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

REPORT

WOODFUEL FLOWS

An overview of four studies carried out on behalf of or with support from

FAO-RWEDP
GCP/RAS/154/NET

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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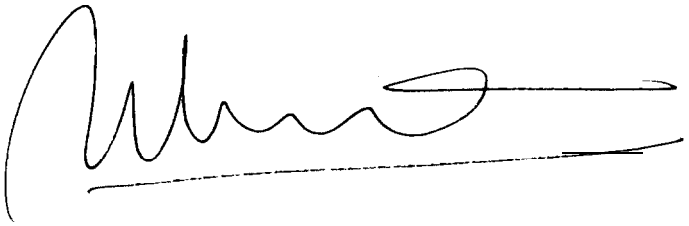
FOREWORD

Woodfuel flows refers to the mechanisms by which wood harvested from a tree eventually reaches the end-users as fuel. These mechanisms can be complex and varied. Gaining an understanding of them involves studying, among other things, characteristics of the woodfuel sources (both forest and non-forest land), harvesting, transport, trade, markets and the actors involved. Woodfuels differ from conventional fuels in their variety of localised markets – which are partly non-monetarized – and their intricate links with rural economies, various site-specific constraints, and the relatively large amount of local labour involved in the 'woodfuel business'. Income generation in woodfuel business goes well beyond the forestry sector, and even provides a safety net for many poor or deprived people. These unique features of woodfuels mean that any policies and interventions aimed at developing wood energy must, in order to be effective, be suited to local conditions and be based on a thorough understanding of local woodfuel flows.

Though woodfuel flows can differ widely from area to area, there are, fortunately, some general lessons that can be learned from the case studies selected and the application of proper methodologies in surveys. The present document provides an excellent overview of these lessons. The overview was completed by Mr Auke Koopmans in the previous phase of RWEDP, but could not be published at the time. In view of the importance of the subject, it is now published for wide distribution. It is expected to be of benefit to readers in the preparation and implementation of further area-based studies on woodfuel flows.



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1. INTRODUCTION AND BACKGROUND[1]

1.1. The Importance of Woodfuels

In many countries, not only in Asia but also in other parts of the world like Africa, Latin America, Oceania, etc. biomass in its various forms is an important source of energy. During the past 5 years several studies have been carried out within the framework of the FAO - Regional Wood Energy Development Program (FAO-RWEDP), both on a country as well as on a regional basis, which have shed some light on the importance of fuelwood and other biomass as a source of energy. This importance is evident from table 1.1 which provides a brief overview of energy use in FAO-RWEDP member countries.

Table 1.1 Sectoral energy consumption as a % of total for RWEDP countries

Country	Commercial energy		Fuelwood and/or charcoal		Residues, dung, etc.		Total traditional energy sources			Year and Source
	Dom.	Oth.	Dom.	Oth.	Dom.	Oth.	Dom.	Oth.	Tot.	
Bangladesh	3.8	9.8	11.7	3.4	57.6	13.7	69.3	17.1	86.4	1981/BEPP, 1987
Bhutan	1.5	11.3	75.1	11.8	0.6	0.0	75.7	11.8	87.2	1988/FAO, 1991a
India	---	---	---	---	---	---	---	---	39.1	89/90 Est. 5)
Indonesia	12.6	33.1	50.9	3.5	---	---	---	---	54.3	1979/WB 1980 3)
Myanmar	0.6	12.0	84.1	---	2.5	0.8	86.6	0.8	87.4	1990/WB 1990a
Nepal	1.2	4.4	92.8	1.5	0.0	---	92.8	1.5	94.4	1982/WB 1983a
Pakistan	7.1	40.1	41.2	11.6	1)	1)	41.2	11.6	52.8	1991/Ouerghi'92
Philippines	10.1	44.8	32.6	5.3	3.5	3.6	36.1	8.9	45.1	1989/WB 1992b
Sri Lanka	6.6	21.6	59.0	10.3	2)	2.3	59.0	12.6	71.8	1990/CEB 1990
Thailand	8.8	60.9	18.9	2.4	1.2	7.6	20.1	10.0	30.3	1988/NEA 4)
Vietnam	2.0	24.0	29.6	4.4	34.7	5.2	64.3	9.6	73.9	1988/FAO 1992a

Note: "Others" includes Industry, Transport, Agriculture, Commerce, Government as well as Other uses. Conversion losses have not been accounted for. -- denotes "No data available" while 0.0 denotes "Neglible amount"
1) Residues are included under fuelwood
2) Domestic fuelwood consumption apparently includes residues also
3) The Domestic sector includes Government use as well as use by Commerce
4) Domestic use includes use by Commerce as well
5) Estimate by the author, based on WRI/UN data for commercial energy and unofficial World Bank data for traditional sources of energy.

Source: RWEDP, 1993e

[1] Most of the information provided in this chapter has been derived from papers presented at the "Expert Consultation on Data Assessment and Analysis for Wood Energy Planning" held in Chiangmai, 23-27 February 1993.

Table 1.1 only shows the importance of the traditional sources of energy in relation to the total amount of energy consumption. By using the quoted and other sources of information, as well as some assumptions, the amounts of traditional energy sources expressed in tons were divided into fuelwood and charcoal, residues such as rice husks and straw, etc., bagasse and dung (see table 1.2).

Table 1.2 Traditional energy use in tons for RWEDP countries

Country/Region	Traditional energy use 1)	Traditional energy use in million tons 2)					Year / Source
	Million tons in 1989	Total 3)	Fuelwood / Charcoal	Resi-dues	Ba-gasse	Dung	
RWEDP countries							
Bangladesh	17.98	31.95	5.86	23.88	1.53	6.70	1981/BEPP, 1987
Bhutan	1.92	0.94	0.92	0.02	---	---	1988/FAO, 1991a 4)
India	176.27	321.83	162.06	51.17	---	119.4	1990 6)
Indonesia	89.05	73.13	---	---	---	---	1979/WB 1980 5)
Myanmar	12.31	28.46	26.33	2.46	7)	---	1990/WB 1990a
Nepal	13.92	11.33	---	---	---	---	1985/TFAP 1988
Pakistan	18.51	60.82	---	---	---	---	1991/Ouerghi '92
Philippines	24.67	35.18	29.15	6.96	---	---	1989/WB 1992b
Sri Lanka	5.29	13.08	12.61	---	0.74	---	1990/CEB 1990
Thailand	37.42	30.37	23.86	3.38	6.32	---	1988/NEA
Vietnam	15.91	46.80	33.18	13.62	7)	---	1988/FAO 1992a
Future RWEDP countries							
Laos	2.38	2.40	2.40	---	---	---	1989/GOL 1990a
Malaysia	5.63	---	---	---	---	---	
Maldives	---	0.09	0.09	---	---	---	1987/ESCAP 1989

Note: 1) This column is based on World Resources 1992-1993 (WRI, 1992) while the data provided in all other columns are derived from the sources given in the last column
2) Conversion factors used as mentioned in the original documents
3) Converted to fuelwood equivalent by using average conversion factors
4) A direct comparison can not be made due to a different population size (700,000 in the FAO study instead of 1.4 million as used in WRI 1992)
5) Traditional fuel use based on Soesastro et al (Soesastro, 1983)
6) Unpublished and unofficial estimates by ESMAP
7) Included under residues
-- No data available.

Source: RWEDP, 1993e

Even though the information provided in these two tables sheds some light on the importance of traditional sources of energy as well as on the amounts used, it provides little insight into the origin of these sources of energy. Fuelwood and charcoal, if solely obtained from forests, would affect the forest cover and this would have to be taken into account in any policy decision with regard to forestry. However, it is known that in many countries part of the fuelwood is obtained from non-forest sources such as private plantations, homesteads, etc. Unfortunately, little is known about these non-forest fuelwood sources and the mechanisms through which this fuelwood reaches the users. For that reason FAO-RWEDP commissioned several in-depth studies to gain a better understanding of the mechanisms involved.

The present paper intends to provide a synopsis of these detailed studies[2]. Besides these studies, use has been made of other information such as that contained in the Pakistan Household Energy Strategy Study, the Philippines Household Energy Strategy Study, the Urban Household Energy Strategies Study in Indonesia (all studies carried out by and for World Bank/ESMAP), papers presented at the "Expert Consultation on Data Assessment and Analysis for Wood Energy Planning" held in 1993 in Chiangmai, Thailand, etc.

By tracing woodfuel flows and by focussing on woodfuel market mechanisms it is hoped to fill in some of the gaps in our understanding of how and under what conditions woodfuels move from a source to the users. This is considered important as it may help in identifying policy gaps with regard to the supply side of woodfuels in the forestry sector. This study, which is a desk study, will concentrate on fuelwood rather than charcoal, but where necessary and where sufficient information exists, wood used for charcoal making will also be covered.

[2] FD no. 36 Charcoal Production and Marketing in Gujarat.
FD no. 38 Marketing of Woodfuels in Peshawar City, Pakistan. A Case Study.
FD no. 39 Woodfuel Flows in the Dry Zone of Myanmar. A Case Study.
FD no. 42 Patterns of Commercial Woodfuel Supply, Distribution and Use in Cebu, Philippines.

2. ORIGIN AND SOURCES OF WOODFUEL

As shown in the previous chapter, woodfuels are widely used in the region both for domestic purposes as well as for industrial use. Common to both sectors is their use of all types of fuelwood such as wood from trees, sawdust, bamboo, charcoal, woody biomass such as stalks, fronds, etc. Another common feature of both sectors is that the origin of woodfuels is often unclear as they are obtained from both forests and non-forest sources. However, there are also some differences. The commercial sector (industries, food vending, etc.) in general buys its woodfuel supplies. This is in contrast to the domestic sector where most of the woodfuels are not traded, particularly in rural areas where many people collect woodfuels or make charcoal themselves. An exception may be rural areas with little forest cover. In these areas part of the woodfuels is traded as well, depending on the availability of alternative sources of woodfuels and other sources of energy. In urban areas traded woodfuels are more important although here too a considerable amount is collected by users themselves. In order to be able to better understand the importance of these commonalities and differences, a brief overview of woodfuels sources will be provided.

2.1. Forest and Non-Forest Woodfuels

As mentioned before, woodfuels are obtained from many different sources even though most of them ultimately may have originated in the forests. For instance, in urban areas construction and/or demolition sites are an important source of woodfuels, particularly for the urban poor. However, much of these woodfuels are offcuts, etc. from timber which once grew in the forests. There is therefore a need to have a definition for woodfuels from forest and non-forest sources. Within the context of this paper it has been assumed that:

Forest based woodfuels are woodfuels which have their direct origin in natural forests

This definition implies that logging wastes are forest based woodfuels as well as woodfuels obtained from forest clearings for agricultural or other purposes such as road construction, etc. It can be argued that these woodfuels should be considered as being different from forest based woodfuels because they were generated as a by-product i.e. they do not have a direct bearing on loss of forest cover. However, the same is more or less true where twigs and branches are cut from trees in the forest. Besides, the literature used for this desk-study is not very clear with regard to the terms "forest based" and "non-forest based" woodfuels. The definition given therefore may not be universally valid. Using the above definition for forest based woodfuels, then:

Non-forest woodfuels are those that are not directly obtained from the forests

These non-forest woodfuels consist of trees growing outside the forest such as those growing in homesteads, along roads, canals, etc. trees on communal land, agricultural land, etc. as well as wood waste such as off-cuts from sawmills, sawdust, wood waste from construction sites, discarded wooden packing materials (boxes, pallets, etc.), scrap-wood collected along roads, garbage dumps, driftwood along rivers and coasts, etc. These "waste" woodfuels are often not covered in studies as they are considered insignificant in comparison to other woodfuel sources. However, a study carried out by the World Bank showed that, for instance, woodfuels from construction sites accounted for 4% of all woodfuel use in urban areas in Indonesia ranging from close to zero in small urban areas to 22% in the very large cities such as Jakarta (WB, 1990). In

Cebu city the amount of scrap-wood was estimated to be close to 20% of all fuelwood used in the city for domestic purposes only. Driftwood is often important along rivers, etc. A study in Indonesia (RWEDP, 1991) showed that some people, after very heavy rains upstream (approximately 1-2 times per year), could collect enough driftwood to last them a few months and sometimes even enough to sell to others.

Again the studies used are often not very specific on what is included under non-forest woodfuels. In some cases other sources of woody biomass are also called woodfuels while other studies categorize these as agro-residues. These include stalks such as those from cassava, cotton and other crops, coconut fronds, fronds from other palm trees, etc.

Although the definitions, as presented earlier, are not very precise and no doubt may lead to ambiguities, it appears that these apply to most of the information presented in the various studies on the origin of woodfuels. Using these definitions, table 2.1 gives an overview of the source of origin of woodfuels for selected countries.

Table 2.1: Overview of the amount of forest and non-forest woodfuels consumed

Country	Total amount of fuelwood consumed	Share (%) of forest wood	Share (%) of wood from other sources
Bangladesh	5.5 million tons	13	87
India	94.5 million tons	26-53	47-74
Nepal	11.3 million tons	66	34
Sri Lanka	9.1 million tons	25	75
Philippines	25.3 million tons	15	85
Thailand (1)	8.8 million tons	48-50	50-52
Thailand (2)	16.0 million tons	50	50
Pakistan (3)	33.0 million tons	27	73
Vietnam (3)	33.0 million tons	25	75

Note: 1 Wood used as fuelwood
2 Wood used for the production of charcoal. Amount has been estimated by the author.
3 The shares are based on estimates, assuming that only an amount equal to the Mean Annual Increment is removed from the forests.

Source: RWEDP, 1993e

Table 2.1 only provides an indication on a countrywide basis, but within countries there often are large variations depending on the local situation with regard to forest cover, population density, availability and stability of supply of alternative sources of energy, cash incomes, etc. For instance, people in the large urban areas in Indonesia used no fuelwood from the forests but people in small urban areas obtained 11% of their fuelwood from forests as shown in table 2.2. In small to large urban areas around 50% of the fuelwood was obtained from own land while fuelwood using households in very large urban areas such as the capital Jakarta obtained only 11% of the fuelwood

from own land (WB, 1990). In Pakistan, also, large regional variations are reported to be common, as shown in table 2.3 (WB, 1993).

Table 2.2 Variations in woodfuel collection sources for urban areas in Indonesia

Woodfuel source	Fuelwood use by urban households (HH) by source and by urban size in % of HH who use fuelwood				
Size of urban area	Small	Medium	Large	Very Large	INDONESIA
% of urban HH using fuelwood	55	30	26	3	23
Own land	44	48	50	11	43
Other people's land	13	10	11	3	11
Forests	11	0	0	0	6
Construction projects	1	0	4	22	4
Others	3	16	10	11	7
Combinations	28	26	25	54	29
TOTAL	100	100	100	100	100

Source: WB, 1990

Table 2.3 Regional variations in woodfuel collection sources in Pakistan

Woodfuel source	Source of collected fuelwood - Frequency of responses				
	Punjab	Sindh	NWFP	Baluchistan	PAKISTAN
Own land	38.7	14.1	39.9	8.4	31.7
Other people's land	40.1	55.3	24.4	9.9	40.3
Common land	9.9	9.0	14.7	48.1	12.1
State forest land	8.4	17.8	17.1	26.3	12.6
Others	2.9	3.8	3.9	7.5	3.3
TOTAL	100.0	100.0	100.0	100.0	100.0

Source: WB, 1993

2.2. Commercial and Non-Commercial Woodfuels

Woodfuels can be collected by the users themselves or bought from other people, traders, shopkeepers, etc. In the first case woodfuels can be collected solely for own use but possibly also solely for the purpose of income generation. In between these two extremes there are many variations with a greater or lesser amount of woodfuels collected for own use with the remainder used to barter, earn cash income, to convert it into charcoal (again for own use or for sale), etc. On the other hand people may buy fuelwood basically for their own use but sometimes also for other purposes such as for income generation.

Again, as is the case with the source of woodfuels, the literature is, in almost all cases, not specific with regard to the trade of woodfuels. An exception is a study carried out by Bensel and Remedio (RWEDP, 1993a) in Cebu city, the Philippines which provides a good insight into this phenomenon. It was estimated that the fuelwood consumption in the domestic sector of Cebu city reached over 55,000 tons per year. Of this amount, close to 43,000 tons were used purely for domestic purposes such as cooking, etc. while the remaining 12,000 tons were used for commercial activities in households such as for instance cooking of food for sale, etc. Figure 2.1 and annex 2.1a and 2.1b respectively show the composition of the woodfuels used and how they were obtained, while annex 2.2 provides various data on woodfuel acquisition.

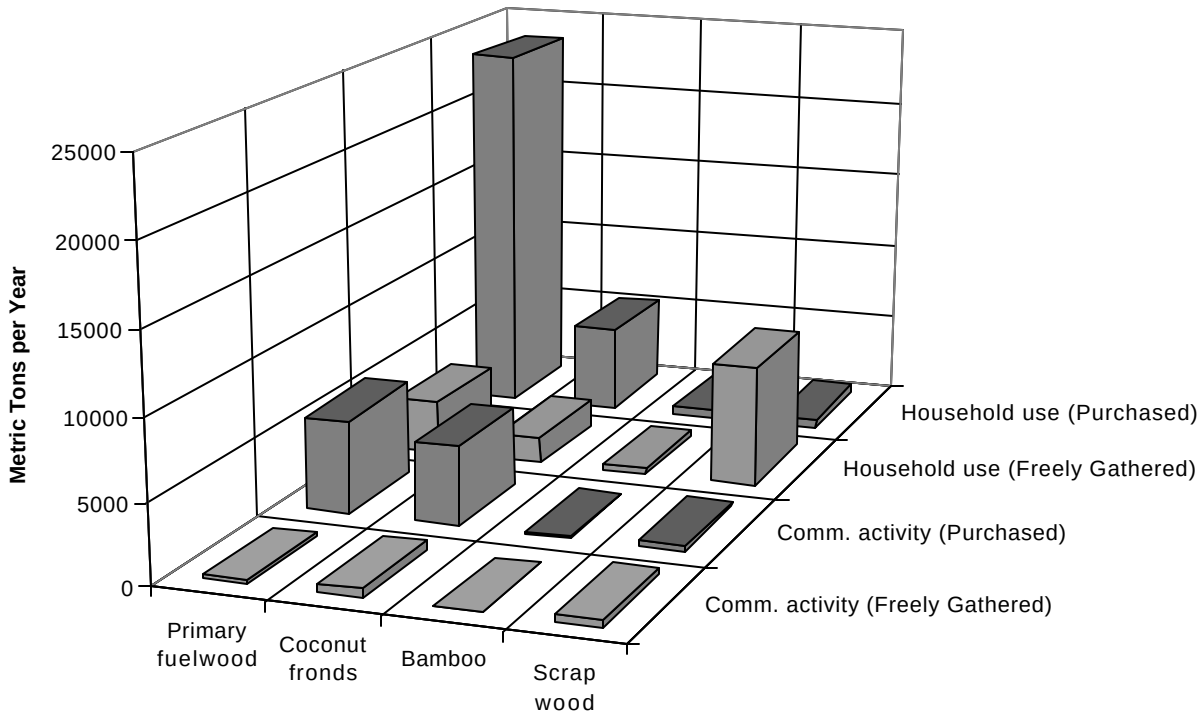

Figure 2.1 Residential fuelwood consumption in Cebu City, Philippines
Source: RWEDP, 1993a

Although these differences, as presented above i.e. forest or non-forest based and commercial and non-commercial woodfuels, can be defined, there are also similarities across all sections. Commercial woodfuels can be forest and non-forest based. The same is true for non-commercial woodfuels. The definition given earlier for forest based woodfuels implies more or less that the use of such woodfuels would increase the loss of forest cover. However, a considerable amount of forest based woodfuels consists of dead wood such as fallen branches, twigs, etc. Another part of these forest based woodfuels consists of lopped off branches without cutting down trees as shown in table 2.4. These phenomena make the process of drawing conclusions about woodfuel supplies and their effects a tricky undertaking.

Table 2.4 Fuelwood and charcoal sources in three farming areas in Thailand

Part/Source/Use	Fuelwood			Charcoal		
	Chiangmai (n = 98)	Khon Kaen (n = 66)	Chachoensao (n = 62)	Chiangmai (n = 10)	Khon Kaen (n = 75)	Chachoensao (n = 66)
Part of tree used						
Fallen branches/leaves	45.9	32.3	51.6	---	10.7	45.5
Lopped branches	35.7	21.2	32.3	50.0	9.3	25.8
Felled trees	13.3	31.8	16.1	40.0	73.3	22.7
Others	5.1	13.7	---	10.0	6.7	6.0
Source of woodfuel						
Public forest	52.0	28.8	11.3	40.0	26.7	12.7
Natural trees on own land	2.0	62.1	35.5	50.0	65.3	40.9
Planted trees on own land	32.8	4.6	30.6	---	5.4	19.7
Purchased wood	10.2	3.0	11.3	10.0	1.3	16.7
Public land	---	---	---	---	---	6.1
Others	3.0	1.5	11.3	---	1.3	4.5
Purpose						
For own use	---	---	---	100.0	85.3	94.0
For sale	---	---	---	---	4.0	3.0
For own use and sale	---	---	---	---	10.7	3.0

Source: Chalamwong, 1990

Charcoal in many cases can be considered a "commercial" woodfuel. However, in countries where charcoal is widely used for domestic purposes such as in Thailand, charcoal making for own use is also common. Although large sized wood is often used for charcoal making this may be obtained both from forest and non-forest sources, making again a general conclusion on origin difficult.

3. WOODFUEL FLOWS, MARKETING AND ACTORS INVOLVED

As is evident from the previous chapter, there are many variations in the source and origin of woodfuels used in rural and urban areas. Notwithstanding these variations, this in general has not much influence on the manner in which woodfuels are moved from the sources to the end-users. Systems of moving wood from the source to the end-user may range from very simple to elaborate systems. For instance, where wood is collected for own use, only the collector is involved whereas where woodfuels are obtained from forests or private woodlots for sale to urban users, many intermediaries can be involved. These intermediaries may range from the owner of the trees, caretaker of the trees, woodfuel cutters, woodfuel converters, woodfuel assemblers, wholesalers, retailers, commission agents both for buyers as well as sellers, transporters, etc. Where many intermediaries are involved, it is quite difficult to trace the flow of woodfuels even though in most cases permits are required to move woodfuels and often also for cutting down trees for use as woodfuel. Many changes can be made along the way i.e. large lots may be split up into smaller lots and shipped to different destinations. Part may be diverted for use as timber, large sized wood may be split, bundle sizes may be altered, weights and volumes may change (drying wood, ingenious ways of re-bundling which increase the volume of bundles without altering the weight), repacking and/or adulteration of charcoal with other materials, etc. This chapter deals with these woodfuel flows and marketing systems and attempts to describe some general system characteristics and actors involved in the supply of woodfuel from the source to the end-users.

3.1. Woodfuel Supply Sources

3.1.1. Forest woodfuel sources

In almost all cases forests are controlled by the government either through the forest department or other forestry related organizations. Formal woodfuel supplies from forest sources are relatively easy to quantify as in almost all cases this will involve controls and permits. The Myanmar study shows that trees destined for fuelwood and charcoal making are marked by Forest Department personnel and permit holders are only allowed to cut the marked trees (RWEDP, 1993c). An exception is bamboo, which is allowed to be cut at will. In Pakistan the Forest Department sells woodfuels through open auctions with lots sorted into species and sizes, each fetching different prices (RWEDP, 1993b). In Nepal, the Forest Department issues permits to organizations to remove woodfuels from certain areas, often in conjunction with permits for timber (Shaikh, 1989).

However, besides the removals allowed for by permits, there are also woodfuel supplies which are removed without official permits. Many people living near or in forested areas collect woodfuels for own use as well as for sale even though this may be illegal and, when caught, may result in confiscation of the woodfuels and possibly fines or even worse. The Myanmar study states that woodfuel gatherers have to be registered and need to carry identity cards and that permit holders (woodfuel traders) are required to employ only registered gatherers/collectors. Even though these regulations exist, a considerable but unknown amount of informal and unauthorized removals take place (RWEDP, 1993c).

Although in most countries the forest department frowns upon the removal of woodfuels without permits, in some countries they allow people, sometimes in exchange for a small "fee" to collect

dead wood such as twigs and small branches (RWEDP, 1991). However, even where this is allowed for own use, a considerable amount of woodfuels are gathered for sale. These amounts, which normally are carried as head- and back loads to the market place, are difficult to quantify. These woodfuel supplies, which can also be called the informal sector supplies, are often sold in the local community as in many cases permits are required to transport woodfuels over larger distances.

3.1.2. Non-forest woodfuel sources

In the case of non-forest woodfuel sources, the quantification of amounts removed is often much more complex, particularly in cases where relatively small quantities are involved. For larger quantities, the relevant authorities often need to be contacted before trees are cut down, although in other countries the cutting of trees on private land is deregulated, with the possible exception of certain species. For instance, in Pakistan trees on own land, whatever their origin, belong to the landowner and apparently may be cut down without restrictions[3]. However, in the international border belt as well as in uplands subject to erosion, trees growing on owned lands can't be cut down, removed or transported without permission from the forest, defense or civil departments. Some species are "classified" such as Deodar (*Cederus deodara*) and *Juniper*, and these can not be cut anywhere (FSMP, 1992).

In the Philippines, farmers may cut down trees on their own land but if the wood is going to be sold and transported, a transport permit is required. The farmer, or more often the trader who buys the woodfuels, will have to apply for a transport permit by showing proof of ownership of the land on which the trees were growing. Upon proof, and often after visual inspection of the wood or trees, a permit is issued for the quantities involved (RWEDP, 1993a). In Gujarat state in India, in the case of charcoal production from wood grown on private lands, permits are required for both harvesting of the wood as well as for converting the wood into charcoal. A third permit is required to transport the charcoal to the markets (RWEDP, 1993d).

Little is known about other non-forest woodfuel supplies such as drift- and scrap wood, saw mill offcuts, etc. Much of these sources are localized i.e. they are only available in certain areas such as along rivers and lakes (driftwood), near sawmills (offcuts), etc. and most of the woodfuel will be used locally. An exception to this general rule are sawmill offcuts which may be transported to larger users such as brick and lime kilns, bakeries and other woodfuel using industries, while part may be converted to charcoal.

3.2. Woodfuel Collection, Cutting and Conversion

As was shown earlier, woodfuel collection is often practiced and, depending on the local situation, may provide a major part of the woodfuels obtained from a particular area. The literature used for this desk study in all cases is not very specific with regard to the terms "collection" or "gathering". It appears that in most cases it includes, besides the collection of dead and fallen wood from all types

[3]The right to cut and the use of products from trees growing on rented land often rests with the landlord, even though the trees may have been planted by the farmers. This lack of rights as well as uncertainty in land tenure is a factor which was found to inhibit the growing of trees in Pakistan (WB, 1993)

of lands, along roads, rivers, scrap-wood, drift wood, etc., the cutting and lopping of branches from individual trees as well as the cutting of whole trees purely for the purpose of obtaining woodfuels.

Although little written evidence could be located, it is thought that quite a substantial portion of "collected" woodfuels is gathered for own use with only a part destined for sale. However, where the sources of collected wood are near to urbanized areas (larger villages and cities) where a ready market may be found for the relatively small amounts collected, a larger part of this collected wood could end up in the market, providing a ready source of cash for the gatherers (Ellenbroek, 1988). In particular, where woodfuels consist of easily marketable species which may be preferred for certain purposes, such woodfuels may be sold while other, less preferred species, are retained by the "collector". In some areas people who gather woodfuel sell it to earn an income while they themselves make do with whatever fuel is available (small twigs, leaves, agro-residues, dung, etc.).

As the amounts involved are often relatively small, only a few tools are required. These normally consist of a knife (machete, etc.), one or more baskets and sometimes a yoke to carry the baskets. The knifes are used to chop the wood into shorter pieces (length varies on location) while the baskets and/or the yoke are used to transport the wood back home, for storage near the road or direct to the market place. Alternatively, in many countries the wood gathered is bundled and carried manually (back- and head loaders). Larger sized woodfuel such as thick branches and trees are normally cut by axe and handled on site i.e. the thick pieces are split, sized and bundled before being transported to a pick-up point which, depending on the distances involved, can be the home of the woodfuel cutter or to a roadside place where it is stored before being transported to other places. Where the local conditions are favorable such as on steep hills above roads, trees cut down may be moved to sites which are easily accessible. At these sites the wood is then cut, split, bundled, etc. before being transported. Where the woodfuels are destined as fuelwood for small industries, etc. the wood normally is only sized but not split as industries often prefer large sized wood as fuel. The same is true where the wood is used for charcoal making as here also larger sized wood is preferred.

Bundle sizes vary greatly from country to country but also depending on end-use. For instance in Cebu in the Philippines two types of bundles are common (RWEDP, 1993a). *Raja* bundles contain sticks that have been carefully sized and split with the wood often being dried for a few days before being bundled. The bundles are uniformly sized with the weight of the bundles showing only small variations of around 4 kg. each. *Raja* bundles are normally destined for sale to domestic users such as for cooking. *Ukay-ukay* bundles often are sold to small industries such as bakeries, etc. and consist of larger sized wood, often un-split or split only once or twice, with bundle sizes showing large variations in weight as well as in the number of pieces in a bundle. In another area of the Philippines (Laguna province) two types of bundles exist: *Raheta* and *Babat* or *Kahoy-kanin* (RWEDP, 1991). A *Raheta* consists of 4-5 pieces of split wood about 42 cm. long while *Babat* consists of 9-10 pieces of split wood and has a diameter of about 17-18 cm. and a length of 52-54 cm. In Indonesia in the Gunung Kidul area (Central Java near Yogyakarta) bundles vary greatly in size and weight (Ellenbroek, 1988). Large sized bundles, locally called *bongkok* can measure 1 m. in length with a circumference of 90 cm. while in another area the same term refers to a bundle with a length of 50 cm. and a circumference of 1 m. In yet another area, only about 15-20 km. from the first area, a *bongkok* may measure 50 by 190 cm. or 50 by 250 cm. (length and circumference). Bundles of fuelwood sold in Myanmar (Ryan, 1991) range from 1 to 2 ft. in girth and are about 1.5 ft. long with weights ranging from 3-5 lbs. (1.5 - 2.5 kg.). Non-standardized units such as, for example, head- and back loads, baskets, bags, etc. are widely used in many countries.

However, the weight and volume of such units, not surprisingly, vary widely as much depends on the persons involved with such units (physical strengths, distance to be covered, terrain, etc.).

Fuelwood destined for the larger consumers such as industries like brick making, lime burning, bakeries, etc. often are not bundled but are sold in bulk by weight, per cubic meter or in another (local) volume measurement. Variations are often found in the volumetric measurement systems. For instance in Nepal *chattas*, measuring 20 ft. by 20 ft. by 5 ft. are used as standard units for fuelwood. However, the type, quality and quantity of fuelwood in a *chatta* can vary considerable and drivers of trucks who transport woodfuels often earn a bonus if they exceed certain weight-to-*chatta* volume targets. This is made possible by selecting the better *chattas* or convincing the people who cut and stack the wood to create better *chattas* for them. The main reason why some *chattas* are considered better than others is that they may contain larger sized woodfuel and/or consist of better species. The latter can often be sold as timber to furniture makers, etc. which brings a better price than fuelwood (Shaikh, 1989).

In Pakistan, however, stacks of woodfuel vary in price depending on the thickness of the wood contained in the stacks. A stack (1,000 cft) of selected wood, which has a diameter over 25 cm., fetches a price which is about 4 times as high as a stack of wood which only contains thin wood with diameters ranging from 2.5 - 5.0 cm. (RWEDP, 1993b).

With regard to wood for charcoal, much depends on local practices. For instance, in Nepal where charcoal making is illegal, charcoal is often made on a very small scale in the forests. Being illegal, charcoal makers tend to speed up the process, resulting in a low grade product (RWEDP, 1991). In other countries, depending on local conditions, charcoal making is either carried out near the place where wood is available, or where transport of wood is relatively easy, it is often carried out near the home of the charcoal makers as they find this makes it easier to control the carbonization process. Wood for charcoal is often larger sized but may consist of all types of wood such as tree trunks, stumps, roots, etc. (RWEDP, 1993a). After having been converted to charcoal, it is packed in bags or baskets. Generally, different types of charcoal are packed separately. In the Philippines a distinction is made between "light" or *magaan* charcoal and "heavy" or *mabigat* charcoal. The latter consists of charcoal made from wood which is considered a good raw material while the former is made of inferior species (RWEDP, 1991).

Kilns used for charcoal making are often of the temporary type such as pit kilns, earth mound, etc. The reason for this is that raw material supplies for charcoal making are often temporary i.e. relatively small amounts are available in a given location which makes frequent moving of the kiln a necessity. However, in Gujarat in India charcoal is made using the earth-mound system even though wood supplies (mesquite or *Prosopis juliflora*) apparently are available locally in relatively large quantities (RWEDP, 1993d). This would make the use of permanent kilns, which in general are more efficient, an option to increase the output.

3.3. Trading Channels and Transport

Woodfuels which are traded have to be transported from the source to the end-user. A differentiation can be made between small woodfuel gatherers (the informal sector) and the larger traders (private sector). Woodfuel gatherers often carry the woodfuel supplies to local markets (head- and back loaders, etc.), where they themselves sell it to the users. The amounts carried in this way are usually quite small even though many people may be doing so. For instance, in Nepal it was estimated that in the Kathmandu valley from 3-6% of the woodfuels used consisted of supplies brought in by head- and back loads (Shaikh, 1989). However, another 16% of the woodfuel supplies could not be accounted for and part of this amount may have consisted of head- and back load supplies as well. Another considerable amount of woodfuel supplies appears to be handled by non-professional or occasional traders. For instance, many truck and bus drivers buy woodfuels along the road and bring these supplies piggyback style to the market. By doing so they are able to earn an additional income. Besides the truck and bus drivers, other people are involved in similar ways by buying woodfuels if available, and when convenient transporting it. These supplies can be for own use, but more often are transported to the market place. Here the wood is sold to shop keepers or, if sufficient time is available, directly to the users.

The practice of occasional trade appears to be common in many countries and is facilitated by he fact that the transport of small quantities is normally considered to be for own use. Most of these supplies, which may account for a considerable but unknown part of the overall woodfuel supply system, therefore circumvent the normal trade channels which in most cases are governed by rules and regulations.

The major part of woodfuel supplies is thought to be handled by woodfuel traders who bring woodfuel supplies in larger quantities from the source to the end-user. These traders acquire the supplies through various channels such as buying directly from woodfuel collectors, farmers or landowners who want to dispose of their trees, through auctions, through permits issued by forest organizations, and various other channels.

In Myanmar, the woodfuel trade is dominated by formal woodfuel traders. The Forest Department issues permits to traders to cut marked trees in the forest. The trader is supposed to use only woodfuel cutters which are registered by the Forest Department. After having been cut, the wood is transported by bullock cart to the traders' places and is sized and bundled. The wood is then transported by truck to the end-users. Truckloads of woodfuels (fuelwood, bamboo, charcoal, etc.) are recorded at Forestry Department checkpoints. These checkpoints are located at major forest exit points and transit points. Checking consists of measuring the volume and calculating the royalties to be paid on the amount transported. Where woodfuels are transported beyond the check point, removal pass fees also have to be paid. Besides these fees, the traders have to pay the Forest Department for the permit to cut wood, unlike for bamboo which can be cut without a permit (RWEDP, 1993c). A permit, in the form of a charcoal kiln license, to produce and transport is required and the same system of levies valid for wood and bamboo applies, albeit with different rates.

In Pakistan, the Forest Department owns and manages forest plantations. Fuelwood is sorted according to species and size class and then stacked, with each stack containing 1,000 cft. These fuelwood lots are sold through open auctions with prices realized at earlier auctions serving as the base or reserve price. Larger sized wood and/or preferred species fetch a higher price than small sized wood and species considered inferior for use as fuelwood. The woodfuels are normally transported by truck or train to depots in the main cities or directly to end-users such as industries, but also to wholesale and retail shops. Transport costs vary widely but are thought to consist of two main parts: A fixed sum for providing the truck with a driver and a variable part which depends on the distance as well as time involved.

The Forest Department apparently does not charge for permits, but along the road local government organizations charge *octroi* and *zila*. These taxes are not uniform i.e. they vary widely from province to province (RWEDP, 1993b, WB, 1993). Acquiring non-forest woodfuel supplies involves local traders, also called assemblers, who buy from woodfuel cutters or from farmers. These traders often have their depots along the roadside where retailers or wholesalers will come to buy the supplies. The traders/assemblers have considerable influence on the price of woodfuels as they are the people who have the links with the retailers and wholesalers. Traders buy both prepared wood as well as on stump. In the latter case the trader will pay the farmer for the trees, hire people to cut down the trees and transport the wood to his depot. It is thought that in such cases the farmer may earn less than he would if he cut the trees and prepared it as fuelwood by himself. Table 3.1 provides a brief overview of the importance of buying on stump.

Table 3.1 Percentage of traders who buy standing trees from private farms

	Urban areas		Rural areas		Along Road sides		Total cases
	Retail	Wholesale	Retail	Wholesale	Retail	Wholesale	
Buy	7%	21%	14%	83%	44%	86%	171
Don't buy	93%	79%	86%	17%	56%	14%	374
Total cases	198	14	77	6	181	69	545

Source: WB, 1993

If the woodfuels are obtained from private land, the supplies are not subject to permits but *zila* and *octroi* taxes still have to be paid during transport. Part of the supplies are obtained from state forests located in the "tribal areas". Although in principle a permit would be required to cut trees, the Forest Department has in fact very little control over these areas with the result that trees are cut at will. Charcoal making is carried out in areas near major demand centers. The transport of charcoal is also subjected to the *zila* and *octroi* tax system.

The Indian study which deals exclusively with charcoal revealed that in the study area charcoal is mainly made using mesquite wood (*Prosopis Juliflora* locally known as *vilayati* or *gando baval*) a shrub species which grows even in the worst of conditions. This species is not very suitable for fuelwood as it is difficult to handle due to its thorns. Besides, the wood is easily attacked by wood boring insects which often results in losses as the wood can only be kept for about six months. Even though mesquite wood is grown on private lands, harvesting, conversion, and transportation

are all subjected to controls by the Forest and/or the Revenue Department. The procedure to cut, convert and transport woodfuels consists of the following steps:

1. An application is submitted by the individual farmer or producer to the Revenue Department seeking permission for tree harvesting.
2. Revenue authorities visit the site and give permission for harvesting.
3. An application is submitted to the Forest Department for permission to convert the wood into charcoal.
4. Forest officials visit the site to estimate the likely quantity of charcoal that would be produced and give permission for conversion.
5. Farmers/producers then apply to the Forest Department for loading and transporting charcoal.
6. In the presence of forest officials, charcoal is loaded on to trucks. The truck number, number of bags loaded, destination, route, and time of departure, and estimated time of arrival are indicated in the pass issued for transport by the forest officials.
7. Charcoal is carried to the specified market with the transit pass.

The reason for the consecutive steps appears to be to ensure that a) only wood grown on private land is cut and used for charcoal making and b) to prevent charcoal made from other wood being added along the way and transported under cover of the permit issued. Unfortunately, the study does not provide information on whether a permit is required to transport the charcoal from the main market to large users such as the calcium carbide factories, etc. Some woodfuel producers claim that the permit system for fuelwood is more cumbersome than for charcoal as a permit for cutting and conversion to charcoal can be granted for a whole plot while in the case of fuelwood a permit to cut and transport the fuelwood has to be obtained for each and every truck load.

Given the number of steps involved, many of them time consuming, charcoal producers sometimes sell the charcoal to local commission agents for a lower price (2 Rs. per 20 kg. bag or about 3-3.5% lower than the normal price). In that case the agent will take care of transport permits, etc. Commission agents assist the farmers sometimes in other ways too. Because of the agents' intimate knowledge of the charcoal markets they can influence the price to a certain extent by withholding supplies when the price is low. In such a case the agent pays the charcoal producer part of the value of the load upon arrival. Whenever prices improve, for instance because of a temporary shortage or when large amounts are required, the remainder is paid. The agent charges the producers 4 Rs per quintal (100 kg.) for this service, equal to about 1.3% of the sales value. Likewise, large consumers of charcoal often appoint their own commission agents who will buy charcoal on their behalf in the market in order to ensure that they receive good quality charcoal which is not adulterated with other materials.

In Indonesia, a considerable amount of charcoal is derived from logging residues. The Forest Company will announce that wood will be available and charcoal makers have to put in their bids. If they are awarded the right to the wood, they have to make an advance payment of 80% of the fee, based upon an estimate of the total charcoal production to be realized from the operation. The charcoal maker will then receive a permit (a so-called SPK certificate) to transport charcoal from that area within a specified period. However, besides this permit, they also need to have permits and licenses for:

- A legal certificate that allows them to trade (SUP and HO),
- A tax registration certificate (NPWP),

- A general permit to produce charcoal (SIPA).

Similar steps must be taken for charcoal to be produced from plantations regardless of whether they are government owned or privately owned. However, despite these regulations or maybe because of all the regulations, a great deal of charcoal is made illegally.

In the Philippines woodfuels are obtained both from the forests as well as from private lands. The study carried out in Cebu (RWEDP, 1993a) describes some woodfuel flow systems prevailing in the area. Most of the woodfuels are obtained from trees growing on non-forest lands. In Cebu a well established system of growing, cutting and using trees for woodfuel exists. Many farmers plant trees on their land (agro-forestry practice as well as purely for fuelwood) while large plots of land often also are planted with trees. Many of the small holders normally take care of the cutting of the trees themselves either when they need money and/or when they have time such as after the harvest. Larger tree holdings are often owned by absentee landowners. In that case the trees are taken care of by a tenant or by local wood cutters who serve as caretaker. Normally, once the trees are to be harvested, a sharing agreement, locally called *pakyaw* (owner of trees being paid) or *bahin* (sharing of the wood), between the landowner and the caretaker/tenant is made. The share for the landowner often depends on the amount of work the caretaker/tenant has put into growing the trees in the past as well as on the amount of inputs required to cut the trees and transport the wood to the road. Such agreements are often made through woodfuel traders as they have the financial means to approach and pay the landowner in advance.

Once the trees have been cut and the wood sized, split and bundled, the woodfuels have to be transported to the market. This can be a straightforward system where the wood is brought by the rural trader to town where it is sold directly to an urban trader or an end-user. In other cases several intermediaries can be involved both in rural as well as urban areas.

Rural traders obtain woodfuels through *pakyaw* or *bahin* agreements, by buying supplies directly from small holders, etc. A permit will be needed to transport the woodfuels and before this can be issued it has to be proven that the wood was obtained from non-forest land. The procedure consists of:

1. The owner of the trees or the trader who buys the wood, will go with the land title deed to the local office of the Department of Environment and Natural Resources (DENR). Information on the amount and type of wood involved has to be provided.
2. The DENR officer will then visit the site and determine the total volume which can be transported.
3. A transport permit is then issued for part or all of the volume of wood. In the first case a notation is made of the balance of wood remaining for which in the future a transport permit can be issued without having to go again through the first two steps.

Once the transport permit has been issued, the trader can start arranging transport. While some of the larger traders have their own transport, most depend on hired trucks. Normally a truck will be hired for a fixed sum and it is therefore in the interest of the trader that the truck is fully loaded. In order to ensure this, a considerable amount of coordination and organization is required from the trader so that sufficient supplies are ready to be loaded either at the traders place or along roadsides where the truck can pick up the wood. The hiring of a truck often involves negotiations between the owner of the truck and the woodfuel trader. Fees negotiated are influenced by distance

but also by accessibility, conditions of the roads to be travelled and the amount of wood to be transported. Besides the negotiated fee, the woodfuel trader often has to pay the driver and assistants some additional amount as well as provide food and other necessities.

While transporting the woodfuel supplies the load may be checked at fixed or "roving" DENR checkpoints. Here the load is checked against the permit issued. Normally traders do not encounter any problems unless the volume shipped exceeds grossly the permitted volume or non-permitted species are transported. The latter normally concern natural growing or secondary forest species. In that case the load as well as the truck may be confiscated and for that reason traders do take the regulations quite seriously. Overloading i.e. transporting more than the permit allows remains common, in particular with split permits. Such permits allow the transport of part of a larger volume of woodfuels (step 3 in the procedure). Transporting more leaves "permit volume" which then can be filled with supplies for which no permit exists. Besides the DENR checkpoints, traders sometimes encounter checkpoints manned by other organizations which often results in additional "payments" to be made to facilitate passage. Once the transport has arrived in urban areas, the process of selling the supplies starts. Some traders bring fuelwood and try to find buyers on the spot, others have arranged buyers earlier, others have fixed arrangements to bring supplies on a regular basis, etc. Sales often involve some kind of credit basis (payment after a certain period, after the wood has been sold, etc.) which also ties up capital. Traders therefore have to be financially quite strong in order to be involved in the woodfuel trade.

Because of this requirement, other systems have developed in some places where smaller traders work together, each specialized in one part of the trade. Some traders go out and buy supplies from small holders and act as "collectors" (also called "assemblers") as they assemble small supplies into larger units. They bring their supplies to a second trader or "stockholder" who pays them cash for the supplies. Other traders then buy the woodfuel from the "stockholder" on credit, secure the permits and bring the supplies to town, either alone but more often in combination with other traders to bring the transport costs per unit down. Once the supplies have been sold, the stockholders are paid. In this way some of the barriers to entry into the woodfuel trade are partly overcome.

Once the woodfuels have been transported to the market i.e. urban areas and/or industries, several additional activities may be undertaken before the woodfuels are sold to the end-users. Woodfuels destined for industries normally are not subjected to further steps in the process, possibly with the exception of charcoal. Charcoal using industries often need a consistent quality of charcoal and in many cases the charcoal supplies must be carefully screened and selected. This is normally done at the factory site. But where intermediaries are involved they may also undertake these tasks. The screening and selection process involves the removal of fines, foreign matter, under-carbonized wood, etc.

After sieving to remove fines, charcoal for domestic use is often repacked from bags into smaller units (smaller bags, baskets, plastic bags, etc.) before being sold. Such repacking is sometimes also done to increase the "apparent" value. For instance, in Thailand retailers claim, and this is confirmed by producers, that retailing charcoal requires a lot of skill. Repacking the charcoal in baskets, using as little as charcoal as possible while making the basket appear to be full, is considered an "art", Without this "art" a charcoal retailer would not be able to survive in the competitive market (RWEDP, 1991). The charcoal trade as reported from India (RWEDP, 1993d) also often involves “dressing” i.e. a few sticks of high grade charcoal are placed at the top of the bag to impress potential buyers.

Fuelwood destined for the domestic market is often sold to wholesalers or retailers after having been transported to the urban areas. Wholesalers as well as retailers often sell the wood as received, but where the wood is still large sized they may split it into smaller pieces. The wood is then bundled in units common for the area. This may be quite large bundles but, depending on where the wood is to be sold, could be very small with only a few sticks of wood in a bundle. Bensel and Remedio report (RWEDP, 1993a) that people sometimes buy fuelwood three times a day. The reason for this can be manifold but low cash incomes and little space to store fuelwood are often mentioned as forcing people to buy in very small quantities, even though this in fact is more expensive.

Other studies consulted (Chalamwong, 1990; Ellenbroek, 1988; Kuyper and Mellink, 1983; Paudyal, 1986; Prior, 1986; WB, 1990 and WB, 1993) show more or less the same system of trade channels and the way woodfuels are transported from the source to the market place. Even though variations are found in the number of intermediaries involved, this normally has little bearing on the general system as described above.

3.4. Woodfuel prices and price structure

The previous section has briefly touched upon the woodfuel trade as described in the various reports of studies carried out within the region. In order to examine the competitiveness of the woodfuel trade the available information on pricing and markups will be covered here. It should be noted that, due to the tremendous amount of variations found in unit weights and/or volumes (see also section 3.2), differences in transport distance and costs, etc. even in relatively small areas, no average prices can be given. Instead, some cases will be presented as described in the various reports and studies.

3.4.1. Fuelwood

Some information is available from various countries on fuelwood pricing and mark-ups starting from the tree till the price the consumers pay for the fuelwood. An overview of some of the information is provided in figure 3.1 and annex 3.1. It should be noted that mark-ups are not profit alone but include all costs involved such as for labor, equipment, operating costs (for transport, etc.), taxes, fines, etc. Besides, a comparison of the actual value of the markups should not be made without taking into account the diverse conditions between countries but also within countries.

Even though conditions are known to vary to a considerable extent, it is surprising to see that in general the mark-ups within the fuelwood trading system do not show large variations and in fact could be considered more or less as "standard mark-ups". Owners of the trees (land/tree owner) apparently account for about 20% of the final sales price while the wood cutters/collectors share amounts to about 30%. Where the land/tree owner is the same as the tree cutter/collector his or her share amounts to about 50-60%. Transport of the fuelwood accounts for about 20-30% of the final sales price while the share for the traders (rural and urban) amounts to about 20-25%. However, it should be noted that the comparison presented takes the final sales price as the basis for the calculation of the mark-up and that the actual mark-up may be higher. This is also evident from table 3.1 which provides an overview of the costs involved and the mark-ups.

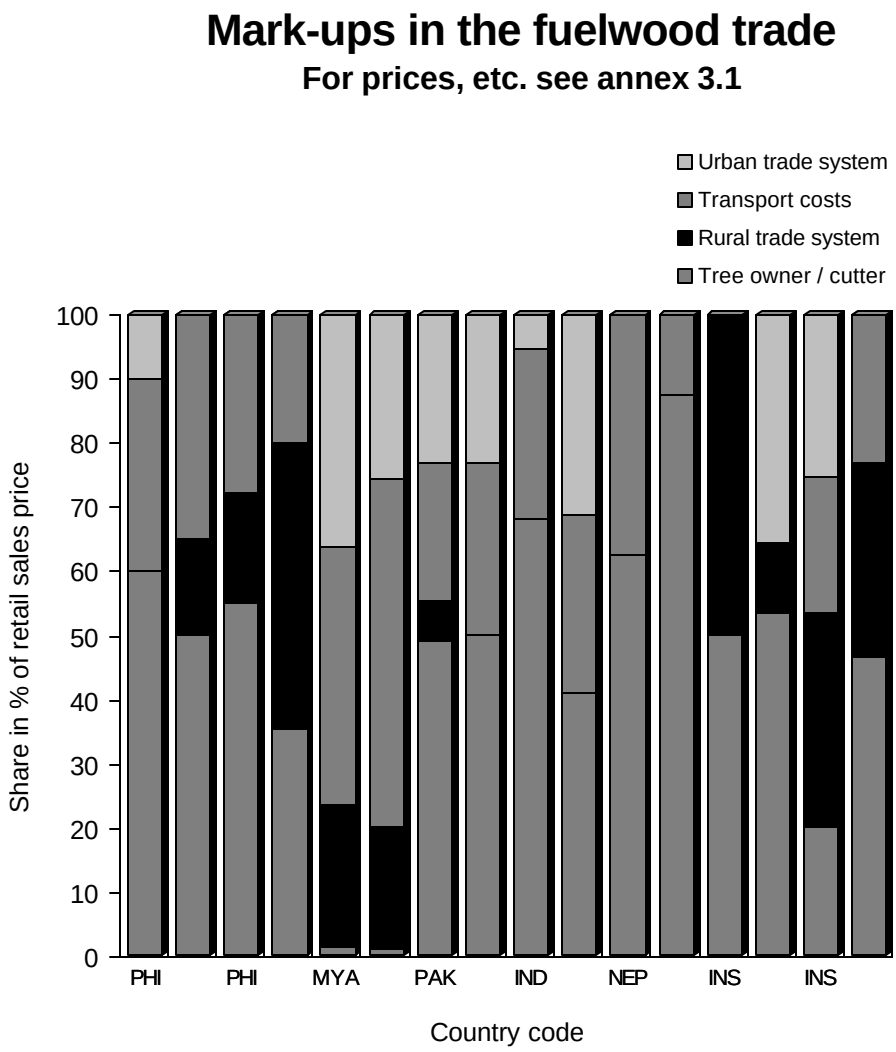

Figure 3.1 Mark-ups in the woodfuel trade system

An exception to the "standard" mark-ups are the two cases in Nepal (woodcutter receiving 63% and 88%). These t3535wo cases concern the informal sector supplies e.g. head- and back loaders who cut fuelwood (often illegally) and transport it themselves to the market without any other intermediary involved (Shaikh, 1989). Both cases are based on the assumptions that the time involved was valued against the going (or opportunity) daily wage rate and that part of the wood transported would be confiscated and fines would have to be paid due to the illegal nature of collection. Even with these "constraints", it was found that the actual earnings of the woodfuel trade were still higher (Rs. 15.90 versus Rs. 12 per day in rural areas and Rs. 42.20 versus Rs. 25 in urban areas) than the going daily labor rate i.e. it was more profitable to cut, transport and sell fuelwood than to work as an unskilled worker (Shaikh, 1989). Another exception may be those cases where many intermediaries are involved (the fourth case in the Philippines and the third case

in Indonesia) Even though the share of the landowner/wood cutter is low, the actual amount received is comparable with the other cases. However, it is not known which species are involved. In Indonesia better species such as *Sono* (*Dalbergia Latifolia*) and *Kesambi* (*Schleichera oleosa*) are considered good fuelwood species and command a price which is double that of species considered inferior such as *jati* (*Tectona grandis*), etc. (Kuyper and Mellink, 1982). The same phenomenon is no doubt also true for other countries.

Another exception is Myanmar where the owner of the trees i.e. the Forest Department receives very little, only about 1% of the final sales price. This is caused by the low royalties levied. These consist of Kyats 5 per stacked ton (50 cubic feet) and Kyats 30 per truckload, equal to about Kyats 4 per stacked ton for a removal pass (RWEDP, 1993c). Unfortunately, no information is presented about the stumpage costs.

3.4.2. Charcoal

The same exercise as described above for fuelwood was also done for charcoal (see figure 3.2 and annex 3.2). Unfortunately, the information available is much less than that for fuelwood but still some general conclusions can be drawn.

As was the case for fuelwood, the owners of the trees together with the charcoal producers receive around 50% of the final sales price, transport requires about 10-15% while the share for the traders (rural and urban) is on average about 30-40%. The higher share for the trader involvement when compared with fuelwood trading is thought to be due to two reasons. One, and probably the most important, is the fact that part of the charcoal is not saleable because during transport as well as repacking part of the charcoal is lost as fines and dust. Besides the charcoal losses, repacking involves additional costs for labor as well as packing material (baskets, plastic bags, etc.).

The sample from Nepal is again an exception. Charcoal production is illegal and therefore as few intermediaries are involved as possible. The charcoal produced is normally transported by the producer directly to the market where it is either sold to consumers or to retailers. As is the case for fuelwood, only one case is known where the real margins (mark-up minus costs) are known. These are also shown in table 3.2.

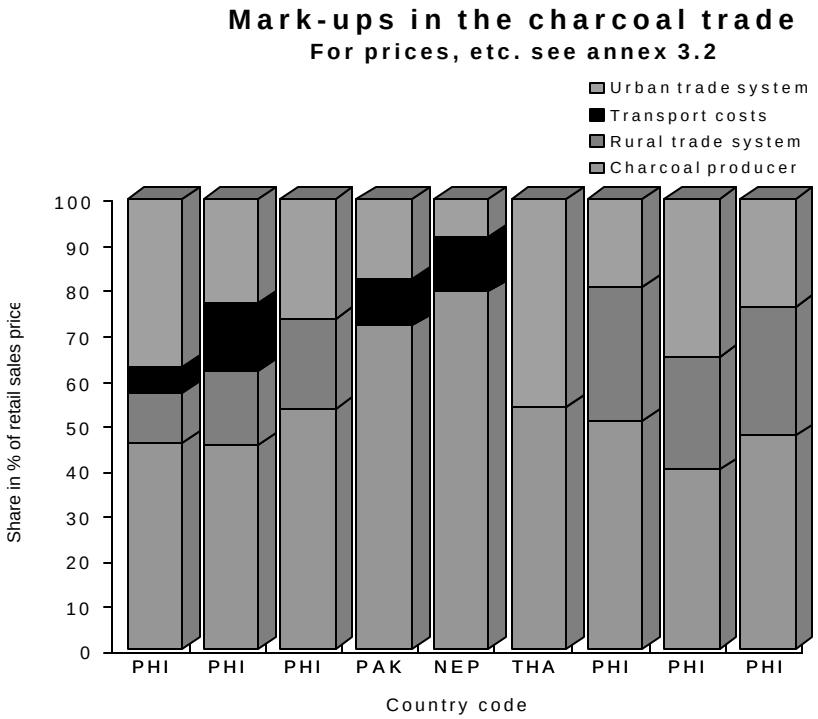

Figure 3.2 Mark-ups in the charcoal trade system

Table 3.2 Breakdown of urban retail prices for fuelwood and charcoal in Indonesia

Breakdown of urban woodfuel price	Fuelwood			Charcoal		
	Mark-up	Cumulative	Actual return	Mark-up	Cumulative	Actual return
Farmer price	38 %	38 %		44 %	44 %	
Labor	4 %	42 %		2 %	46 %	
Transport	16 %	58 %		6 %	52 %	
Fees	3 %	61 %		1 %	53 %	
Return to Assembler	13 %	74 %	21 %	15 %	68 %	28 %
Packing				6 %	74 %	
Duties	3 %	77 %		3 %	77 %	
Return to Wholesaler	13 %	90 %	17 %	13 %	90 %	17 %
Return to Retailer	10 %	100 %	11 %	10 %	100 %	11 %

Source: Ellenbroek, 1988

In Indonesia it is reported that charcoal makers normally do not buy wood from smallholders as this increases their costs because transactions have to be made with each seller and the wood has to be transported to the kiln site (RWEDP, 1991). It is not known if this bias against smallholder wood supplies also applies to other countries.

3.4.3. Price fluctuations, trends and overall value of the woodfuel trade

The literature used for this desk study does not provide much information on price fluctuations over time. It appears that prices do change a bit with the seasons i.e. during the wet season the price of woodfuels tends to rise when compared with dry season supplies. Another factor which is quoted as having a seasonal influence is agricultural activities. During periods when a lot of labor is required on the farms, woodfuel prices tend to rise, basically due to supply shortages (Ellenbroek, 1988).

When looking at price changes over longer periods of time, it appears that prices have changed only a little, when adjusted for inflation. However, information on woodfuel prices over time is only available for Pakistan while charcoal prices are known for Pakistan, Myanmar and India. For India only actual charcoal prices, not adjusted for inflation, are given, while for fuelwood only deflated prices are given for a few years. According to Leach (1987) the real price of fuelwood increased by 34% in 10 major cities during the period 1970-1982. Figure 3.3 and 3.4 provide a brief overview of some actual and deflated woodfuel prices. The HESS study in Pakistan provides an overview of the wholesale and retail prices based on index figures using constant 1957 prices (WB, 1993). The data show that the two indexes remain more or less constant till the early seventies but afterwards the index for the wholesale price rises faster than the retail index (annex 3.3). This may indicate a narrowing of the retail margin but without access to the raw data no further conclusion can be drawn.

Very little is known about the overall value of the woodfuel trade. In Pakistan it has been estimated that the 12.4 million tons of woodfuels traded had a value equivalent to 11.3 billion Rupees (about 450 million US$) or equal to about 10% of Pakistan's exports in 1991-92. Besides the traded woodfuels, a large amount is gathered for own use and this amount was estimated to be about 18 million tons. If this amount was valued by assuming that the time spent could have been used for other income generating activities, the value would be about 19 billion Rs or about 760 million US$. However, the market value of this amount of wood was estimated at about 14 billion Rs. The difference of 5 billion Rs. can be considered as a loss incurred because of the woodfuel collection and could have been avoided if people had been engaged in income generating activities and had the capacity to buy their woodfuels. However, in practice this is not the case as very few job opportunities exist in rural areas, particularly for women and children (WB, 1993).

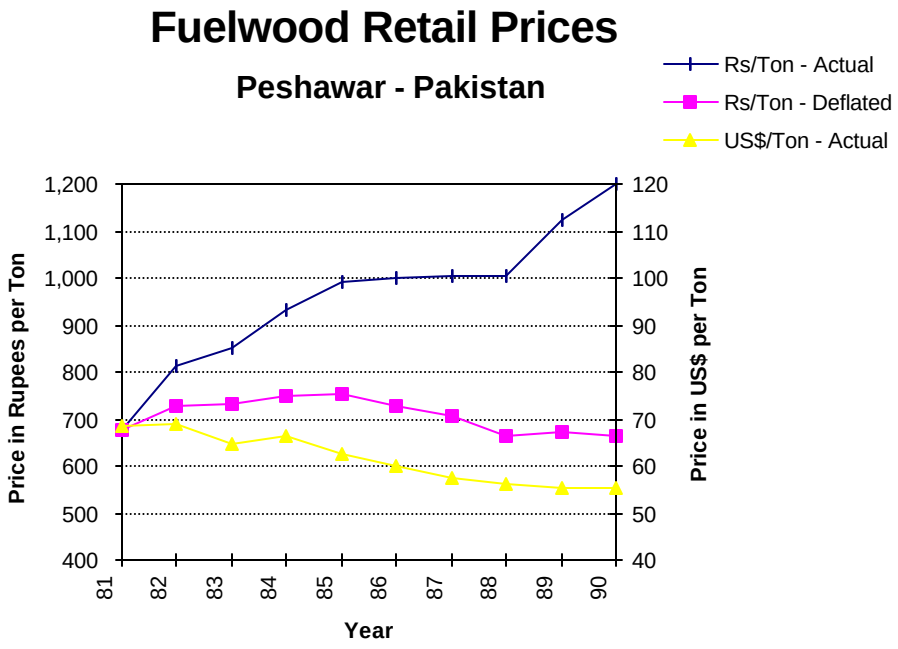

Figure 3.3 Actual and deflated fuelwood retail prices in Peshawar, Pakistan Source: RWEDP, 1993b

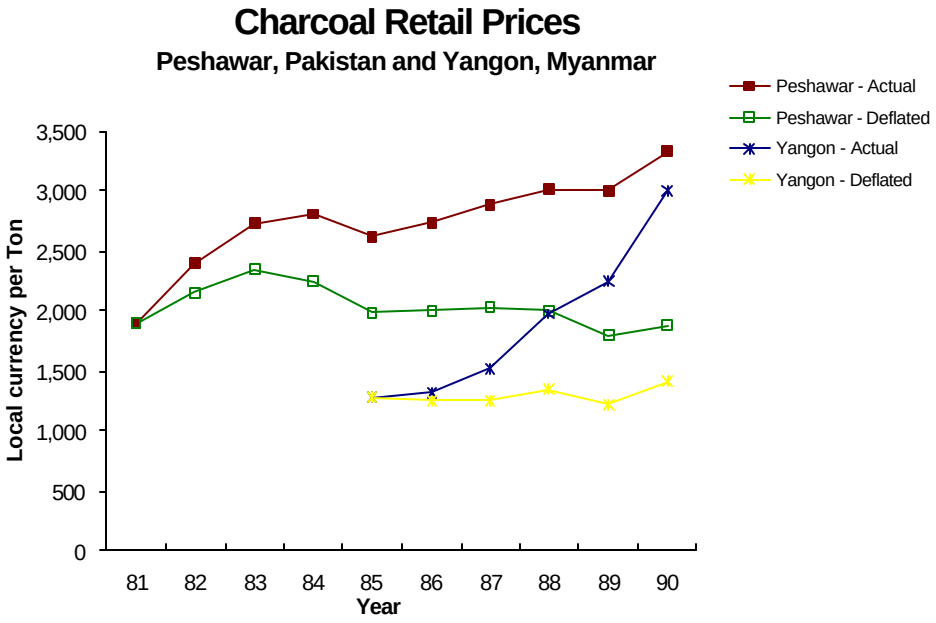

Figure 3.4 Actual and deflated charcoal retail prices in Peshawar, Pakistan and Yangon, Myanmar. Source: RWEDP, 1993b and Ryan, 1991.

3.5. Employment generation

The supply of woodfuels involves considerable handling ranging from cutting the trees, collecting woodfuels, transport, preparation (splitting, bundling, debarking, carbonization, packing, etc.), assembling, and selling to wholesale and retailers before the product reaches the end-user. The woodfuel trade can therefore be considered labor intensive. This is also borne out by the literature reviewed. In the Philippines, it is estimated that over 830,000 households (536,000 gathering, 158,000 charcoal making and selling, 40,000 rural traders and 100,000 urban traders) are engaged in the woodfuel trade from gathering to retailing with 10% of all rural households earning about 40% of their cash income from woodfuels (WB, 1992). Assuming that from 1-2 people per household are actively involved this would imply that 2% of the population was somehow involved with the woodfuel trade.

In Pakistan close to 100,000 people are involved with the trade i.e. wholesalers and retailers (WB, 1993). Out of this number, 73% are permanently employed while 27% are temporailry employed. The number of people involved with woodfuel gathering is not given but, considering the ratio of 1 household involved as trader to 5 households involved with gathering and charcoal making, apparently valid for the Philippines, the total number of people involved with woodfuels can be roughly estimated to be about 600,000. This would imply that 0.5% of the population is involved with the woodfuel trade. Besides the people involved with the trade, it was estimated that over 7 million households collected woodfuels for own use (WB, 1993).

A rough estimate for India showed that at least 3-4 million people were involved in the woodfuel trade, making it the largest source of employment in India's energy sector (Agarwal, 1987). In Nepal it was estimated that out of a population of about 48,000, around 2,800, or close to 6%, were involved with supplying woodfuel to the population of Pokhara (Paudyal, 1986).

Many of the people engaged in woodfuel gathering and collecting appear to be women and children in those cases where it involves the small(er) sized woodfuels. In the case of larger sized woodfuels as well as where whole trees are cut, men apparently are more often involved. They normally do the cutting and splitting while women are often involved in bundling the split wood. For instance, in Pakistan it was estimated that in the households which collected woodfuels for own use (over 7 million), about 6.5 million males and close to 10 million women and children were involved (WB, 1993).

4. REVIEW OF WOODFUEL FLOWS CUM MARKETS AND CONCLUDING REMARKS

As mentioned in chapter 1, the scope of this paper is to provide an overview and analysis of 4 studies dealing with woodfuel trade and which were carried out for or with support from the FAO Regional Wood Energy Development Program. The studies covered woodfuel flows in relatively "small" areas. In two cases the demand for woodfuels (fuelwood as well as charcoal) was used as a starting point to determine how much was obtained from each source (RWEDP, 1993a and 1993b). One case described a forest fuelwood supply system (RWEDP, 1993c) and the other study covered a charcoal trading system (RWEDP, 1993d). The studies, with the exception of the Cebu study (RWEDP, 1993a) were short term (2-4 months duration). This has meant that the influence of seasons, be they climatic, or agricultural, could not be covered. Due to this as well as other factors, as well as due to the disparity of the topics covered[4] , it was difficult to use the four studies as a main data source for providing an overview of the woodfuel flow and trade system. Thus additional studies were used.

With the aid of these other studies, dealing with woodfuel use, woodfuel flows, etc., it has been possible to provide a general overview of the flow of and trade in woodfuels. It should be noted that the majority of woodfuels used in the countries where the studies took place were not traded i.e. people collect woodfuels for their own use and it is expected that, by and large, woodfuels will remain a non-monetized resource. Woodfuel flows and trade concern basically those amounts which are obtained from woodfuel "rich" areas, normally in rural areas, for use in woodfuel deficit areas such as in urban areas as well as for industrial applications. The woodfuel flows encourage people to sell woodfuels and we can see that involvement in the woodfuel trade effects people's own woodfuel use. For example, sellers often use lower grades than they would normally if the woodfuel flows did not exist. Moreover, even though poor rural people may be employed in the woodfuel trade they may not have the same access to the woodfuels which they had prior to the establishment of the woodfuel flows. They may, in real terms, be worse off than before although they now have a cash income.

A major conclusion which can be drawn from the studies is that the woodfuel trade system can be very simple and straightforward but at the same time may be a complex system with sometimes up to 7-8 intermediaries involved. Both systems can co-exist, even in the same area i.e. one system does not exclude the use of other systems. The systems are extremely flexible in that intermediaries, used for one trade, may be by-passed in other trades. Woodfuel trade systems do often result in specialization i.e. the users of woodfuels are separated from the sources of supply. This may result in more waste within the system and in end-users having less influence on the quality of the end-product.

Simple systems appear to be easier to track than more complex systems. However, even within a simple system with only one trader involved between the source and the end-user, many activities

[4] With a more "strict" Terms of Reference more information could have been supplied with very little additional input. In the future, if more comparative studies are to be carried out, thought should be given to the drawing up of detailed "Terms of References" such as for instance provided for woodfuel supply and demand studies in the framework of the "Tropical Forest Action Program". This may help in providing more concise and comparable output which is then easier to analyze.

may take place which influence the system. For instance, a trader may buy several different trees and species on a plot as woodfuels. Better species command a better price, straight trunks could be sold as timber, wood may be split, sorted and bundled in various sizes and for different end-users, etc. (bundle sizes with the same name can show very large differences in size and weight even in relatively small areas). In cases where such a trader also buys from other sources (which may be rural or urban), the wood from different sources may be mixed and be destined for different markets (fixed contracts, direct sales, etc.) each with its own selling price. With more actors involved it becomes increasingly difficult, if not impossible, to trace the woodfuel flows, even if relatively small areas and quantities are involved.

Based on the available information it appears that the woodfuel flow and trade system can be roughly divided into three general sub-systems although there may be a considerable overlap between the systems. The first sub-system consists of the informal sector such as supplies brought in by individual people (head- and back loaders). The second sub-system consists of the formal sector supplies which basically consist of woodfuels sold directly by government agencies. The third system is tentatively called the private sector although this is a misnomer as the private sector is also involved in the other two systems. However, the system basically covers woodfuel supplies which are obtained from private lands. Figure 4.1 provides an overview of woodfuel flows within the three different sub-systems.

The informal sector woodfuel supplies bypass in general all regulatory systems put into force by governments. The origins of the wood involved are not known but may consist of wood gathered in the forests, from common and private lands, etc. The people involved are generally poor and landless and the woodfuel trade is often one of the few options they have to earn some income. The trade appears to be straightforward with the people who gather the wood also being involved in the transport and sales directly to the end-users or retailers. Such supplies are normally used in the same area from which they were obtained i.e. there has to be a ready market nearby for the system to operate. However, part of these informal sector supplies are transported over longer distances such as by truck drivers who buy woodfuels along the road side and transport them to market centers. The quantities involved are normally small i.e. what can be cut and transported by one person. The overall impact on the woodfuel supply system is not known, but is thought to be small when only commercial woodfuel flows are considered. When supplies for own use are included, the impact of this informal system on the overall woodfuel supply is thought to be enormous, not only in rural areas but in urban areas as well. Earnings of the woodfuel trade with this system remain almost completely with the persons involved i.e. the gatherers, with only small amounts required for transport, etc. The owners of the trees, i.e. the forest department or the community in general, do not receive any stumpage fees and this trading system may therefore have a detrimental effect on the forest cover.

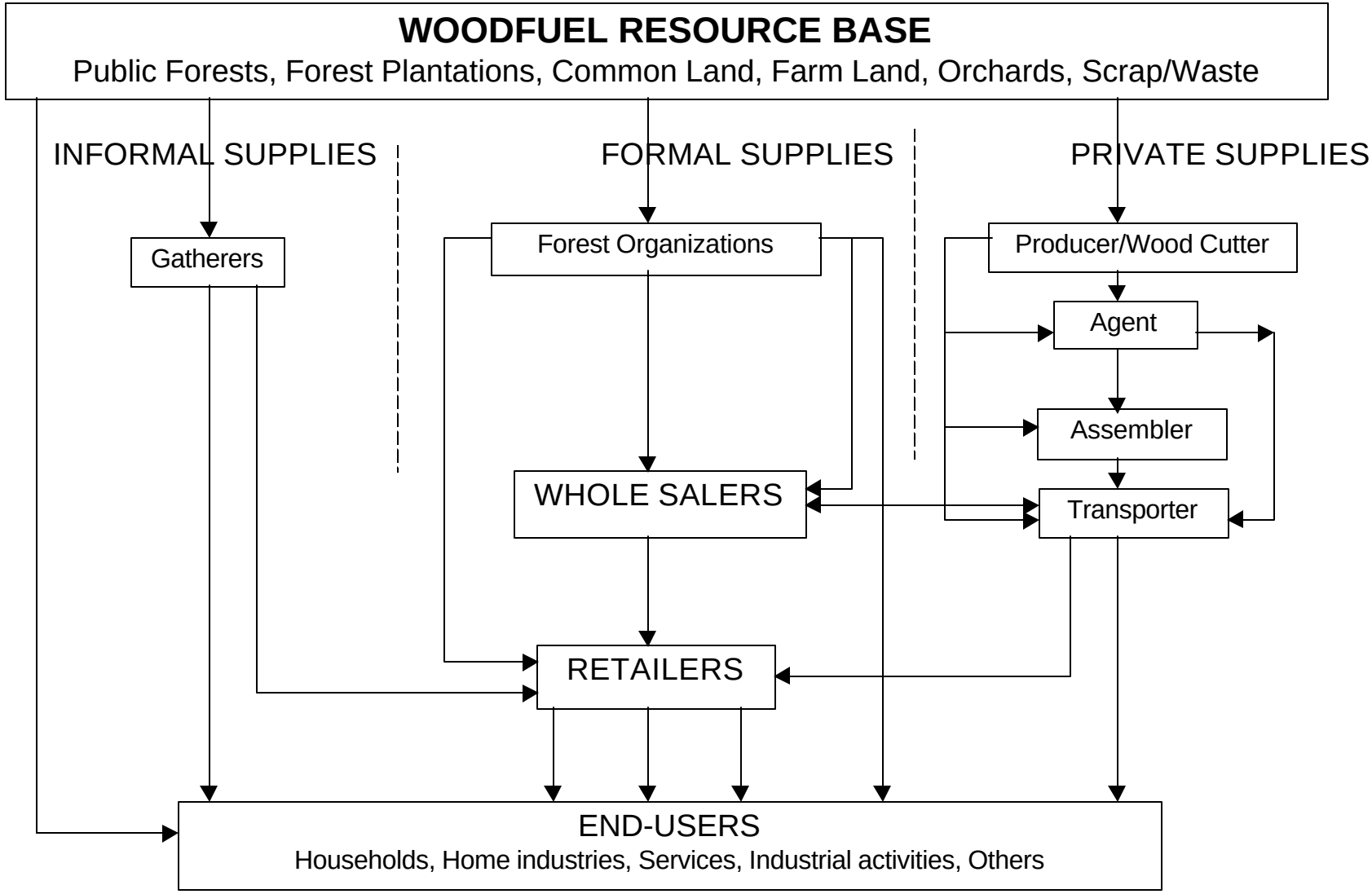

Figure 4.1 Overview of woodfuel flows within three different sub-systems

The formal sector supply system is much more regulated than the two other systems, basically because the supplies originate from formal organizations such as the Forest Department, Fuelwood Corporations, etc. The woodfuel flow system is more easy to follow from the source to the end-user. Quantities involved are often large and are almost exclusively traded. Much of the woodfuel supplies are prepared by the formal organizations involved such as for instance in Pakistan where the Forest Department cuts trees in their plantations and then sells the wood through auctions. Depending on the country and/or location, the impact on the overall wood supply system could have a relatively large impact (see section 2.1). Much of the earnings involved accrue to the trading system and although forest departments may receive royalties, this in many cases appears to be insufficient to offset the cost of growing the trees. For instance the royalty levied in Myanmar was found to be only Kyats 9 or 1.5 US$ at the official exchange rate per stacked ton (50 cubic feet). In Nepal the National Fuelwood Corporation paid the Forest Department Rs. 78 (about 2.5 US$) per metric ton of wood.

The third main sector, **the private sector** supply, is in general thought to have the largest impact on the overall traded woodfuel supply system but at the same time is also the least transparent. It is thought that this system is prevalent in those areas where markets are located at some distance from the source i.e. woodfuel owners may not have direct access or have difficulties in getting direct access to the markets. Woodfuels come from various sources such as private land, agricultural land, common village land, etc. Where in the other two systems the woodfuels are cut and sold directly by the main actors involved i.e. gatherers in the informal sector and formal organizations in the formal sector, a considerable part of the woodfuel supplies are sold as trees with the owner in most cases not involved with the preparation of the woodfuels. In many countries the private sector supplies are subject to the same rules and regulations with regard to transporting the wood as the formal sector supplies. In most countries the cutting of trees on private lands has been deregulated, sometimes with the exception of certain species and/or trees growing in fragile areas.

Even though woodfuel supplies are normally subject to rules and regulations, the actors involved in the trading system have found many ways to circumvent the system, and thereby making it less effective. Besides, the regulatory system may favor the larger traders as obtaining permits is often cumbersome and time consuming. Having to obtain a permit may be a reason why many tree owners sell the trees on stump even though they could earn more if they also cut the trees, transported the wood and sold it to urban based traders. However, there are probably other reasons for this practice too. The relatively small amounts involved may make transport more expensive, there may be a lack of labor to cut down trees, lack of access to urban trade channels, etc. Lack of cash to pay labor to cut down the trees may be another obstacle. Even if assistance were to be provided free of charge such as in Indonesia with the "Gotong Royong" system (a mutual help system), many farmers may not want to make use of it as participation implies that they themselves would also have to assist other people when asked and this could be inconvenient. Last, but not least, farmers who sell trees on stump may grow trees for reasons other than to supply woodfuel, and selling the trees or part of the trees may be only of secondary importance to them. However, there is also some evidence (see annex 3.1) that the tree owners may get a lower price per unit when selling mature trees on stump. This may be a reason why many farmers sell their trees after only short rotation periods (WB, 1993).

With this private sector sub-system it was found that shares in the earnings from the woodfuel supply system were fairly constant, not only in any one area but also in a single country and surprisingly it was found to be more or less valid across the board. Tree owners and tree cutters

earn about 50% of the final end-use selling price with the tree owners receiving about 20%, equal to about 5 - 15 US$ per ton depending on area, species, etc. This amount is much more likely to persuade farmers to grow trees for woodfuels. In fact, in Pakistan it was shown that growing trees may be more attractive than growing food crops and that growing trees produced much higher earnings per unit of capital input as well as labor input (WB, 1993 - Leach). At the same time, as many of the trees planted are of the nitrogen fixing variety, crop yields may increase considerably after trees have been grown on agricultural land. For instance, cotton yields increased as much as 2 to 3 fold after *Babul* trees (*Acacia nilotica*) had been growing on the land for a few years.

For charcoal the same 50% share was found to be valid for the tree owners and charcoal makers combined. Where large quantities are involved, the price the tree owner, wood cutter and/or the charcoal maker receives may be higher as in that case some of the intermediary steps can be cut out of the system. In both cases transport costs ranged from 10-30% while the traders retained from 20-40% of the final selling price. However, these amounts include all costs and should not be assumed to be profits only.

A major factor in woodfuel flows is transport. Transport apparently accounts for 10-30% of the cost price of woodfuels. Part of these costs are directly attributable to real costs (vehicle, loading and unloading) and another part attributable to licenses, fees, etc. In Pakistan such fees (octroi and zila taxes) show large differences from area to area.

There appears to be a generally held belief that traders earn most in the woodfuel supply system. Based on the evidence, this belief may not be true and traders who are rich probably did not get rich from woodfuel trading. Indeed it is sometimes suggested that only the rich can afford to engage in woodfuel trading. Evidence for this is anecdotal and suggests that much of the trade involves credit. To support this argument, it is stated that some traders would like to opt out of the trade due to the financial risks involved but that this is not possible due to "social" obligations. Further studies will be required to provide a more convincing picture of the monetary and non-monetary earnings from the woodfuel trade.

The studies provide little insight into the relationship between woodfuel prices and prices for alternative sources of energy. Prices of woodfuels have risen over time but when inflation and/or general price indexes are taken into account, it appears that prices have hardly changed. By converting actual woodfuel prices to actual US dollars, it was found that the woodfuel price remained more or less constant even though the actual price in local currency rose (see figure 4.2). This may indicate that woodfuels have become more competitive in price when compared with fossil fuels assuming that the latter have to be imported, have become more expensive and that they were not subsidized. An exception is Myanmar where the charcoal price in US dollars rose from 150 US$ to over 450 US$ per ton over a period of 6 years. However, not enough information is available to draw a general conclusion.

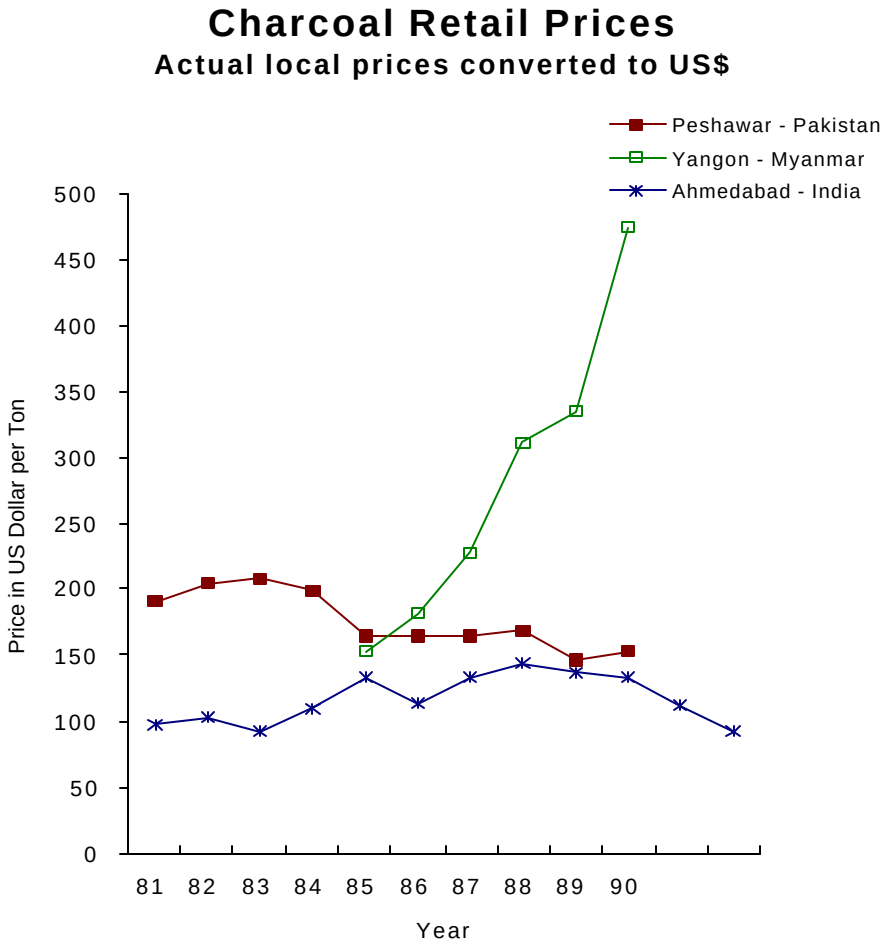

Figure 4.2 Charcoal prices in US dollars for three locations

Overall it can be expected that in many countries the demand for woodfuels will remain strong and may even increase in absolute terms due to increases in population. This increase in the amount of woodfuels used should not be considered bad although it may increase pressure on the tree sources. Woodfuels, unlike fossil fuels, are local resources and therefore do not have to be imported using foreign currency. Woodfuels, being renewable and being locally available offer many people a relatively secure supply of energy. Woodfuels can at the same time be an environmentally sound energy option as the net addition of CO_2 and other greenhouse gases is zero if harvested on a sustainable basis. At the same time the woodfuel trade provides employment in rural and urban areas and for many landless and poor people it appears to be an important source, and sometimes the only source, of cash income.

The available information has provided a good insight into woodfuel flows and their governing factors. For instance, the studies indicate that in forest scarce areas such as in Pakistan and some areas in the Philippines and Myanmar, planted trees are becoming more important, if not very important, for woodfuel supplies, not only for own use but for sale as well. However, at the same time a lot still has to be learned. A few subjects which warrant further investigation,

particularly with regard to planted trees, are: how does a tree grower decide whether the stumpage fee offered is fair in relation to the amount of wood available (size and age of trees versus volume of woodfuels obtained from the trees) and his inputs; would a tree owner be able to earn more if sufficient information is made available to him or her with regard to woodfuel prices in urban areas or if better access to these woodfuel markets could be created; the role of transport and regulatory expenses in woodfuel pricing; the regulatory system itself - to what extent do regulations impede woodfuel growing and woodfuel flows, particularly from non-forest lands; the influence of land tenure on the growing of trees for fuel; the availability of financing for tree growing, etc.

Answers to these as well as other questions may provide an even better understanding of how and under what conditions woodfuels are moved from the source to the end-user. This is considered important as it may help in identifying policy gaps with regard to the supply side of woodfuels from both forest and non-forest resources.

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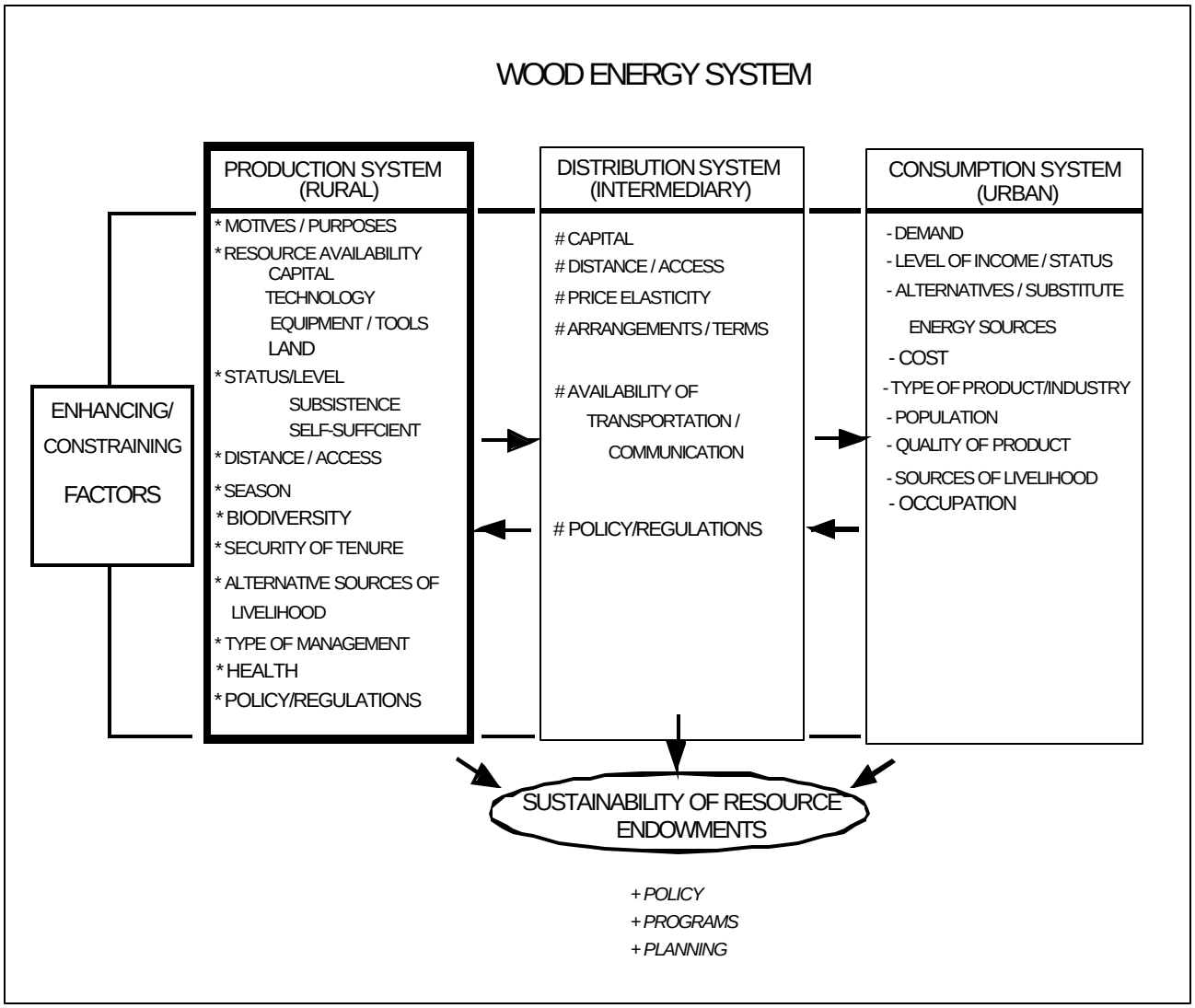
ANNEX - 1

Annex 1.1 A typical model of the determinants of rural-urban dependency on wood energy



ANNEX - 2

Annex 2.1a Source and composition of woodfuels used purely for domestic purposes in Cebu city in 1992

Type of fuelwood	Amount of fuelwood in tons and percentage					
	Gathered for free	%	Purchased	%	TOTAL	%
Primary fuelwood	3,420	8.0	23,577	54.8	26,997	62.8
Coconut fronds	1,678	3.9	5,388	12.5	7,066	16.4
Bamboo	393	0.9	476	1.1	869	2.0
Scrap wood	7,588	17.7	477	1.1	8,065	18.8
TOTAL	13,079	30.4	29,918	69.6	42,997	100.0

Source: RWEDP, 1993a

Annex 2.1b Source and composition of woodfuels used for commercial activities in the domestic sector in Cebu city in 1992

Type of fuelwood	Amount of fuelwood in tons and percentage					
	Gathered for free	%	Purchased	%	TOTAL	%
Primary fuelwood	229	1.8	5,864	47.0	6,093	48.8
Coconut fronds	527	4.2	4,940	39.6	5,467	43.8
Bamboo	--	--	110	0.9	110	0.9
Scrap wood	490	3.9	323	2.6	813	6.5
TOTAL	1,246	10.0	11,237	90.0	12,483	100.0

Source: RWEDP, 1993a

Annex 2.2a Variations in woodfuel supply sources in India in 1978-79 (million tons)

Woodfuel source	Rural areas			Urban areas			TOTAL	
	Logs	Twigs	Total	Logs	Twigs	Total	Tons	%
Own land	5.2	9.1	14.3	---	---	---	14.3	15.1
Other people's land	0.3	3.0	3.3	---	---	---	3.3	3.5
Forests	4.6	18.9	23.5	---	---	---	23.5	24.9
Road sides, etc.	1.3	24.4	25.7	0.4	1.6	2.0	27.7	29.3
TOTAL COLLECTED	**11.4**	**55.4**	**66.8**	**0.4**	**1.6**	**2.0**	**68.8**	**72.8**
Purchased	8.7	3.3	12.0	11.1	2.6	13.7	25.7	27.2
TOTAL	**20.1**	**58.7**	**78.8**	**11.5**	**4.2**	**15.7**	**94.5**	**100.0**

Source: Leach, 1987

Annex 2.2b Acquisition method of woodfuel supplies in urban areas in Indonesia

Urban area size and acquisition source	Percentage of urban population who collect fuelwood				
	Small	Medium	Large	Very large	INDONESIA
Purchase only	28	44	34	7	31
Gather only	58	36	46	80	53
Purchase and collect	14	20	20	13	16
TOTAL	100	100	100	100	100

Source: WB, 1990

Annex 2.2c Quality of firewood collected or bought in Pakistan (based on frequency of responses - not indicative of relative quantities involved)

	Types collected (Female responses)	Types most often purchased (Male responses)
Stems and branches	3,474	3,513
Leaves, twigs and shrubs	5,808	780
Roots	467	---
Other / waste wood	183	446

Source: WB, 1993

Annex 2.2d Sources of firewood for urban and rural households in Pakistan (firewood users only)

	INCOME GROUP			TOTAL
	Low	Medium	High	
RURAL				
Buy only	22.5%	29.8%	40.2%	28.8%
Collect only	69.1%	58.5%	50.8%	60.9%
Buy and collect	8.3%	5.7%	9.1%	10.3%
URBAN				
Buy only	78.4%	85.0%	91.6%	84.3%
Collect only	18.8%	9.4%	5.8%	11.5%
Buy and collect	2.1%	5.8%	2.3%	4.2%

Source: WB, 1993

Annex 2.2e Transportation modes for collected fuelwood in Pakistan

Mode of Transport	URBAN	RURAL	PAKISTAN
Head and back load	61.5%	81.4%	80.4%
Animal load	9.9%	10.0%	10.0%
Vehicle load	17.4%	7.6%	8.1%
Other	11.2%	1.0%	1.5%
TOTAL	100.0%	100.0%	100.0%

Source: WB, 1993

ANNEX - 3

Annex 3.1 Fuelwood prices, price structure and price mark-up in some countries

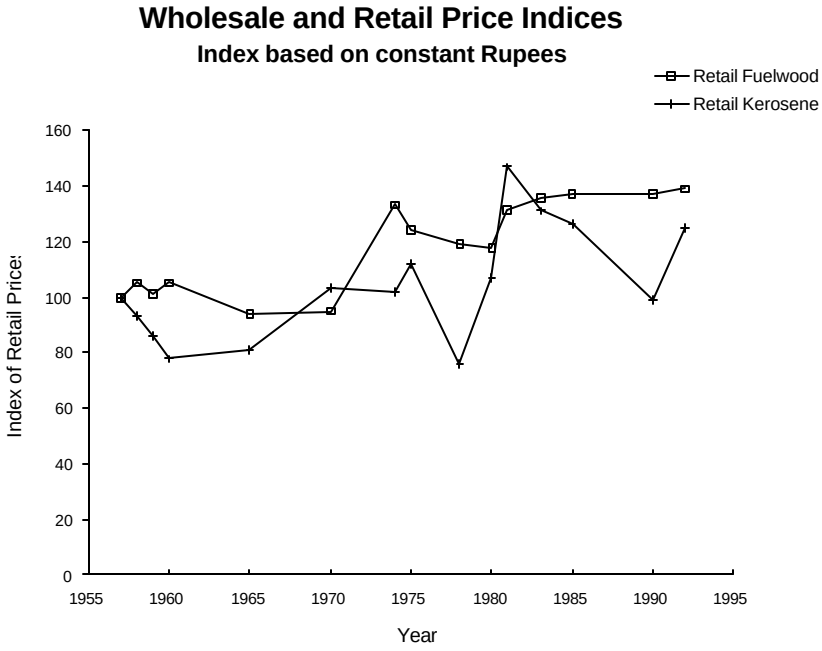
Country	PHI	PHI	PHI	PHI	MYA	MYA	PAK	PAK	IND	NEP	NEP	NEP	INS	INS	INS	INS
Amount retained by		1	1		2	2			3	4	5	6	1		7	
Land/tree owner	250	133		220	9	9		750	96	547			2500	3750	3750	3500
Wood cutter/collector	500	267	330	170			800		40	109	250	660				
Transport		280	168	220							150	94			4000	1750
Assemblers							100						500	750	750	1000
Rural wholesalers		120	102	270	150	150							2000		2750	750
Rural retailers				220											2750	500
Transport	375				275	425	350	400	53	442						
Urban retailer	125				246	202	375	350	11	502				2500	4750	
Local currency per ton	1250	800	600	1100	680	786	1625	1500	200	1600	400	754	5000	7000	18750	7500
US$ per ton	51	33	25	45	107	124	75	69	11	69	17	32	13	18	48	19
Markup in % by each intermediary based on the final sales price																
Land/tree owner	20	17		20	1	1		50	48	34			50	54	20	47
Wood cutter/collector	40	33	55	15			49		20	7	63	88				
Transport		35	28	20							37	12			21	23
Assemblers							6						10	11	4	13
Rural wholesalers		15	17	25	22	19							40		15	10
Rural retailers				20											15	7
Transport	30				40	54	22	27	26	28						
Urban retailer	10				36	26	23	23	6	31				36	25	
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

REMARKS:
1 - Fuelwood sold directly to large end-users (factory, bakery)
2 - Price of a stacked ton of 50 cft.
3 - Price based on theoretical yields of planted trees
4 - Fuelwood supplied by National Fuelwood Corporation to permit holders
5 - Road side supplies in rural areas (forest wood taken without permission)
6 - Headload supplies to urban areas (forest wood taken without permission)
7 - High quality fuelwood

Annex 3.2 Charcoal prices, price structure and price mark-up in some countries

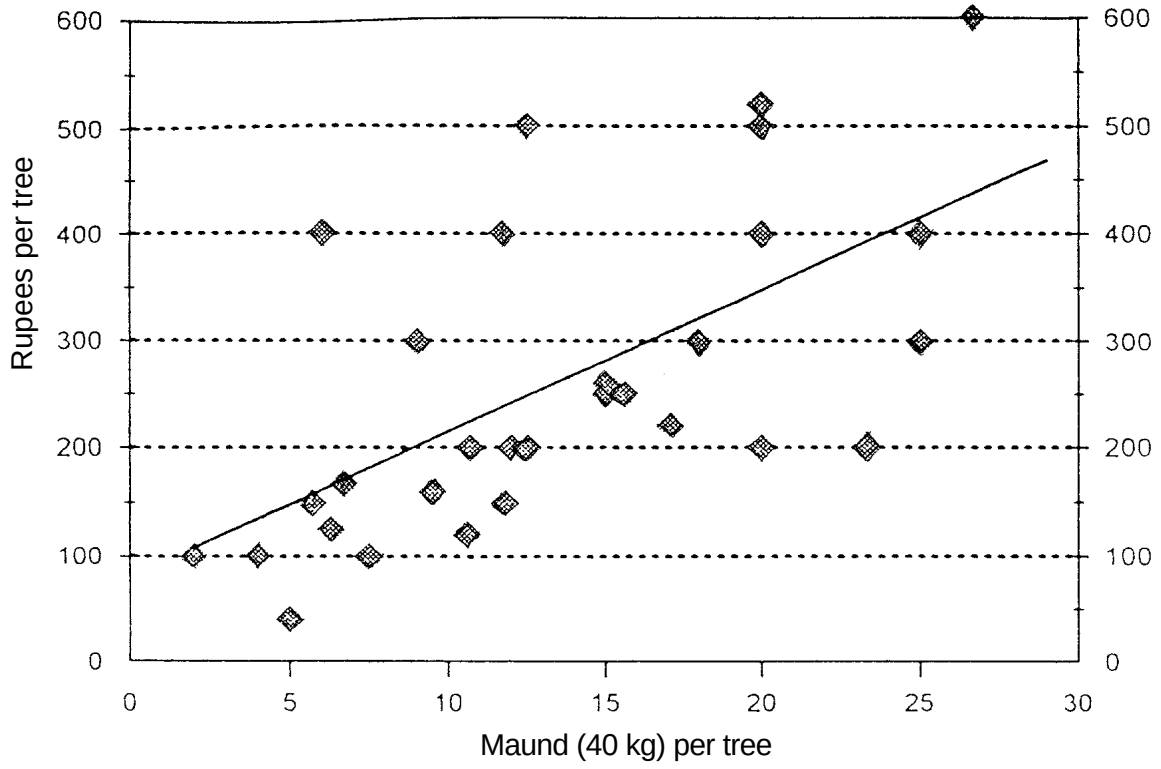
Country	PHI	PHI	PHI	PAK	NEP	THA	PHI	PHI	PHI
Amount retained by									
Land/tree owner	952					1,875			
Wood cutter/collector				1,944		714			
Producer	1,905	1,636	848	1,656	5,750	919	1,700	1,600	1,800
Assembler		262	106						
Stockholder		327	212						
Rural trader	714						1,000	1,000	1,100
Transport	357	540		500	900				
Urban wholesaler	357			300					
Urban repacker	714								
Urban retailer	1,250	835	424	600	600	3,000	650	1,400	900
Local currency per ton	6,249	3,600	1,590	5,000	7,250	6,508	3,350	4,000	3,800
US$ per ton	256.21	147.60	65.19	200.00	311.75	260.32	119.60	142.80	135.66
Mark-up in % by each intermediary based on the final sales price									
Land/tree owner	15	0	0	0	0	29	0	0	0
Wood cutter/collector	0	0	0	39	0	11	0	0	0
Producer	30	45	53	33	79	14	51	40	47
Assembler	0	7	7	0	0	0	0	0	0
Stockholder	0	9	13	0	0	0	0	0	0
Rural trader	11	0	0	0	0	0	30	25	29
Transport	6	15	0	10	12	0	0	0	0
Urban wholesaler	6	0	0	6	0	0	0	0	0
Urban repacker	11	0	0	0	0	0	0	0	0
Urban retailer	20	23	27	12	8	46	19	35	24
Total	100	100	100	100	100	100	100	100	100

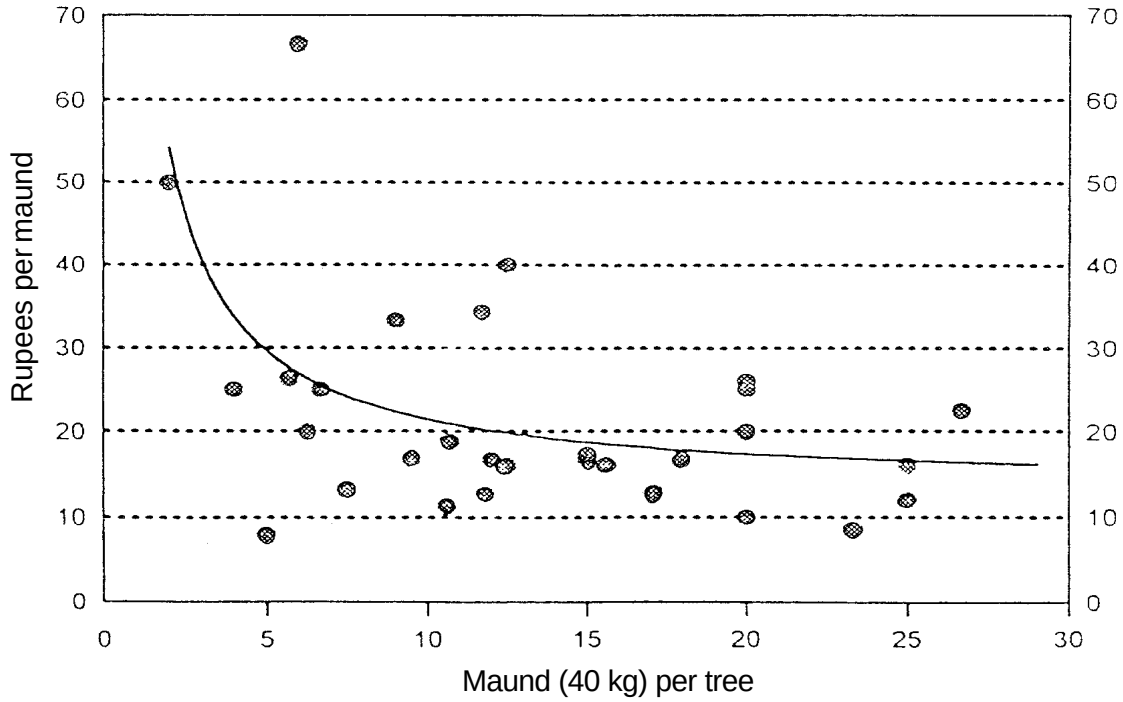
Annex 3.3 Wholesale and retail price index data for fuelwood and kerosene (Source: WB, 1993 - Leach)



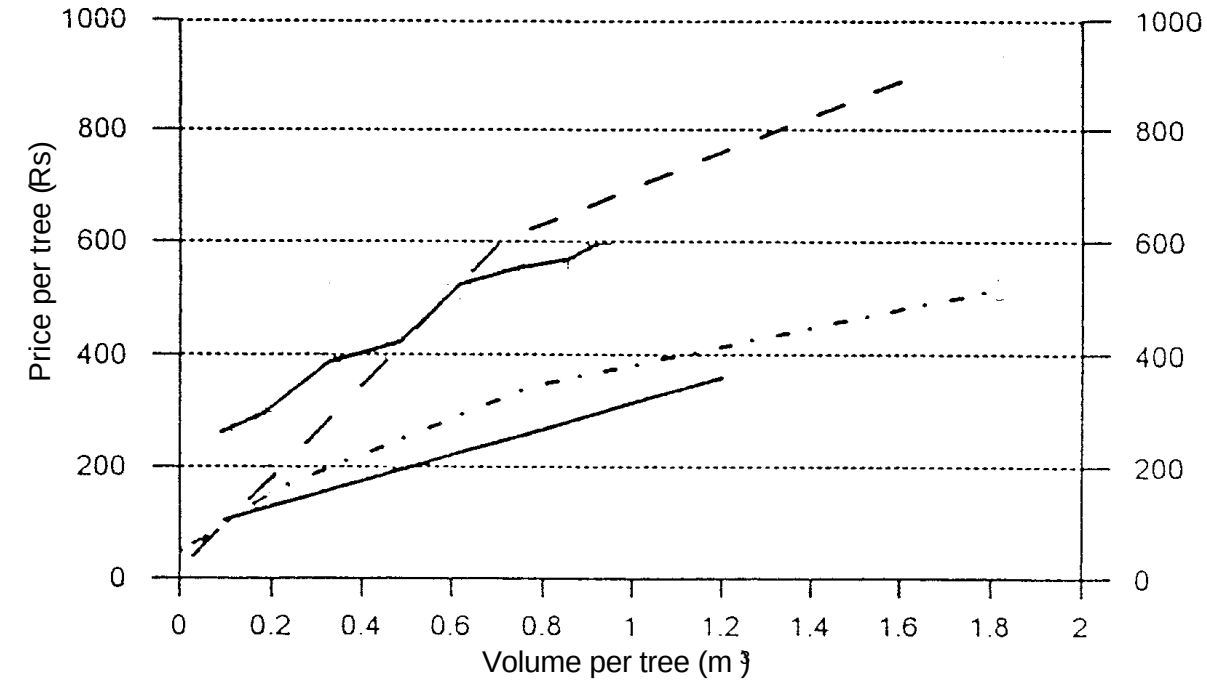
ANNEX - 4

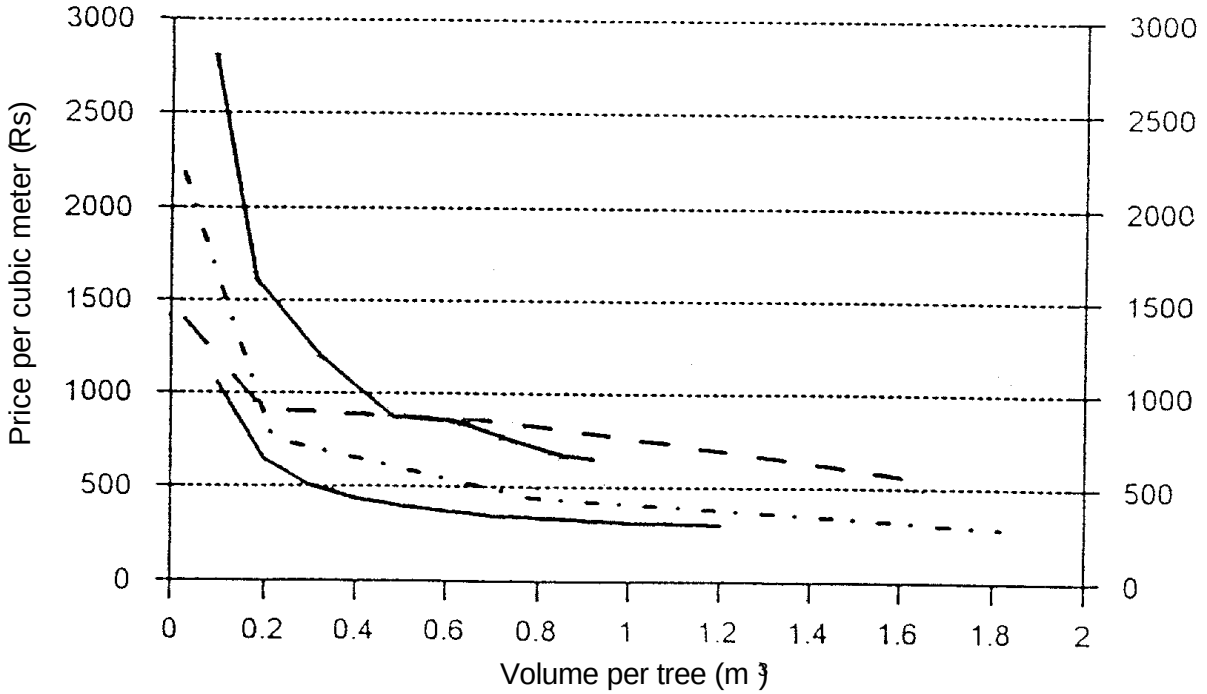
Annex 4.1a Prices for standing tree sales according to tree weight (Source: WB, 1993)





Annex 4.1b Prices for standing tree sales according to tree volume (Source: WB, 1993)





Eucalypts (Faisalabad) — Babul (PFI) — Shisham (PFI) — All types (HESS)