Forestry Services Division Headquarters

1. Mr. Ganesh Kumar Pradhan	Offtg. Joint Secretary
2. Mr. Til Bahadur Mongar	Deputy Director

Forest Resources Development Section

3. Mr. Dhan Bahadur Dhital	Head
4. Mr. Pasang Wangchen Norbu	DFO

Nature Conservation Section

5. Dr. Sangay Wangchhuk	Head
6. Miss Durga Devi Sharma	DFO
7. Mrs. Deki Yonten	ACO/PM/JDNP
8. Mr. Damber Singh Rai	PM/BMNP
9. Mr. Hans Blom	UNV

Forestry Development Corporation

10. Mr. Ugyen Thinley	Managing Director
11. Mr. Tashi Geley	Div. Manager, Wang Division
12. Mr. Tshering Wangchuk	Div. Manager, Haa Division
13. Mr. Sangay Tenzin	Div. Manager, Geylephu Division
14. Mr. Jit Bahadur Rai	Div. Manager, Engineering Div.
15. Mr. Namgay Dukpa	OIC/ Sha Logging, Wangdue
16. Mr. Narayan Pradhan	Div. Manager, Shongar Division

Territorial Divisions

17. Mr. Namgay Wangchuk	DFO, Thimphu
18. Mr. Gopal Mahat	DFO, Paro
19. Mr. Mr. Kinga Dorji	DFO, Gedu
20. Mr. Kado Tshering	DFO, Samtse
21. Mr. Abilal Baskota	DFO, Wangdue
22. Mr. Techu Dorji	DFO, Tsirang
23. Mr. Sonam Tshering	DFO, Sarpang
24. Mr. Karna Bahadur Samal	DFO, Monggar
25. Mr. Kin Gyeltshen	DFO, Trashigang
26. Mr. Dorji Rinchen	DFO, S/Jongkha

Social Forestry and Afforestation Section

27. Mr. Bap Pema	ADF

Policy and Planning Division, MoA, Forestry Sector

28. Mr. Shankha Raj Gurung	Planning Officer

Renewable Natural Resources Research Centres

29. Mr. Phuntsho Namgyel	Officer In - Charge/Yusipang
30. Mr. D. B. Chetri	Asst. Research Officer/Yusipang
31. Mr. Dennis Desmond	Research Advisor/Yusipang

FAO/UNDP

32. Mrs. Sofie Kobayashi	Program Officer, Thimphu

Dzongkhag Forestry Extension Officers (DFEO)

33. Mr. Phurba Dukpa	DFEO, Tsirang Dzongkhag
34. Mr. J. N. Pradhan	DFEO, Thimphu Dzongkhag
35. Mr. Dorji Dukpa	DFEO, Paro Dzongkhag

Institutes

36. Mr. K. B. Subba	Principal
37. Mr. Kaka Tshering	ADF
38. Mr. Sherab	Trainee Officer/RIM
39. Mr. Pema Wangyel	Trainee Officer/RIM
40. Mr. Kinley Namgyel	Simtokha Rigshung Institute

Education Division

41. Mr. Tshering Tenzin	EEU, CAPSS

Division of Power

42. Mr. Tempa Gurme	Asst. Engineer
43. Miss Deki Yangzom	Junior Engineer, TPU

Dratshang Lhentshog

44. Mr. Chhudap Penjor Lopen
45. Mr. Sangay Wangdi

Armed Forces

46. Mr. Hemant Gurung	Major, RBP, Thimphu

IMTRAT

47. Mr. Sunil Kumar	Major, HQ, Thimphu

Project Dantak

48. Mr. Loknath	Captain, HQ, CE (P), 99 APO

Ministry of Trade & Industries

49. Mr. S. Tobgay	Coordinator, Smokeless Stove Programme
50. Miss Kinley Wangmo	Asst. Programme Officer

Public Works Division

51. Mr. J. P Sharma	Assistant Engineer

Industries

52. Mr. Lungten Chojai	Manager, BCCL, S/Jongkha
53. Mr. Phub Dorji	Dy. Manager (F), BBPL, Samtse
54. Mr. D. N. Gyeltshen	Manager, TCC, Thimphu

APPENDIX 2: COURSE PROGRAMME

"National Training Course on Woodfuel Production and Marketing"

20 - 22 April, 1998

Venue : Bhutan Forestry Institute, Taba Programme:

19-04-98	***Arrival of the outside participants to Thimphu.***
20-04-98 Day One	
0900 hrs.	Arrival and registration of the participants.
0930 hrs.	Arrival of the Chief Guest, His Excellency Dasho Khandu Wangchuk, Honourable Deputy Minister, MOA.
0935 hrs.	Welcome Address by Mr. Tashi Geley, Divisional Manager, FDC. Introduction by Dasho Sangey Thinley, Honourable Joint Secretary, FSD.
0945 hrs.	Regional Overview on Woodfuel by Mr. Tara Bhattarai, Wood Energy Specialist, RWEDP, Bangkok.
1000 hrs.	Inaugural Address by the Chief Guest.
1015 hrs.	Vote of Thanks by Mr. T.B. Mongar, Dy. Director, FSD.
1020 – 1100 hrs	Announcement of group photographs and tea break.

S E S S I O N O N E

Chairman:	Dasho Sangey Thinley, Joint Secretary, FSD.
Rapporteurs:	Miss Durga Devi Sharma, ADF, NCS Mr. Pasang Wangchen Norbu, DFO, FRDS.
1100 – 1120 hrs	***"An Analysis Of Woodfuel Use In Thimpu"*** - ***Case Study*** (Resource persons - Dasho D.B. Dhital, Head FRDS and Mr. Namgay Wangchuk, DFO, Thimphu).
1120 - 1130 hrs.	*Discussions*
1130 – 1230 hrs.	***Presentations by*** a. Representative from Dratsang Lhentsog b. Representative from Education Division c. Representative from Education Division d. Representative from Education Division e. Representative from Health Division f. Representative from Public Work Division
1230 – 1300 hrs	*Discussions*
1300 – 1400 hrs	Lunch Break

S E S S I O N T W O

Chairman	Dasho Sangey Thinley, Joint Secretary, FSD.
Rapporteurs:	Mr. Pasang Wangchen Norbu, DFO, FRDS. Mrs. Deki Yonten, NCS.
1400 – 1415 Hrs.	***"Presentations On The Findings Of The Workshop In June' 95"*** (Resource person, Mr S. R. Gurung, Planning Officer, PPD, MoA)
1415 – 1425 hrs	Discussions.
1425 – 1505 Hrs.	***Presentations:*** a. Mr. Karma Dukpa, DFO, Bumthang. b. Mr. Kuenga Dorji, DFO, Gedu. c. Mr. K.B. Samal, DFO, Mongar. d. Mr. Gopal Mahat, DFO, Paro.
1505 – 1515 hrs	Discussions.
1515 – 1545 hrs	Tea Break.

S E S S I O N T H R E E

Chairman	Dasho Sangey Thinley, Joint Secretary, FSD.
Rapporteurs .	Mr. Pasang Wangchen Norbu, DFO, FRDS. Mr. Chador, ADF.
1545 – 1600 Hrs	***"An Overview Of The Woodfuel Situation In South Asia"*** (Resource person - Mr. Tara Bhattarai, Project Expert, RWEDP, Bangkok).
1600 – 1610 hrs	Discussions.
1610 – 1650 hrs	***Presentations:*** a. Mr. Namgay Wangchuk, DFO, Thimphu. b. Mr. Techu Dorji, DFO, Tserang. c. Mr. Kin Gyeltshen, DFO, Tashigang. d. Mr. A. Baskota, DFO, Wangdue.
1650 – 1700 hrs	Discussions.

21-04-98 ***Day Two***

S E S S I O N F O U R

Chairman :	Dasho Sangey Thinley, Joint Secretary, FSD
Rapporteurs:	Mr. Pasang Wangchen Norbu, DFO, FRDS. Mr. Tandin, ADF.
0915 – 0930 Hrs	***Socio Cultural Aspects Of Wood Fuel Use, "Case Study Of Radhi, Chumi And Paro Shaba"*** (Resource person - Dr. Sangay Wangchuk, Durga Devi and Deki Yonten).
0930 – 0940 hrs	Discussions
0940 – 1030 Hrs	***Presentations:*** a. Representative from the Royal Bhutan Army. b. Representative from the Royal Body Guard. c. Representative from the Royal Bhutan Police. d. Representative from the IMTRAT. e. Representative from the GREF.
1030 – 1040 hrs	Discussions
1040 – 1055 hrs	"***Highlights On Energy Demand Supply And Role Of Wood Energy*****"** (Resource person : Mr Tempa Jurme & Mrs. Deki Yangzom, Division of Power).
1055 – 1105 hrs	Discussions.
1105 – 1130 hrs	Tea Break.

S E S S I O N F I V E

Chairman :	Dasho Sangey Thinley, Joint Secretary, FSD.
Rapporteurs:	Mr. Pasang Wangchen Norbu, DFO, FRDS. Miss. Durga Devi Sharma, ADF, NCS.
1130 – 1145 hrs	***"Need For Co-Ordination For Distribution Of Fuel Wood"*** (Resource person - Mr. T.B. Mongar, Dy. Director, Technical Co-ordinator).
1145 – 1155 hrs	Discussions.
1155 – 1245 hrs	***Presentations:*** a. Representative from Bhutan Carbide and Chemical LTD. b. Representative from Bhutan Ferro Alloys LTD. c. Representative from M/s. Tashi Industries. d. Representative from Bhutan Board Product, Tala.
1245 – 1300 hrs	Discussions.
1300 – 1400 hrs	Lunch Break.

SESSION SIX

Chairman :	Dasho Sangey Thinley, Joint Secretary, FSD.
Rapporteurs:	Mr. Pasang Wangchen Norbu, DFO, FRDS.
	Mrs. Deki Yonten, NCS.
1400 – 1415 hrs	***"Fuelwood Research Needs In Bhutan"*** (Resource person - Mr. Phuntsho Namgay, O/C, RNRRC, Yusipang).
1415 – 1425 hrs	Discussions.
1425 – 1440hrs	***"Alternatives To Wood Energy"*** (Resource person - Dr. Sangay Wangchuk, Head, NCS).
1440 – 1500 hrs	Discussions.
1500 – 1530 hrs	Tea Break.

SESSION SEVEN

Chairman :	Dasho Sangey Thinley, Joint Secretary, FSD.
Rapporteurs:	Mr. Pasang Wangchen Norbu, DFO, FRDS. Mr. Tandin, ADF.
1530 – 1630 hrs	Group Exercises
1630 – 1700 hrs	Presentation and review of group exercise.

22-04-98 *Day Three*

0900 – 1130 hrs	Field visits to Chamgang/Helela Forest Management Unit, to look at the firewood operated areas
	(Resource person - Mr. Namgay Wangchuk, DFO, Thimphu).
1130 – 1330 hrs	Visit to Ramtokto Saw Mill, to see the disposal of saw dust, and on way back to Taba visit to retail firewood sales depot, FDC Colony).
	(Resource person-Mr. Tashi Geley, Divisional Manager, FDC).
1330 – 1430 hrs	Lunch Break at Taba.
1430 – 1530 hrs	Presentation and review of the workshop proceedings by Pasang Wangchen Norbu, DFO, FRDS.
1530 hrs	Tea Break.

CLOSING CEREMONY

1800 hrs.	Arrival of the Chief Guest.
1815 hrs.	Presentation of the workshop proceedings by Tashi Geley, Divisional Manager, FDC.
1835 hrs.	Closing Address by the Chief Guest.
1845 hrs.	Vote of Thanks by Mr. Namgay Wangchuk, DFO, Thimphu.
1900 hrs.	Open Air Dinner - Courtesy of the Honourable Deputy Minister of Agriculture, Dasho Khandu Wangchuk.

APPENDIX 3: WELCOME ADDRESS

by

Mr. Tashi Geley, Divisional Manager,Wang Division, Forestry Development Corporation.

Honorable Chief Guest, His Excellency Dasho Khandu Wangchuk, Deputy Minister, Ministry of Agriculture,

Dasho Bap Kezang , Joint Secretary, Revenue and Customs,

Brigadier Dhendup Tshering, Commandant, Royal Body Guard,

Mr. Tara Bhattarai, Wood Energy Resources Specialist, Wood Energy Development Programme, Bangkok,

Miss Sofie Kobayashi, FAO Programme Officer, Thimphu,

Distinguished Guests, Representatives from Various Organisations and Institutions, Colleagues, Participants, Ladies and Gentlemen:

It is a great privilege and honour for me to organise this important Workshop on Fuelwood Production and Marketing which is being hosted jointly by the Forestry Services Division, Ministry of Agriculture and the Regional Wood Energy Development Programme, FAO, Bangkok, and which is being held here in the Bhutan Forestry Institute, Taba.

I, on behalf of the Forestry Services Division, the Workshop Organising Committee, and on my own behalf, would like to thank and extend a warm welcome to His Excellency Dasho Khandu Wangchuk, Deputy Minister, Ministry of Agriculture, who, despite his busy schedule, could be with us today and grace the occasion. Sir, your gracious presence here today is a clear indication of the very importance you have attached to this workshop.

A special welcome to all the guests from various organisations and institutions who have come to participate in this important workshop.

A hearty welcome is extended to Mr. Bhattarai, Wood Energy Resource Specialist, Regional Wood Energy Development Programme, FAO, Bangkok who has travelled all the way from Bangkok to be with us today and contribute many valuable suggestions.

I extend a warm welcome to Miss Sofie Kobayashi, FAO Programme Officer, who was also instrumental in organising this workshop.

Last but not the least, I welcome those participants and resource persons who have gathered here to contribute to this workshop and make it a worthwhile event.

Your Excellency and distinguished guests, I feel greatly privileged to inform you that this workshop has participants from the Royal Bhutan Army, Royal Bhutan Police, IMTRAT, Project Dantak, Dratshang Lhentshog, Public Works Division, Health Division, Education Division, Improved Stove Project under the Ministry of Trade and Industries, Division of Power, Royal Society for Protection of Nature, Dzongkhag Forestry Extension Officers, Forestry Services Division, Forestry Development Corporation and Non Governmental Organisations like the Bhutan Chamber of Commerce and Industries, Bhutan Carbide and Chemicals Ltd., Bhutan Ferro Alloys Ltd.,Bhutan Borad Products Ltd., Karma Charcoal Ltd. We pledge Your Excellency and distinguished guests that we shall do our best to achieve the aims and the objectives of the course.

Once again, I welcome you all to this Inaugural Session of the Workshop.

APPENDIX 4: INTRODUCTION TO THE WORKSHOP

by

Mr. G. K. Pradhan, Officiating Joint Secretary, Forestry Services Division.

Honourable Chief Guest, Dasho Khandu Wangchuk, Deputy Minister for Agriculture, Distinguished Guests, Participants, Ladies and Gentlemen:

I once again take this opportunity to welcome you all to this inaugural session of the National Workshop on Woodfuel Production and Marketing and I would like to go on to highlight the salient features of the workshop.

I am very glad to inform you that this workshop is the first of its kind at the national level being organised under the auspices of the Regional Wood Energy Development Programme of FAO. Today we have arrived at a situation where fuelwood production and utilisation in the urban areas have become issues of concern to us all. Therefore, development strategies of rational utilisatiion of woodfuel through appropriate technologies and the adoption of alternative energies are the only choices to strike a balance between the woodfuel demand and supply. Thus this workshop is organised with the following objectives:

1. To create general awareness of the patterns of woodfuel supply and demand in the country.
2. To foster appreciation and support for the government's efforts to balance supply and demand.
3. To introduce alternatives to woodfuel.
4. To promote better woodfuel management decisions.
5. To create a better understanding among all parties concerned of the responsibilities for ensuring rational woodfuel use.

To address the above objectives, the workshop is divided into three main parts.
The first part of the workshop will deal with the present status of use and distribution wherein we have presentations from major woodfuel consumer agencies and case study reports from selected territorial divisions.

In the second part, we have some in-depth technical reports on the analysis of woodfuel use in Bhutan, fuelwood research needs in Bhutan and socio-cultural aspects of fuelwood use.
The third part of the workshop is a group exercise which will be undertaken in order to come up with recommendations for the future, including alternatives to fuelwood.

A half day trip is arranged to Chamgang and some nearby saw mills to give some practical insights to the workshop participants.

Honourable Chief Guest, Ladies and Gentlemen, at this point I would like to introduce the workshop participants in brief. We have here the representatives from the RBA, RBP, RBG, PWD, Project Dantak, IMTRAT, the Division of Health, Education, and Power, Dratshang Lhentshog and senior forest officers from all over Bhutan.

We are also fortunate to have with us Mr. Tara Bhattarai, Wood Energy Resources Specialist of the Regional Wood Energy Development Programmme, FAO, Bangkok as the workshop facilitator.

With this short introduction, I wish all the distinguished participants very successful deliberations and a fruitful outcome.

Tashi Delek!

APPENDIX 5: WOODFUEL: AN OVERVIEW

by

Mr. Tara Bhattarai, Wood Energy Resources Specialist,
RWEDP, FAO, Bangkok

Honorable Chief Guest, Dasho Khandu Wangchuk, Deputy Minister, Ministry of Agriculture, Chairman of the Inaugural Session Mr. G. K. Pradhan, Officiating Joint Secretary, Forestry Services Division, Distinguished Guests, Participants, Ladies and Gentlemen:

I am delighted to be here with you this morning in the opening session of the "National Training Course on Integrating Woodfuel Production and Marketing into Forest, Agriculture and Tree Production Systems in Bhutan". I, on behalf of the Regional Wood Energy Development Programme (RWEDP), which is a regional programme of the FAO in Asia, under a trust fund arrangement with the Government of the Netherlands, would like to express our sincere appreciation to the Royal Government of Bhutan, through its Forestry Services Division, Ministry of Agriculture, for accepting our invitation to host this important national training course in Thimphu from 20-22 April 1998.

I would like to extend our hearty greetings to Joint Secretary Dasho Sangay Thinley and many other senior colleagues in the Forestry Services Division; without their keen interest and positive support this important national training course would not have been possible.

As you are aware, a large number of households and a variety of traditional industrial commercial activities in Bhutan rely heavily on wood and other biomass for energy. It is also true that there has been a visible trend of inter-fuel transformation in Bhutan during recent years, at least in urban households and in the modern industrial, commercial and transportation sectors. And the transformation has been mostly in favor of commercial fuels like electricity, coal, gas and other fossil fuels. This has been a common phenomenon in virtually all RWEDP member countries. Like most countries in Asia, the RWEDP member countries are giving a high priority to economic growth, through rapid industrialization and economic liberalization, and as a consequence, the demand for commercial fuel is also increasing due to a massive introduction/adoption of modern energy intensive technologies. The accelerating pace of urbanization has been the other factor contributing to a growing demand for commercial fuels in the domestic sector as well.

But Bhutan also presents a unique scenario of energy production and consumption in the region. From being a net importer of virtually all (over 91%) traded commercial energy consumption in the country in 1979, it has become a bulk exporter of hydroelectricity in recent years. Its hydroelectricity production increased from a meagre 3.5 MW in 1981/82 to 341.6 MW in 1987/88, an average growth rate of 65% per annum. It is also interesting to note that the share of traditional fuel, mostly woodfuel, in total energy consumption, has not declined. Its share was still as high as 85% in 1993 from its 99% share in 1973. And in absolute terms, its use has remained constant between 1991-1993, at 12 petajoules per year. The major consumer of energy in Bhutan is still the household sector. It consumes about 76% of the total energy supply of which 98% is accounted for by traditional fuels. The remaining 23% is the combined share of all other non-domestic sector energy users, i.e. industries, commercial, agricultural and forestry sector related activities, and government institutions. Only 2% of the

household sector energy consumption is met by commercial fuels of different kinds. Also in the non-domestic sectors, as much as 50% of the energy requirement is met by traditional fuels, particularly by fuelwood and charcoal. The provisional energy balance for 1988/89 showed shares of 87%, 12%, and 1% for wood energy, other conventional fuels, and residues respectively.

Except in large urban centres and towns, most fuelwood consumed in the domestic as well as non-domestic sectors is procured from free supply sources, either by self collection or by using hired labour. Even the larger users of woodfuel, i.e. agro-processors, government institutions, commercial establishments, road construction agencies, monasteries, etc., rely heavily on public forests as free sources of fuelwood. This trend in energy consumption is not likely to change soon, despite the fact that Bhutan has become a net exporter of hydroelectricity.

Among the crucial factors which maintain the present heavy reliance on traditional fuel include: (a) the dispersed population and non-uniform distribution of forest area (b) the remote mountainous terrain requiring household energy not only for cooking but also for space heating during winter months (b) the rugged topography that is environmentally vulnerable due to its bio-physical setting and the unique Himalayan ecosystem, (c) the high investment cost associated with infrastructure development for commercial energy distribution and management, (d) the low earnings level of the rural people in mountainous areas whose subsistence economy does not allow them to switch-over to alternative commercial fuels for domestic uses, etc.

Despite this harsh reality, most development planners, particularly in the forestry and power sectors, have not yet duly acknowledged the important contribution made by wood energy in the national economy and energy balance of Bhutan. Unless this gets due recognition and wood energy is fully integrated into the relevant sectoral plans and programmes, a sustainable supply of wood energy cannot be guaranteed in the future and adverse impacts on the socio-economy as well as on the local environment are likely to result from unsustainable fuelwood harvesting. The task of balancing woodfuel supply and demand in areas of localised scarcity and abundance, due to the skewed distribution of existing natural forests and population, will be a much harder task without advance planning and interventions. Further, the health impact of improper woodfuel utilization in open hearths, both for cooking and space heating at the household level, can be significant, particularly for women, children and the old.

Therefore, considering the peculiarity of the energy sector and the importance of the wood energy system, as well as the positive contribution of the traditional woodfuel-based industrial and commercial activities in Bhutan, from the point of view of both employment and off-farm income generation in rural areas, including for women, RWEDP invited the Forestry Services Division, Ministry of Agriculture, to organise this national training course in Bhutan, with the primary aim of disseminating information related to wood energy development at different levels.

This national training course is a first country level activity of RWEDP in Bhutan during its current third phase. RWEDP is, therefore, pleased to assist the Forestry Services Division in organizing this important in-country event on wood energy development, after the latter's active participation in many other regional level courses in the past. A large number of professionals (18 from the forestry, power and women's development sectors, as well as from the NGO sector has participated in these regional level activities. In the present context you may recall the sub-regional training workshop entitled: "Integrating Woodfuel Production into the Implementation of Agriculture, Forestry and Rural Extension Programs in South Asia", organised in Dhaka, Bangladesh in October 1995, in which two participants from

Bhutan participated. The present course is a national follow-up, and during the next three days of deliberations, field observations and group sessions, participants are expected to critically review the situation that is currently affecting woodfuel production and marketing in Bhutan and try to identify issues that need to be addressed with new interventions in order to promote the integration of wood energy into forestry, agriculture and rural development schemes. To guide the participants of the course, a number of presentations will be made by selected resource persons. These, plus participants' own experiences and the findings from field observations shall be used to review the prevailing situation regarding wood fuel production, marketing and utilization. And based upon these findings, joint recommendations shall be drafted to address the critical issues identified in the group sessions. This course is expected also to enhance capability to design and implement future local level training courses, which shall match the situation in participants' working areas.

Before I conclude, once again, I would like to express on behalf of the FAO-RWEDP and on my own behalf, our sincere appreciation to all the persons responsible for organizing this important national training course in Bhutan. I wish the participants and resource persons every success in their endeavor. And I am looking forward to interacting with you all during the next three days of the training sessions. I am confident that the outcome of the course will be a significant contribution to both policy makers and sectoral program designers for the future development of wood energy in Bhutan.

Thank you.

APPENDIX 6: OPENING ADDRESS

by

His Excellency, Dasho Khandu Wangchuk, Deputy Minister, MoA

Distinguished Guests, Participants, Ladies and Gentlemen:

I would like to begin by joining my colleague, Tashi Geley of the Forestry Development Corporation, in extending a very warm welcome to all participants. Given the importance of woodfuel in our country for the well-being of our people, we in the Ministry of Agriculture consider this Workshop a crucial step towards ensuring the sustainable management and supply of this important source of energy.

To the participants from outside the Ministry, I would like to say that we are happy that your organisation is participating in this workshop. On behalf of our Ministry and myself, I take this opportunity to thank all such organisations for their participation. Managers and major consumers of woodfuel have to meet to become aware of the resource situation and to find ways and means together to ensure that this important resource is not depleted over the years.

As responsible individuals in your organisations and communities, I am confident that over the next few days, you will participate actively in the deliberations of the workshop and share your experiences and views with your fellow participants.

I urge my colleagues from the Forest Services Division to use the workshop to highlight their concerns about resource depletion and to create awareness of the need to use the resource judiciously so that it is there for future generations.

I would now like to spend some time on the Royal Government's policy and strategy related to sustainable management and utilisation of our forest resources.

We are most fortunate that our leaders and forefathers had the wisdom and the foresight to conserve and use the natural resources sustainably. This policy has been even more vigorously followed during the reign of our beloved King, His Majesty Jigme Singye Wangchuck, who declared way back in the mid 1970s that the primary focus of the forestry sector should be on conservation and proper management of these important resources and not revenue generation, which was to be considered a secondary function.

As a result, today we have a forest cover of over 72% of the total land area and the coverage is increasing despite the development and modernisation activities all over the country. We have 26% of our land area under the protected area systems such as National Parks, Game Sanctuaries etc. Our country is considered a 'hot spot' for biological diversity. In following the policy of ensuring sufficient forest cover, our National Assembly has declared that we must have 60% of our land area under forest cover at all times.

For all these achievements, we can all be justifiably proud. However, they should not make us complacent. We have ahead of us the sacred task of handing over a country with its environment in pristine state to future generations, just as our forefathers have done to us. This is not by any means an easy task, given the pressure on our forest from the high population growth rate, urbanisation, industrialisation etc.

However, while our task is more difficult and complex than that which our forefathers faced, we have more means as well as international support for our endeavors. We should therefore be determined to succeed in managing our natural resources sustainably. In any case, if we are to let our children inherit a happy and prosperous Bhutan, we have no choice but to succeed. In our mountainous terrain and fragile ecology, unsustainable management and utilisation of our forest resources will have far reaching and damaging social, economic and environmental implications. There will be soil erosion, landslides, floods, and acute shortages of water for all purposes. Agriculture will be affected; our hydropower generation, on which much of our future economy is being based, will be affected, the green hills and mountains we see today will be replaced by bare and barren hillsides; and the current situation of abundance of wood and wood-products will become a thing of the past.

The reason why I have dealt at length with the overall forestry related policy, strategy, current situation, emerging dangers and tasks ahead of the nation in a Workshop on Woodfuel Production and Marketing is because as long as we have good forests, we will have fuelwood.

Specifically on fuelwood, I need not say much about its importance in the daily lives and welfare of our people as all of us here are well aware of it. In our country, the main source of energy for cooking and heating is wood. Our per capita consumption of fuelwood is among the highest in the world. The demand for fuelwood from the industrial and infrastructure development agencies like the PWD is on the increase.

Given its role in the day-to-day lives of our people, the Royal Government is committed to meeting the demand for this important source of fuel. However, there is a need to make judicious use of our forests so as to ensure availability of woodfuel for all times to come. For this, appropriate policies and strategies based on a deep understanding have to be developed, and this is the purpose of this Workshop. While our policy is to meet the fuelwood requirement of our people, strategies for wider adoption of alternative sources of energy, use of fuel efficient stoves and heating systems, waste minimisation, plantation of fast growing trees suitable for fuelwood, and sustainable management of extraction areas will have to be drawn up to meet this objective.

I am confident that at the end of the Workshop, you will come up with recommendations on sustainable management and production of fuelwood and I look forward to receiving them.
In concluding, I request you to participate and deliberate in the workshop with the main objective of avoiding a situation where our people are not able to cook the food they produce, are not able to keep themselves warm during the cold winters, and we have to close down our wood-based industries as is the sad and tragic story in many countries.

With these words, I have the pleasure of declaring the Workshop on Woodfeul Production and Marketing inaugurated and wish all of you success in your deliberations.

Thank you and Tashi Delek!

APPENDIX 7: VOTE OF THANKS AT INAUGURAL SESSION

by

Mr. T. B. Mongar, Deputy Director, Forestry Services Division

Honorable Chief Guest, Dasho Khandu Wangchuk, Deputy Minister, Ministry of Agriculture, Respected Dashos, Distinguished Guests, Participants, Ladies and Gentlemen:

I, on behalf of the Forestry Services Division, the workshop organising committee and on my own behalf, take the opportunity to propose the Vote of Thanks to all of you for kindly joining us in this august ceremony for the National Workshop on Wood fuel Production and Marketing.

We are specially thankful to the Chief Guest, Dasho Kahndu Wangchuk, Honourable Deputy Minister for Agriculture for kindly consenting to preside over the occasion despite his busy schedule. Your Excellency's very presence in this venue reflects the importance and support rendered to this workshop. Sir, we are deeply inspired by your presence here and we the participants and the organising committee assure your excellency that we will strive to the utmost to incorporate the lessons learned from the workshop into our daily work.

We are also thankful to the Dashos and distinguished guests from various agencies for sparing their valuable time to be here with us on this auspicious occasion.

We convey our heartfelt thanks and gratitude to the Regional Wood Energy Development Programme in Bangkok through the FAO Programme Officer at Thimphu for its generous support without which this workshop would not have been possible.

Thanks are also due to the Principal, BFI and his staff for his kind permission to use the venue and campus for convening this workshop.

We convey our sincere thanks to all the agencies, namely : PWD, RBA, RBP, RBG, Project Dantak, IMTRAT, Health, Dratshang Lhentshog, BBS, Education, BCCL, etc. who have readily agreed to support and participate in this important workshop.

Lastly, we express our thanks and gratitude to the Joint Secretary of Forest Services Division, Dasho Sangay Thinley, for his continuous support and inspiration in making this workshop happen.

I once again thank you all.

APPENDIX 8: CLOSING REMARKS

by

Mr. Tara Bhattarai, Woodfuel Energy Resources Specialist, Bangkok

Ladies and gentlemen, as a representative of the FAO/RWEDP, I feel very happy to have attended these three days of deliberations and presentations. As a result of the hard work which has gone into enhancing our understanding of the wood energy issue, I am confident that we are all now in a better position to promote woodfuel energy development not only in Bhutan but throughout Asia. The discussions we have engaged in have been highly pertinent and a considerable amount of intellectual energy has been spent on formulating some important recommendations to strengthen fuelwood management in Bhutan. I thank every one for their hard work, their active participation and for keeping a record of everything that went on.

It was intended that the Chief Rapporteur would present a summary of the workshop proceedings but, unfortunately, due to time constraints this was impossible. Nevertheless RWDP intends to publish the workshop proceedings and the material that has been recorded here will be incorporated into that document.

On behalf of the RWEDP, I extend my sincere appreciation, through you Mr. Chairman, and the Forest Services Division, to the Royal Government of Bhutan for accepting our invitation and hosting this important national training course. And I personally acknowledge the laudable efforts made by everybody involved, including a number of other institutions, Ministries and Departments as well as the donor agencies, to ensure its success. Having said that I also thank the local FAO representation for their kind support. I do expect further support in the future. As a follow-up to this activity, RWEDP has scheduled one more national training program on national planning sometimes in October this year, which will look more into resource assessment data base development and at how to integrate wood energy into planning at a variety of levels. We are by now fully aware of the importance of a reliable fuelwood database to planning.

Once more, I would like to thank all the participants and resource persons who have contributed to the great success of this training workshop.

Thank You.

APPENDIX 9: VOTE OF THANKS AT CLOSING SESSION

by

Mr. Namgay Wangchuk, DFO, Thimphu

Honorable Chairman, the Oftg. Joint Secretary, Forest Services Division, Mr. Tara Bhattarai, Regional Woodfuel Energy Development Programme, Distinguished Guests, Fellow Participants, Ladies and Gentlemen.

On behalf of the Forest Services Division, Ministry of Agriculture, Royal Government of Bhutan and the Organizing Committee of this National Training Course on Woodfuel Production and Marketing, I would like to propose a Vote of Thanks to everyone associated with this training course. for the last three days we have had very fruitful deliberations and productive discussions which were both an educative and a revitalising experience. Such an important training course, organised jointly by the Forest Services Division, Ministry of Agriculture, and the Regional Woodfuel Energy Development Programme, Bangkok, could not have been more appropriate and timely considering the worldwide concern for fuelwood which is the daily source of energy for millions of rural people in the developing world. The primary purpose of the workshop was to draw the attention of the individuals, concerned governmental and non-governmental organisations, and the international community, to the seriousness of the unsustainable production, marketing and utilisation of fuelwood resources. Another purpose was to bring such problems to the awareness of the decision-makers and to encourage them to formulate appropriate strategies and action programs to address and tackle the problems of fuelwood production and supply systems. At the close of the workshop I can honestly state that I believe that this workshop has indeed fulfilled the above mentioned objectives. This would not have been possible, if not for the wholehearted support of the Honorable Joint Secretary of Forest, Dasho Sangay Thinley, who is unfortunately not present with us today. I would like to thank the Officers of the Forest Services Division, HQ, notably Mr. G. K. Pradhan who is presently the Offtg. Joint Secretary, and also the Chairman of this closing ceremony, and Mr. T. G. Mongar, Technical Coordinator, for their individual contributions in supporting and arranging this important training workshop here at the Bhutan Forestry Institute, Taba.

This training workshop would not have been possible if not for the financial support of the Regional Woodfuel Energy Development Programme based in Bangkok and the noteworthy individual contribution of Mr. Tara Bhattarai, Wood Energy Resources Specialist of the Programme who has come all the way from Bangkok to advise and guide the participants throughout the workshop. We would like to thank you Mr. Bhattarai from the bottom of our hearts for your support and contribution. Thanks are also due to the FAO Office here in Thimphu who took the trouble to initiate and coordinate this workshop here in Bhutan. On behalf of the Forest Services Division, Ministry of Agriculture and the Organising Committee I would now like to thank each and every learned participant from outside the Ministry of Agriculture, namely the Ministry of Trade and Industries, Ministry of Social Services, Department of Education, Division of Power, RSPN, monasteries, National Smokeless Stove Project, IMTRAT, Project Dantak, BCCL, BBPL, Tashi Carbon and Chemicals Ltd., Public Works Division, RCSC, Kuensel and BBS. I would also like to thank all the forestry officials

including the *Dzongkhag* forestry sub-sector, from various territorial as well as functional Divisions, for making it to this training workshop and sharing their expertise and experiences with other participants. I wish them a pleasant and safe journey back to their stations. It would not be fair on my part if I forgot to thank the Principal and Staff of the Bhutan Forestry Institute for arranging this convocation hall for the purpose of holding this workshop and for making this place beautiful for the occasion.

Mr. Tashi Geley, Divisional Manager, Wang Division, Forestry Development Corporation, who is the main coordinator of this workshop has suffered many sleepless nights and has made many tireless efforts in organising the workshop and making it a great success. I would sincerely thank him on behalf of the Forest Services Division and the RWEDP in Bangkok.

Thanks also the many people behind the scenes who were involved in secretarial work before and during the course of this workshop, to the various people who showed us round during the field trip today, and to the catering group which has done a great job of satisfying our taste buds by serving us with delicious meals during the last three days.

Finally, once again I would like to thank Mr. Bhattarai for supporting and organising this important training workshop and for being with us. We wish him a pleasant stay while in Bhutan and a safe journey back to his office in Bangkok.

APPENDIX 10: FIELD TRIP TO CHAMGANG – HELELA FOREST MANAGEMENT UNIT

by

Mr. Namgay Wangchuk, DFO, Thimphu Division

Background information was prepared by Mr. Namgay Wangchuk and distriburted to workshop participants.

BASIC INFORMATION :

Plant Period	-	1st Jan. 1993 - 31st Dec. 2002
FMU Area	-	4,694 ha
Production Forest	-	3,108 ha
Protected Forest	-	1,586 ha
Elevation (a.m.s.l.)	-	2,600 m – 4,000 m.
Gross Volume	-	1,988.800 m^3
Growing Stock	-	1,548.700 m^3
Broad - leaved Forest	-	32.4 percent (351 ha)
Conifer Forest	-	67.6 percent (2,734 ha)
Annual Allowable Cut (AAC)	-	13,000 m^3

GOALS AND OBJECTIVES:

i. To improve the forest cover.
ii. To provide fuelwood to the local population.
iii. To supply of timber and fuelwood to the locally based wood using Industries.
iv. To increase the productivity and stocking of the forest.
v. To protect the watershed values.
vi. To protect and conserve the environment, ensure the preservation of genetic diversity.

DISTRIBUTION OF TIMBER/FUELWOOD:

7,500 m^3	of conifer:	Allocated to the FDC to meet local industrial and constructional demand.
2,400 m^3	of Hardwood:	Allocated to various hardwood users for firewood.
1,500 m^3	of Hardwood:	Allocated to FDC to be extracted as logs otherwise allocated for firewood.
1,600 m^3	of Hardwood:	Allocated to various hardwood users for firewood production or sold as oak logs.

MODE OF FUELWOOD SUPPLY:

6 ha of hardwood coupes demarcated annually. Clear felling system adopted in these coupes.

Hardwood firewood also collected from the thinning operations and group selection system (GSS).

Individual tree selection of the dead, dying, diseased trees, over matured, top broken, hollow, wolf trees etc. for conversion into fuelwood.

PROBLEMS AND CONSTRAINTS:

1. Constant pressure on timber especially fuelwood.
2. High preference and high demand for hardwood species for fuelwood for firewood by local people/organizations.
3. High demand for forest products due to close proximity to Thimphu Town.
4. Local people prefer forest products along the forest roads for easy collection and transportation.
5. Overcutting of *cham* sized trees and poles for *tsim* for rural area of Thimphu.

FUTURE PLANS AND PROPOSALS:

1. Future fuelwood supply (especially hardwood firewood) will be shifted to Gidakom FMU, to ease the excruciating pressure on Chamgang/Helela FMU.
2. Armed forces supply of hardwood firewood will be reduced and diverted to Gidakom FMU.
3. PRA with local people is important in convincing them to accept softwood for cooking and heating.
4. More broad-leaved species will be planted in the harvested areas.

The existing forest composition will be maintained in their natural state as far as possible.