RURAL-URBAN INTERDEPENDENCIES IN THE COMMERCIAL WOOD ENERGY SYSTEM IN MAJALAYA SUB-DISTRICT, WEST-JAVA

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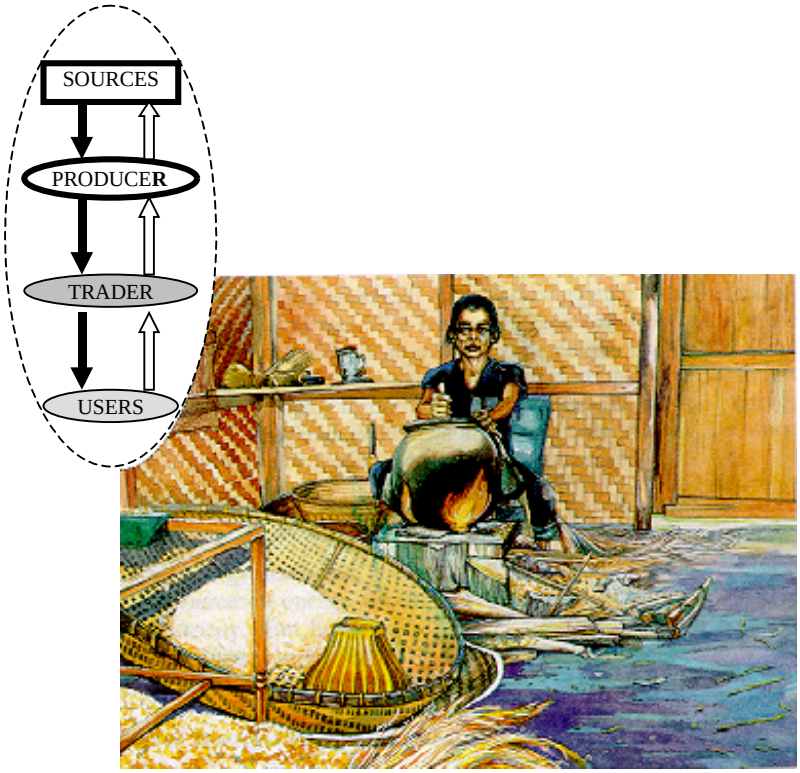

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1. INTRODUCTION

1.1 Rural-Urban Wood Energy Systems

Energy has an essential function in all human life. It is needed by all social classes, in cities and in rural areas. Some energy sources are entirely commercial (kerosene, liquid propane gas), while others are partly non-commercial (fuelwood, charcoal, agricultural residues). Meeting people's energy needs is a complicated business. Energy consumption is related to social status. High status people use more and different kinds of energy. Energy consumption also differs from rural to urban areas. Urban areas, with better infrastructure and more facilities, have more sources of energy available to them.

In Indonesia, especially in West Java, fuelwood is still commonly used both for household consumption and for business activities. The fuelwood is obtained from forests, but also from upland fields and home gardens, so users of wood energy are often found in rural areas. In urban areas, alternative energy sources such as kerosene and LPG are more readily available and more widely used; but fuelwood and charcoal are also widely used in urban areas. Wood energy flows from rural areas, where it is more abundant, to urban areas, either as fuelwood or in processed form as charcoal.

People in both urban and rural areas still use wood energy for a combination of reasons. It is cheaper and easy to obtain and to use. For some purposes wood energy is preferred, even in urban areas. In areas where wood energy is abundant, some people not only use wood energy but they also produce it, periodically selling fuelwood or charcoal to people who live in town or to urban middlemen who distribute it to retailers in the urban area. The bulk of wood energy sold to town passes through middlemen. Throughout West Java all cities, large or small, get wood energy from nearby rural areas if it is available or from other districts if necessary.

1.2 Type of Energy Used

Meeting human energy needs has become a critical issue. New technology has provided people with alternative sources of energy. Both households and industries use fuelwood, charcoal, kerosene, LPG and electricity. But households typically use fuelwood and kerosene, while most industries use electricity or gas, except for small industries which tend to use kerosene. Often a single consumer will use more than one type of energy.

1.3 Changes in Types of Energy Use (Energy Substitution)

Household consumers of wood energy have been stimulated to change to the use of kerosene, and in cities it is now common for LPG to be used for daily cooking. Small industries and home industries have also shifted away from the use of wood energy in some cases. But many commercial consumers are unwilling to abandon wood energy as long as they can obtain it. While cost is often a major consideration, many people who can afford alternative energy sources still prefer to use charcoal or fuelwood.

In rural areas the use of such alternative energy sources is still very limited because they are expensive, and non-commercial energy sources are still readily available. There is a high correlation between income levels and the use of commercial energy. But rural inhabitants have reasons other than fuel costs for using wood energy. The use of wood energy is an integral part of many farm activities, home industries, and animal husbandry. Tobacco curing requires wood energy to preserve and improve product quality. In the preparation of certain food products wood energy is essential to the drying process. And in the highlands people use fuelwood to boil cattlefeed.

In general, the shift from wood energy to alternative fuels is most pronounced in urban areas and in rural areas near cities with insufficient land for forests or tree planting. Such change most commonly takes place to meet household needs. Some households will get all of their energy from kerosene or gas, while others combine commercial energy with wood energy. But if wood energy is readily available, many people will use it until it becomes too difficult to acquire.

1.4 Wood Energy Supply and Demand

Indonesia is rich in commercial energy sources (kerosene, fuel oil, gas) and in non-commercial energy sources (wood fuel, agricultural residue). But it is difficult to estimate the true situation in regard to biomass energy supplies, partly because Indonesia consists of many islands with different ecosystems and cultures. A more serious difficulty is that only a fraction of total fuelwood supplied, the recorded removals from forest lands, are known. Unrecorded removals from forest and non-forest lands are thought to constitute the bulk of all fuelwood used in Indonesia.

Some surveys of wood energy indicate a national decrease in recorded wood energy supplies from forest lands. Hadi Soesastro *et al*. (1983) reported that during 1970-1978 the recorded fuelwood production in Indonesia decreased. The use and demand for wood energy are also difficult to estimate with precision, but household demand probably exceeds that of other sectors. A survey by Raymond Atje (1979) found that during the 1970-1976 period fuelwood consumption accounted for more than half of the total energy consumption in Indonesia. Another survey (Bekkering and Rusmanhadi 1987, in Smiet 1990) reported that average annual household fuelwood consumption in Indonesia was 1 m^3 per capita, or 3.03 metric tons per household per year, with an average family size of 5.3 persons. In West Java the annual demand for fuelwood per capita ranged from 0.35 m^3 up to 2.22 m^3, with an average demand of 0.75 m^3 per capita per year.

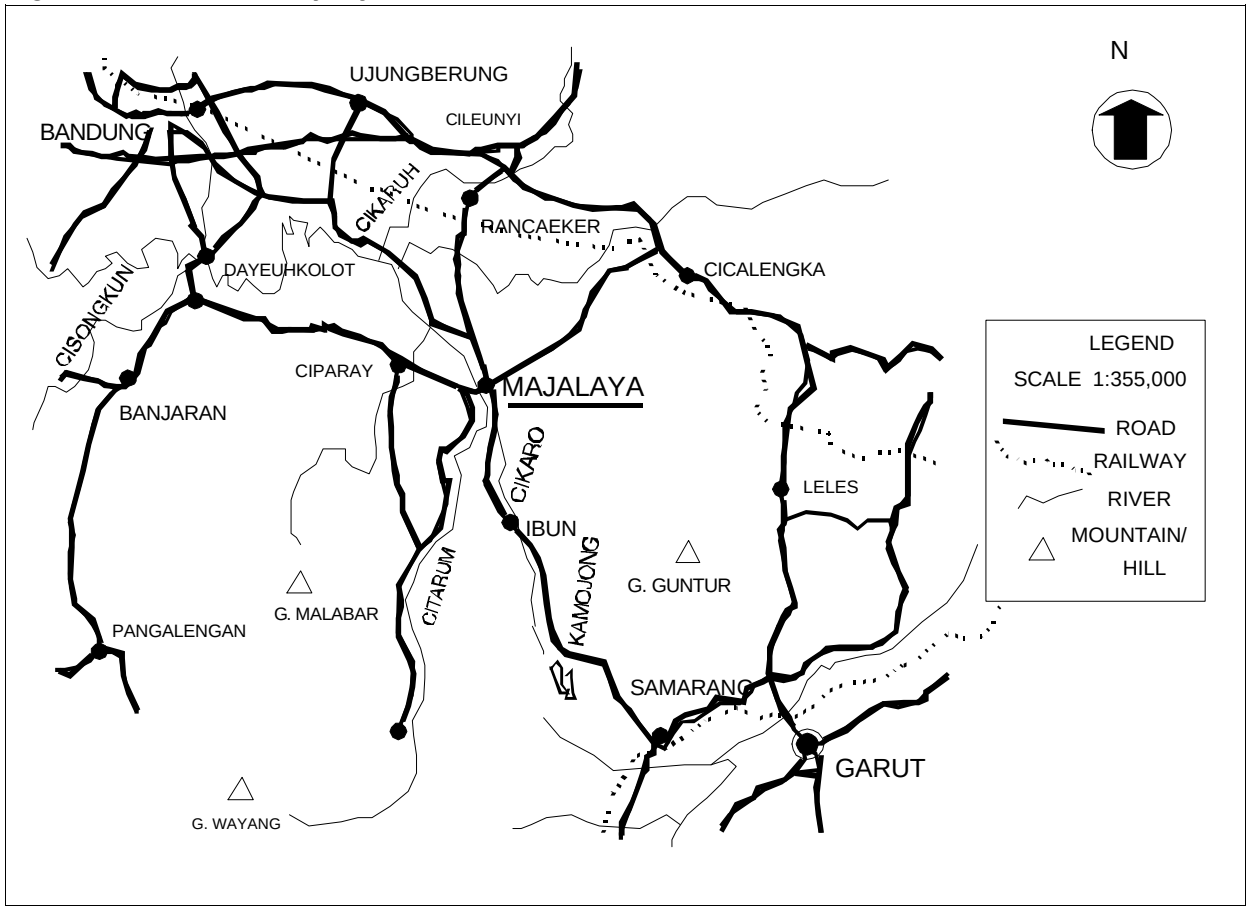
1.5 The Future of Wood Energy

It is difficult to predict either the demand or the supply of wood energy because so many factors are involved, especially the extent to which the government subsidizes alternative energy sources. A reduction of existing subsidies for alternative fuels will probably increase the demand for wood energy, especially among low income households. If the subsidy for fuel oil is stopped, the demand for fuelwood may increase substantially.

1.6 General Description of the Study Area

Majalaya is a sub-district town within Bandung District in the Province of West Java. It is located about 40 kilometers to the southeast of Bandung City, along the Citarum River. It is connected to some smaller towns surrounding it by asphalt roads in good condition and has appropriate transportation links (see Figure 1).

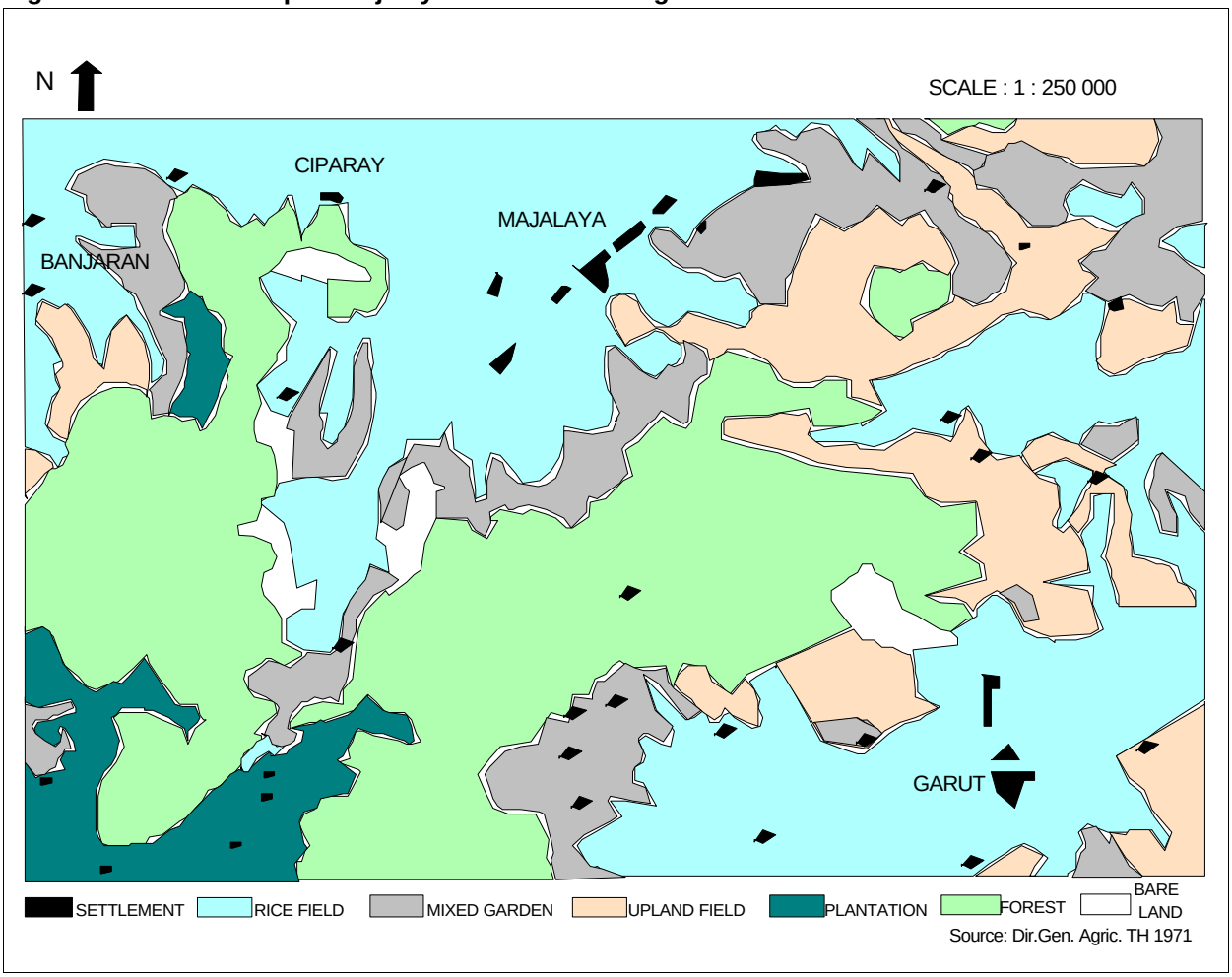
Figure 1 Location of Majalaya Town



Majalaya is located in the plain area of the Bandung valley, about 675 meters above sea level. On three sides are rice fields with year-round irrigation systems. To the south the terrain becomes undulating and then mountainous. There are terraced fields in the lower undulating sections, changing to upland gardens and agroforestry systems on the outer periphery until the terrain becomes mountainous. In the mountainous area there are production forests and a natural forest reserve. At the highest point in the mountains, some 1500 meters above sea level, there is the Kamojang Geothermal Electric Power Project.

Majalaya was selected as the study area because it is a small city (population 43,700) that obtains its wood energy from the rural areas around it. Certain sectors in the town are very dependent upon wood energy. This setting reveals the interdependence of rural and urban communities in meeting their basic needs, including energy. The inhabitants of Majalaya get the wood energy they need from villages and forests located in nearby mountainous areas. Within the sub-district, 69 percent of the land is used for rice fields, 7 percent for upland fields, 20 percent for settlement, and the rest for a variety of other uses (Figure 2). Since water is available for irrigation, rice fields are the dominant form of land use in the valleys. In the wider region (including Banjaran to the west and Garut to the south) that is covered by Figure 2, the extent of the forest area is considerable.

Figure 2 Land Use Map of Majalaya and Surroundings



2. THE USE OF WOOD ENERGY IN MAJALAYA

2.1 Wood Energy Consumption in the Urban Area

2.1.1 Urban Households

In Indonesia generally, and in West Java in particular, the main use of fuelwood in the household sector is for cooking. To meet other household energy needs, such as lighting, kerosene or electricity are more commonly used. No two households have exactly the same patterns of energy consumption.

In the town of Majalaya kerosene is used more than fuelwood or charcoal, while gas energy is used only in upper income level households. But in some parts of town people still use non-commercial energy sources like fuelwood or crop residues for cooking. This is especially true of lower income households, such as the homes of daily workers or industrial workers, who can be found in great numbers in Majalaya.

Some households use both fuelwood and kerosene for cooking. Some use only fuelwood. A lack of kerosene cooking facilities is usually due mainly to economic reasons, to avoid the expense of buying and maintaining a kerosene burner. But while some like kerosene because it is clean and convenient to use, others find it to be too much work. Also, cooking with charcoal is customary. But when fuelwood and charcoal become difficult to obtain, most households will change to using kerosene. The way kerosene and fuelwood are combined and the relative proportions of their use vary among households. Some households use wood energy only to cook rice and cook everything else with kerosene. Other households use wood energy only when their supply of kerosene is exhausted, just until they can get more kerosene. This is a common situation in urban Majalaya. There are also households that meet most of their energy needs with fuelwood and use just a small amount of kerosene. Such households usually get their fuelwood from several different sources, purchasing part of their supply and obtaining the rest through their own efforts or getting it from neighbors.

One respondent explained that her family of seven used only three liters of kerosene per month, for cooking. Most of their energy came from fuelwood, part of which was obtained from a neighbor and the rest collected from a nearby river bank. Another respondent said she rarely used kerosene because she cooked with fuelwood. Her husband collected fuelwood from along the river, and they grew bamboo along the edge of the river as another source of fuelwood. One trip to gather fuelwood could provide enough wood to cook for two people for about one week.

On the other hand, some families use only a small amount of fuelwood and get most of their energy from other sources. Variation among households in the proportion of energy derived from different sources involves several factors: family size, income level, cooking habits, and the extent of kerosene usage. A typical family of four might use about 0.1 m^3 of fuelwood for cooking rice and about four liters of kerosene for the rest of their cooking. But if this family used only fuelwood, it would consume about 0.25 m^3 of wood in a week. A family of six that used no kerosene would consume about 0.35 m^3 of fuelwood in a week. Several respondents said that the use of kerosene was more common than the use of fuelwood. One respondent said he used kerosene only when he was busy, but when there was less work to do he would use fuelwood for cooking.

In both urban and rural areas of Majalaya sub-district charcoal seems to be used routinely only in ironing clothes. It is rarely used for cooking, except in the preparation of certain dishes, like the Indonesian "shishkabob" (*sate*). But such dishes are usually prepared only for special occasions. For one session of ironing one pack of charcoal (about 0.25 kg) would be used. Households vary greatly in the frequency of ironing. Some iron once a week; others, nearly every day. Some vary the frequency of ironing depending on how busy they are.

2.1.2 Sidewalk Food Vendors and Small Restaurants

Because they come from the lower to middle economic strata, sidewalk food vendors use the cheapest form of raw materials possible. For energy, this means using wood energy. But there are also non-economic reasons that inhibit the shift to commercial energy sources. Some foods are cooked with wood fuels simply to economize (i.e., fried bananas). But other dishes are thought to be more appetizing when cooked with charcoal, with *sate* being a typical and important example.

There are from 17 to 19 *sate* vendors in Majalaya town. Each uses on average from two to four kilograms of charcoal every day, depending on the volume of sales. One vendor said he sold about 12 kg of *sate* every day, using about 2-3 kg of charcoal. On week-ends, sales double. Charcoal use increases then, but not proportionately, because the energy is used more efficiently with a higher volume. Sidewalk vendors prepare and sell other kinds of food, mostly for low and middle income customers. Roasted rice flour (*surabi*) is one of the most common such dishes, sold by vendors in several sections of the town. All roasted rice flour is cooked with fuelwood, although any kind of wood is used. Some vendors have attempted to shift to kerosene, but they abandoned the experiment because the cooking took longer and was felt to impart an unpleasant taste and smell to the product.

Selling *bubur kacang* (made of soybean and palm sugar)

A typical vendor of roasted rice flour uses 1.5 to two bundles of fuelwood per day, at a price of Rp. 500 (US$0.27) per bundle (containing about 0.01 m^3 of wood each). Inexpensive forms of fuelwood (scraps from construction sites, twigs) are used instead of the more expensive fuelwood from the forest. Some vendors of cooked rice also still use wood energy, consuming at least one or two bundles of more expensive fuelwood (about 0.02 m^3) daily, at Rp. 750 (US$0.41) per bundle.

2.1.3 Small Scale and Home Industries

Not only households but also small industrial operations use wood energy. Charcoal is used by textile factories as a filament, and at several places in West Java charcoal is used in producing bricks and roof tiles. Several types of small-scale industries in Majalaya still use wood energy. Among these food processing is important. In particular, wood energy is used to prepare smoked fish (*pindang*) and to roast sticky rice with melted coconut sugar (*borondong*). Charcoal is also still used by blacksmiths and tinkers, who produce and repair household metal utensils.

Pindang (fish) preservation

Several vendors in Majalaya shifted from fuelwood to charcoal in preparing smoked fish. There is, they say, less need to constantly regulate the fire when using charcoal, which makes the work easier but more expensive. Most vendors still use wood. To prepare 40 kg of a common kind of smoked fish (*bandeng*, or *Chanos chanos*) requires about 0.01 m^3 of wood, costing Rp. 750 (US$0.41). To prepare the same amount of fish would take 3 kg of charcoal, costing about Rp.300-350 (US$ 0.48-0.57).

Another kind of small industry in Majalaya that uses charcoal is blacksmithing. Although blacksmiths are not as numerous as food vendors, the team found at least five smithies located in a single village near central Majalaya. Blacksmiths depend upon a certain kind of charcoal, called *gebur*, sometimes referred to as "light charcoal," especially that made of *Castanopsis argentea* (*saninten*), which is currently to be found only in forests, and there only in a very limited area. This type of charcoal is said to burn with a bright red flame, producing higher temperatures than ordinary charcoal. At this heat steel can be welded with iron.

It is also economical to use *gebur* charcoal because it will quickly go out when not fanned by the bellows, as opposed to ordinary charcoal which will continue to burn. Charcoal consumption differs with each smithy, depending on the kind of work done. A smithy who takes miscellaneous orders for work typically uses at least 50 kg of *gebur* charcoal per day. Smithies who continuously turn out products, such as utensils, will need at least 70 kg of *gebur* charcoal per day. Smithies purchase charcoal in volume at a price of about Rp.20,000 (US$10.81) per 100 kg.

According to one respondent, charcoal made of *Castanopsis argentea (saninten*) has been scarce for the past two months, affecting the work of blacksmiths. In the absence of *gebur* charcoal, fewer utensils requiring joints of steel and iron were produced. There are other wood materials that can serve as substitutes for *gebur* charcoal--*Areca cathecu* (*jambe*), *Chinchonna sp.* (quinine), and coconut shells--but these potential substitutes are also in short supply.

The blacksmiths believe that there are two main reasons for the shortage of *Castanopsis argentea (saninten*) wood for making charcoal. The charcoal producers are mainly onion growers or farm laborers, who have other seasonal demands upon their labor. The people who obtain this kind of wood may also be reducing their level of activity because they obtain it illegally and are afraid of getting caught. Forestry officials have recently increased their control activities.

Pandai (smithy)

One blacksmith shop has tried to use coal as a substitute for *gebur* charcoal, apparently with satisfactory results. But because coal is difficult to obtain, *gebur* charcoal is used as much as possible, supplemented by ordinary charcoal from the market.

Brick industries also use fuelwood to process bricks. There are hundreds of brick producers in Majalaya sub-district, but their demand for fuelwood has been diminishing. They once used many types of trees for fuelwood: *Hevea brasiliensis* (rubber), *Camelia sinensis* (tea), *Engelhardia spicata* (*ki hujan*), *Albizia falcata* (*jeungjing*), and others. But because fuelwood has been getting more expensive and more difficult to obtain in recent years, they have begun to substitute crop residue (i.e., rice husks) for wood.

Other types of home industries also use wood energy. Many villages around Majalaya town have a number of households that produce a common local cake called *borondong*. These people use fuelwood to roast sticky rice, to boil coconut sugar that is added to the rice, and then to dry the final product. Thirty producers were found in just one village (Ibun), and five in another village at Majalaya town itself. One household estimated it made *borondong* cakes three weeks out of four, with a daily consumption of two *pikuls* of fuelwood. One *pikul* equals about 0.02 m^3 of fuelwood, or two "bundles," so each producing household would use about .04 m^3 of fuelwood per day.

2.2 Wood Energy Usage in Rural Areas

The villages around the town of Majalaya are mostly surrounded by ricefields. Most households have a small home garden taken up mainly by a variety of annual plants. The aesthetic function is dominant in these small gardens, however, especially in the more urban areas. People in these areas have difficulty providing themselves with wood energy. Among the higher socioeconomic strata, there is a tendency to use alternative fuels, such as kerosene or LPG, but poor people use wood energy as much as possible, resorting to kerosene only when their fuelwood supply is exhausted. Wood energy is widely used for subsistence purposes and also for commercial purposes by food vendors and other small industries.

2.2.1 Type of Wood Energy Used

In addition to wood energy and kerosene, low-income inhabitants of Majalaya use residues of various kinds for fuel: waste from building materials, packaging, and agricultural wastes. Usually, such materials are used for cooking. Most of this fuel is obtained near home, but sometimes people seek it in town, utilizing information provided by neighbors. Some people manage to scrounge enough free fuelwood to meet their needs. Others buy it in large amounts. Some who live near the river get fuelwood carried down from its wooded upper reaches as driftwood.

Charcoal is generally bought in the market and used sparingly. Because it is expensive, it is rarely used in most households except to cook particular dishes on special occasions, and for ironing.

2.2.2 The Seasonality of Wood Energy Use

There appears to be no direct relationship between the kinds of energy people use and seasonality. People have no system for combining or alternating different energy sources on a seasonal basis. Instead, they proceed opportunistically. The relative use of various energy sources at any given time depends upon the ease with which particular people can obtain energy that meets

their needs. If a building is demolished and rubble remains, if agricultural residues are available, if scraps of lumber are left at a construction site, certain people will gather this material and burn it. People who no longer use wood energy let others take crop residues, wood scraps, fallen limbs, and other potential sources of wood energy from their property. Residues are the principle energy source for some people, supplemented by kerosene when no residues are available.

Wood energy is used more at certain times of the year, however. The need for heating in cooler weather increases fuelwood consumption. And both fuelwood and charcoal usage doubtless increases when ceremonies come along, as in the *Rayagung* month.

3. THE PRODUCTION AND DISTRIBUTION OF WOOD ENERGY

3.1 Wood Energy Producers

3.1.1 Charcoal Producers

Charcoal production is not monopolized by any socioeconomic stratum but involves many different parties of diverse backgrounds. As in other regions, charcoal producers in Majalaya sub-district come mainly from low income rural families. They are small-scale farmers or landless laborers who engage in charcoal production to supplement inadequate incomes. In one village (near Leuweung Cikawao), charcoal producers are onion growers who make charcoal during periods of free time in the agricultural work year.

Charcoal makers are usually backed by an investor who has obtained a concession from forestry officials. There are also some small-scale producers who get their own raw materials from the forest illegally. Sometimes people make charcoal in or beside a village, with raw materials purchased from the owners of gardens, agroforestry plots (*talun*), or paddy fields in the village. This is called "village charcoal." Such operations are rarely undertaken now because raw materials are scarce and profits are low.

The skill of charcoal-making is passed down in families and acquired from friends and neighbors. Like those who gather fuelwood, people who make charcoal usually do it as a supplementary activity, in addition to farming. Some people are involved in charcoal-making simply as laborers. Others act as both producer and supplier, selling the charcoal they have made in both rural and urban areas. Charcoal making has been going on ever since colonial times. During the Japanese occupation charcoal was produced on a large scale. The Japanese even built charcoal factories, producing the once well-known "Isikawa" variety of charcoal, made for the last time in 1943. The most common types of charcoal made now are the common (*bekem*) and "light" (*gebur*) varieties (See the description of the charcoal making process on page 142).

People usually make more money by producing charcoal than by working as agricultural laborers, but the risks are also higher. When working on a farm, a laborer would be paid Rp. 1250-1500 (US$0.68-0.81), plus lunch, for a workday lasting from seven a.m. until one p.m. But the average net income from making charcoal is about Rp. 2000 (US$1.08) per day.

The Charcoal Making Process

The first step in making charcoal is selecting a proper site. Sites with a great deal of sand or gravel are avoided, and loose soil is preferred. The next step is defining the area to be cut. Unless a particular kind of charcoal is desired, just about any kind of wood can be used to make charcoal. Either first or second class wood will produce heavy charcoal. Pine trees will produce light charcoal. Although light charcoal can be produced from first or second class wood if desired.

Generally, charcoal is made in association with timber cutting activities. This may involve either selective cutting or clear cutting, but charcoal makers prefer to work where there has been a clear cut. It is preferred to use local workers. Often prayers are performed to insure a successful transformation of the wood. There have been occasions when for no apparent reason the wood was not transformed to charcoal.

Usually "hard," or "heavy," (*beukem*) charcoal is produced. "Light" charcoal is produced by a somewhat different process, which is simpler and quicker. Light charcoal can be made one day and sold the next. But the production of "light" charcoal is much less efficient, producing only 40 kg of charcoal from the same amount of wood that would produce about 70 kg of "heavy" charcoal. Heavy charcoal can be made from various kinds of wood (red acacia, *Acacia montana*, *Carpaceae*, *Altingia*, etc.). Light charcoal is usually made from a hard wood, such as *Carpaceae*. The price of light weight charcoal is higher than that of heavy charcoal.

The following steps are followed to make charcoal:

1. The wood is cut in relatively equal lengths of about 1.5 meters.

2. Borders are prepared and plant material is gathered.

3. A pit is dug to accommodate the amount of wood to be transformed, usually a rounded hole about half a meter deep.

4. The wood is placed into the pit in layers, with smaller pieces of wood and the bottom and larger pieces on top, arranged as neatly as possible.

5. About 25-30 cm from the rim, a border of stakes is constructed around the pit.

6. The space between the pile of wood and the stakes is filled with fresh plant leaves, which are in turn covered with a layer of dry biomass from the forest about 25-30 cm thick, varying slightly depending upon the size of the pit.

7. The entire pile is then covered with soil. The thickness of the soil layer should not be greater than the layer of fresh leaves.

8. The wood is ignited by inserting live coals through holes in the side of the pile that have been prepared for this purpose. If white smoke can be seen after an hour or two, it means the wood is burning satisfactorily. The kiln is usually ignited in the afternoon, when the soil is driest. When the wood is burning well, the holes are covered with soil.

9. The kiln must be tended twice during the first 24 hours, which is the critical period in ensuring a successful transformation. This is usually done in the morning and in the afternoon. The mound is trampled down to eliminate space between the burnt pieces of wood. The time needed to complete the process depends upon the volume of wood.

10. To ascertain that the transformation has been completed, a small hole is made on the top of the mound. If dark smoke emerges, the charcoal is not ready. When the smoke turns whitish in color, the transformation is complete. The layers of soil and leaves must be removed gradually and replaced with a covering of soil to extinguish the fire. This cover of dirt must be left in place for a full day and then removed slowly before the charcoal is removed. The charcoal may then be broken into the desired sizes and placed into sacks.

Usually charcoal makers work in groups for a charcoal company. Small-scale individual producers prefer to produce *gebur* charcoal, the special kind used by blacksmith shops. The price offered by a middleman for 100 kg of *gebur* charcoal is Rp. 20,000, while common charcoal sells for only Rp. 12,000 (US$6.49) per 100 kg.

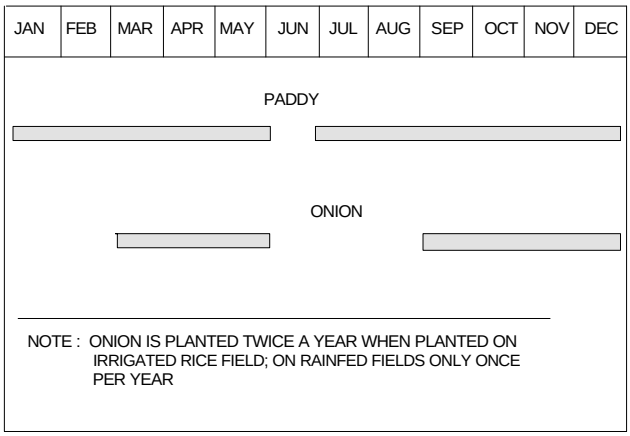
Charcoal-making is usually work for adult men only. Sometimes charcoal is produced near one's home, but production sites are often far from villages. Some villages (e.g., Pasanggrahan, in the western part of the sub-district) contain a number of men skilled in making charcoal. Villages near the heavily forested areas to the south and southeast of Majalaya town contain many charcoal workers. Usually charcoal workers form a group and work when requested by a company.

Charcoal can be made at any time, although production is more difficult during the rainy season, because movement is difficult in remote forest areas. Illegal operations by individuals usually produce only about two sacks of charcoal per day, each sack weighing about 40-50 kg.

3.1.2 Fuelwood Producers

An important component of the wood energy system is the gatherer of fuelwood, who usually lives in villages near the forests to be found to the south and southeast of Majalaya town. These are either protection or production forests. Fuelwood pickers are usually either farmers with very small landholdings or landless laborers. This work pays less than farm labor. Adult men, women, and children all gather fuelwood. This activity goes on to some extent throughout the year, although it is more common and more productive during the dry season, when movement in and around the forest is easier.

One fuelwood gatherer interviewed was an onion farmer who lived near the forest. From his small plot of land, only about 700 m^2 (50 *bata*), he can get only enough rice to feed his family of six for two months. Growing onions after the rice is harvested provides enough additional income to buy clothing, maintain his home, send his children to school, and so on. But to do all this and still have enough to eat throughout the year, he must gather and sell fuelwood. He gathers fuelwood from the forest about every other day, obtaining about one *pikul* (approximately 0.2 m^3) each day, which he sells for Rp. 1,500.



Crop Calendar in One Fuelwood Producer's Village

For landless laborers, fuelwood gathering is a very important part of their subsistence income. When employment in or around the village is available, they choose to work. But on average a farm laborer seems to find only about two months of employment per year; and when there is no work to be had, these people gather and sell fuelwood to survive.

Some fuelwood gatherers are professionals, while others are amateurs. Professionals are more selective in the wood they gather. One key informant asserted that amateurs are more

destructive to the forest, because they select neither the type nor the size of wood they take. Professionals usually have a vehicle to transport the wood, and they sell fuelwood in large amounts. Amateurs usually sell fuelwood by the *pikul* (in lots of two small bundles) in individual transactions, and only occasionally band together to hire a vehicle to transport their wood to a better market.

Fuelwood gatherers usually work from about five a.m. until nine or ten a.m. one day, gathering wood, and then spend the next day selling what they have gathered. Thus, in a two day period, they will earn about Rp. 1,500-2,000 by gathering and selling about one *pikul* of fuelwood. More money can be made by working in groups. A group of four will be able to send to the middleman 30 to 50 bundles, at a price of Rp. 600 per bundle. If the transportation cost is Rp. 7,000-10,000, then each worker will net Rp. 2,750-5,000.

Fuelwood gatherers reported in interviews that they take only deadwood, fallen limbs, or twigs from the forest. Tree cutting is forbidden, and fuelwood gatherers appear to be well informed regarding the law. But we frequently observed fresh fuelwood on the market. The rules are understood, but necessity often drives people to disregard the law. In fact, increased control activities by foresters always coincides with a decreased level of fuelwood supply.

3.2 The Marketing of Wood Energy

The marketing of fuelwood and of charcoal will be discussed separately because the two activities have different characteristics. Each will be discussed in terms of flow, quality, price, and quantity.

3.2.1 The Flow of Charcoal

Charcoal is produced mainly along the mountains to the southwest and southeast of Majalaya town. The farthest point, Gunughalu, is about 90 km away; the closest, Kamojang, about 10 km. Kamojang, a thriving center of charcoal production, supplies large amounts to Majalaya, while others provide charcoal not only to Majalaya but also to other cities, such as Bandung and Cimahi.

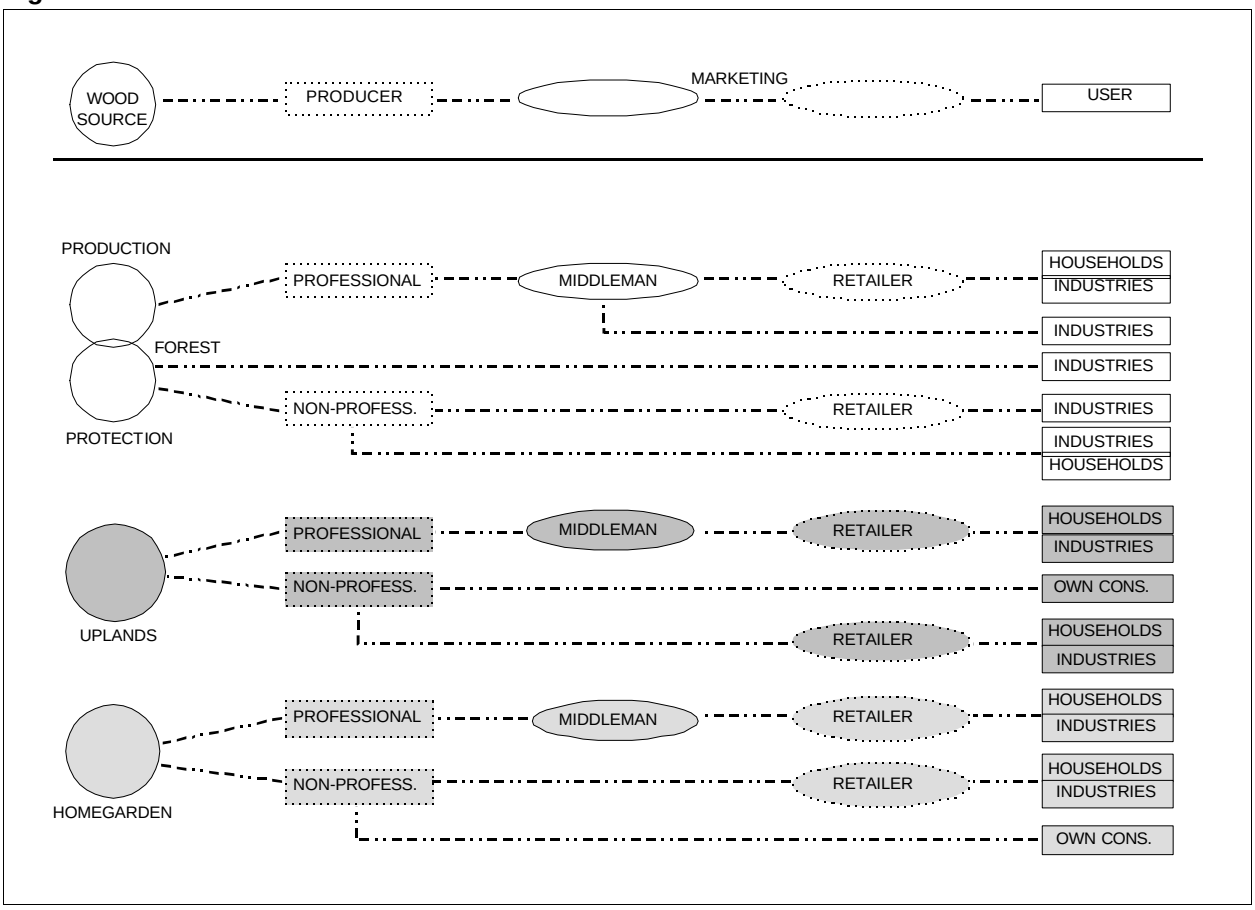
Charcoal is produced with wood from the government forest and from private land and farms. Producers of charcoal are involved in one or the other of two systems of distribution. Producers with some capital make charcoal in the forest and carry it on their shoulders to sell in town. This is usually done by farmers who are engaged in charcoal production as an off-season supplementary economic activity. Sometimes these producers sell charcoal to local users as well.

The second system of distribution involves charcoal makers selling their labor, but at higher wages than they would receive for agricultural work. This system is more elaborately organized, usually by relatively well-to-do absentee middlemen. It has larger working areas and better transportation facilities. There are seven such big middlemen living outside the production area. One lives in Majalaya town and sells his charcoal there. This second production system provides a greater and more regular supply of charcoal to Majalaya town than the system composed of small-scale individual producers.

Middlemen supply retail shops in town where the inhabitants purchase their charcoal. These retailers also buy from the small vendors who have brought their charcoal to town. There are about three retailers in the town of Majalaya, all located in the market area. Charcoal is normally paid

for upon delivery to the retailers, but one retailer reported sometimes providing a cash advance to regular suppliers. Retailers seldom order charcoal, because their stocks are closely watched by middlemen. The flows of charcoal are schematically represented in Figure 3.

Figure 3 Charcoal Flows



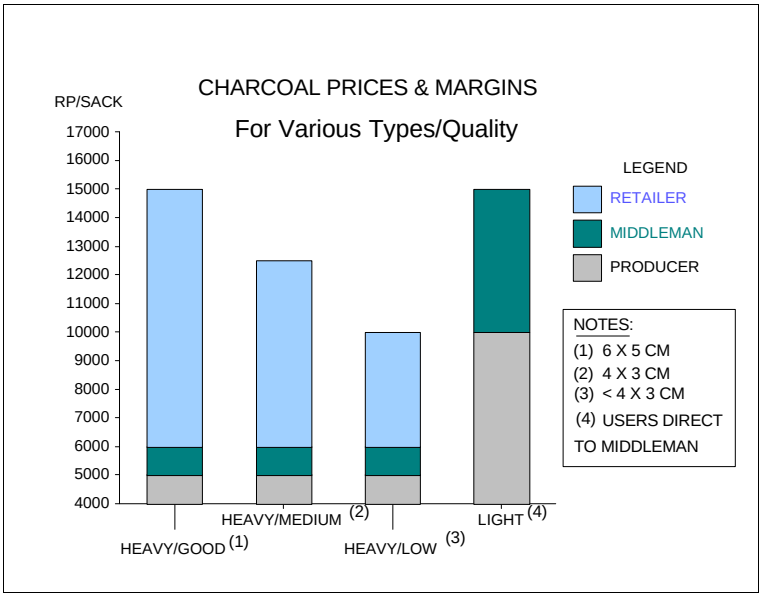
3.2.1.1 Quality and Price of Charcoal

The bulk of charcoal produced is used either in food processing or by small industries. Quality is monitored throughout the process of production and distribution. Producers and middlemen select heavy woods to the extent they are available to ensure product quality. Generally such wood is from slow-growing trees found only in forested areas. If charcoal is made by skilled workers following proper procedures, quality is also maintained in the processing phase. During transportation and storage, the quality of charcoal is also checked and discussed. When the charcoal is received by retailers, it is again checked for quality, this time mainly according to size. Three sizes are usually distinguished: large, medium, and small. Large pieces are more expensive than the same amount of smaller ones (See Figure 4).

Consumers also bring quality consciousness to the marketplace and judge charcoal according to their particular standards and needs. Food processors usually consider good charcoal in terms of weight (heavy), size (big), texture (fine), shine (glossy), and shatter-resistance (high). Those in small industry and providers of services--blacksmiths, makers of galvanized appliances,

solderers--prefer charcoal that is smaller, lighter, and more brittle. *Gebur* ("light") charcoal is not distinguished by different grades of quality, but it is generally preferred to be of medium size.

Figure 4 Charcoal Prices



The price of charcoal depends on both quality and availability. When demand increases while supply decreases, prices rise. In general, charcoal supplied to industrial and service operations is more expensive (by weight and by volume) than that purchased by food vendors, because they require charcoal made from certain hardwoods.

3.2.1.2 Quantity of Charcoal

The quantity of charcoal entering the town of Majalaya in any given period depends upon the level of activity of producers and middlemen. There are two large middlemen who supply much of the town's charcoal. The first usually produces charcoal based on tenders proposed by a forest company, within a legal context. He supplies charcoal to two towns, Majalaya and Ciparay. There are altogether five outlets in these two towns, and he provides them with a total of about one ton of charcoal every day. There are two retailers in Majalaya town who receive the roughly 400 kg per day that he delivers to Majalaya.

The second middleman seems to operate in a very different fashion. Instead of working through legal concessionaires, he apparently often hires workers to produce charcoal for him in the forest without getting permission from the forestry officials and then distributes this illegal charcoal to Majalaya town and elsewhere, sometimes even to the city of Bandung. The team had difficulty tracking down this second middleman. He reportedly makes his deliveries in a small truck in the middle of the night. We strongly suspect that he delivers illegal charcoal, but there is no way to estimate how much charcoal he brings into Majalaya nor where else he may take it.

This middleman may be viewed as operating on a large scale in the same way as the small-scale producers who take wood from the restricted forest illegally and then process it and sell it themselves, often carrying it to market on their shoulders. Charcoal production in forest areas is so much more efficient and profitable than that made with wood from private lands that village charcoal production away from the forests is now rarely practiced. There are two other retailers in Majalaya town who specialize in selling illegal charcoal.

The two retailers who buy legal charcoal from the first middleman, combined, sell on average from 200 to 500 kg of charcoal per week, depending on the situation. Most weeks, a retailer can sell about 200-300 kg. During holidays or times of celebration, however, especially during Rayagung month, sales may soar to a ton per week.

3.2.2 Fuelwood Marketing

The marketing of fuelwood, like that of charcoal, involves flow, quality, price, and quantity.

3.2.2.1 Fuelwood Flow

Majalaya is one of several areas in the Bandung valley that get wood fuel from forests around the Kamojang area. This is where most of the fuelwood in Majalaya comes from, so most of the fuelwood is from forest wood types.

Producers live around the production forest and the protection forest in the Kamojang area. Virtually all of them use fuelwood to meet their own energy needs as well as selling it. Some fuelwood producers work year round at gathering and selling fuelwood, while others are only seasonal producers. Both kinds of producers generally sell their fuelwood directly to middlemen. Some of the five middlemen who live in or near Majalaya sometimes also act as retailers in Majalaya town. Individual fuelwood gatherers usually carry the wood to market for sale, but sometimes they jointly rent a truck to ship to middlemen in town. They also sometimes sell fuelwood directly to consumers, both in their village and in town, taking what they cannot sell themselves to a middleman. Almost all the fuelwood in Majalaya appears to come from the forest in one way or another. The research team seldom found commercial fuelwood that came from agricultural lands (See Figure 5).

Figure 5 Fuelwood Flows

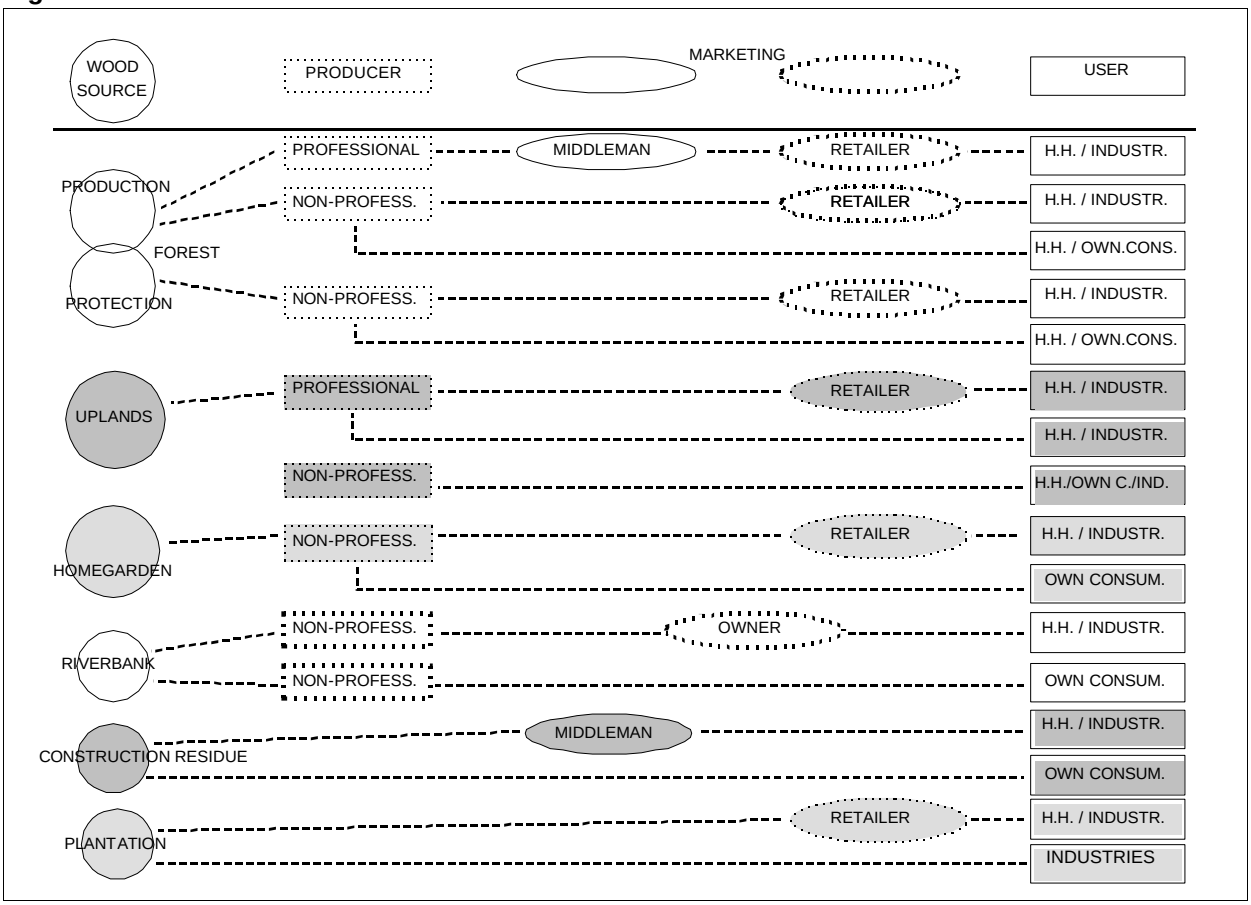
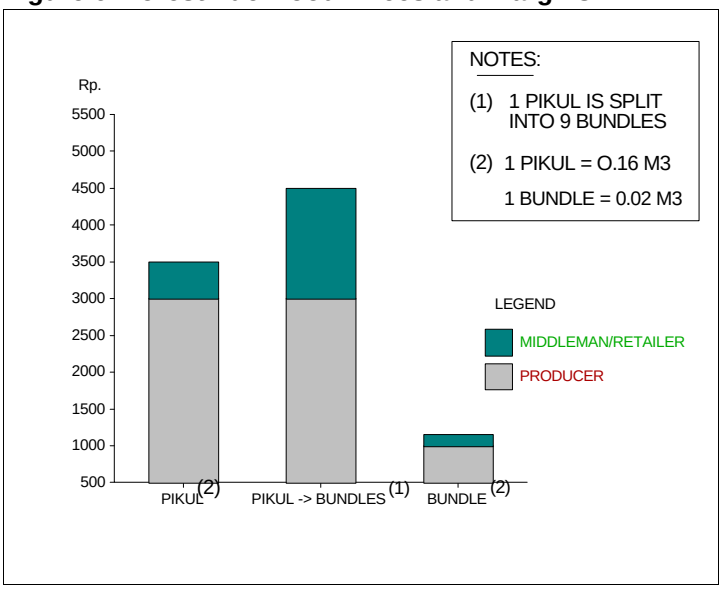


Figure 6 Forest Fuelwood Prices and Margins



3.2.2.2 Quality and Price of Fuelwood

All users of fuelwood interviewed in Majalaya town agreed that the best quality wood comes from the forest. It seems to burn longer and to produce more heat than wood from farmlands. Forest fuelwood is more expensive than fuelwood from farmlands. E.g. *Albizia falcataria* fuelwood from farmlands fetches 6500 Rp/m^3 ; that is about half of the price of most fuelwood from forest species. Retailers recut and divide the bundles they purchase from producers to get more and smaller bundles for sale.

Figure 6 indicates the price and margins of various ways of processing fuelwood from forest lands.

3.2.2.3 Quantity of Fuelwood

The volume of fuelwood supplied to the city of Majalaya varies considerably. Seasonal gatherers of fuelwood provide significant amounts only when there is a lull in the agricultural work cycle. When farmers are busy, the production of fuelwood decreases; when there is little to do on the farms, it increases. When forestry officials are active, fuelwood production drops; when they are lax in enforcing regulations, it rises. It is very difficult to estimate accurately the amount of fuelwood now flowing into Majalaya town.

It is clear, however, that the situation today is very different than it was in the 1950s, when about 60 *pikuls* of fuelwood were delivered to Majalaya every day and sold by day's end. This amounted to about 9.6 m^3 of fuelwood per day. Deliveries now seem to be both smaller and more irregular.

Most but not all of the wood energy used in Majalaya comes to the city through the services of middlemen from several sources located to the south and southeast of the city. Two of these localities supply wood energy more frequently than any others. From these two sources, at least three truckloads of fuelwood, carrying a total of about 45 *pikuls* of fuelwood, are sent to the city in each shipment. This amounts to about 7.2 m^3 of fuelwood per shipment, but shipments are irregular. Days, sometimes even weeks, may go by with no shipment because of a lack of supply at the source.

In times of shortage, however, we suspect that when a shipment leaves these localities not all of the fuelwood reaches Majalaya town. Some may get diverted. A portion of the loads, for example, may get taken to textile factories that still rely on wood energy. So urban consumers cannot be assured of a steady supply of fuelwood.

The shipments of fuelwood that arrive in Majalaya from these two localities go to the two middlemen who are major suppliers of fuelwood. But there are four retailers of fuelwood in Majalaya, and they also buy fuelwood directly from other producers. And there are also some producers who sell directly to consumers.

It seems to us unlikely that fuelwood consumption has actually decreased, but even crude estimates of consumption are difficult to make with any confidence. The situation is too complex.

4. ACQUISITION OF WOOD

4.1 Wood Energy Sources

Both the wood energy used by households and that used in small or home industries can come from many sources. Home gardens and private land may provide only a very small amount of the wood energy used in Majalaya.

4.1.1 Home Gardens

Previous studies have indicated that the home garden plays a meaningful role in meeting household energy needs. But in this study it appeared that very little wood from home gardens went into the wood energy commercial distribution system. Households were frequently observed drying wood for their own use, but not for commercial purposes. The types of wood that come from home gardens were never observed moving to urban areas for sale, or even being traded among the inhabitants of rural villages.

4.1.2 Upland Fields

One potential source of wood energy for Majalaya is the upland fields near the town. Most of this land is privately owned, and people do use wood from their own land to meet their own household needs, but rarely for commercial purposes. It appears that upland fields do not make any significant contribution to meeting the commercial wood energy requirements of the region. This may be due to the small average size of landholdings. Also, according to one wood seller, the wood that does appear on the market from such agroforestry plots (*talun*) is usually *Albizzia falcata*, a low quality source of wood energy. Even these trees, however, are not commonly seen on private upland agroforestry plots in many areas of the Majalaya sub-district.

One respondent reported planting 104 *Acacia montana* trees along the boundary of his property in 1965. They serve as boundary markers and as a source of wood for his household. Beginning three years after planting, he has been cutting one tree per week for fuelwood. He leaves the main trunk standing as high as three meters, so it will send out more sprouts. Each tree is cut approximately every two years.

Landowners who have planted trees that can be used in charcoal production do sell them to charcoal producers as a source of income. A landowner who planted the edges and steep slopes of his 3,600 m2 of land with *Acacia montana* said that he is able to sell wood from these trees to a charcoal producer once every three years as the sprouts keep regenerating. He has

already sold wood from these trees five times, with a total income of about Rp. 265,000. As a bonus, when he sells the wood for making charcoal he and his neighbors can use as fuelwood the branches and twigs not suitable for making charcoal. Those who want to use the scraps and remnants as fuelwood must help in cutting the wood. Wood from home gardens or agroforestry plots accounts for only a small fraction of the charcoal that is produced.

Charcoal producers prefer to work in forest areas for several reasons. Usable wood on private land away from the forests is scattered, owned by many different people, and generally of poorer quality. The transaction costs of getting the necessary quantity and quality of wood to the production site are quite high. There are also technical reasons for working in the forest area. Charcoal producers believe that lands in settlement and agroforestry areas have stony soil that is not suitable for charcoal production. Especially for producing "common" (*bekem*) charcoal, the loose soil with fewer stones found in forests is most suitable.

Fuelwood Collection in Rural Area

4.1.3 Plantations

Plantations can also be a source of wood energy. Although they cannot furnish wood on a continuous basis, they can make periodic contributions to energy needs. Sometimes wood from plantations can even be used to make charcoal. But plantations seldom cut wood unless they are changing crops or renewing stock. Rubber plantations must renew trees every 25 years. Tea and coffee plantations must prune the trees every two years. Thus wood can be obtained for use as fuelwood or in charcoal production.

There is no plantation in Majalaya sub-district that has plants suitable for wood energy use. One fuelwood middleman from Majalaya reported that years ago he obtained wood from a rubber plantation some 150 km away, but that this sort of operation is no longer profitable.

4.1.4 Forests

Based upon observation of the marketing and consumption patterns in Majalaya sub-district, we find the forest to be the major source of wood energy. A Natural Reserve Forest and a Production Forest are located to the south-southeast of the town of Majalaya, under the control of two divisions of the Department of Forestry (PHPA and the State Forestry Corporation *Perum Perhutani*). Certain sections of the forest are often visited by people seeking fuelwood. These areas are located in the Kamojang forest area, and some of them are within the boundaries of the Natural Reserve Forest.

Fuelwood is also obtained from other forested areas both within and outside of the sub-district. Lands under Perhutani control are a desirable source of wood for making charcoal, some of which is for use in Majalaya town. This is obtained both legally and illegally.

Perhutani does sometimes grant concessions to charcoal producers when there is clearing activity in some portion of the forest under their control. But wood for making charcoal is obtained illegally from these lands, and also from forests around Majalaya town. Datar kumeil, in the Kamojang forest area, is frequently used as a source of wood for charcoal production.

4.1.5 Other Sources of Wood Energy

One unusual but widely used source of wood energy is the Citarum River. People who live along the banks of the river get significant amounts of various kinds of wood from the river and its banks that help meet their household energy needs. Driftwood is widely used for fuelwood. People also frequently cultivate bamboo along the side of the river. This serves both to control erosion and to provide fuelwood.

One respondent reported that one stick of bamboo would meet the energy needs of his small household of two for a week. Two clumps of bamboo planted on this land beside the river, occasionally supplemented by driftwood, are normally adequate sources of wood energy. He rarely buys fuelwood, and sometimes has wood to sell to others.

Packaging Material for Fuel

The supply of driftwood available from the river is highly variable. During the wet season, especially after a heavy rain that produces flooding upstream (which usually happens once or twice a year), the amount of driftwood sharply increases. After the last big flood, some people were able to collect enough driftwood to provide wood energy for their households for several months, up to three m^3. Some even sold some wood.

Following a heavy rain, as the floodwaters begin to recede, large numbers of people come to the river with ropes and hooks to snag the wood floating by.

4.1.5.1 Construction

In converting big logs to lumber for use in construction, there is much waste. These wood scraps can be used as fuelwood. They may either be used by the manufacturer of the lumber or sold. More scrap lumber is produced in the actual construction process. This has a small value compared to the lumber used in construction, but it is a useful source of fuelwood. When a building is torn down it also yields much potential wood energy. In Majalaya some people buy old houses to get the wood, some of which they can use or sell for construction, the rest of which can be used or sold as fuelwood.

Construction Residues for Fuel

Because of a rapid increase in construction in Majalaya, both in housing and industrial development, old buildings are constantly being torn down and new ones built. This provides a source of wood energy for low income consumers. Both consumers and small traders ask to purchase wood from construction and demolition sites. Wood energy obtained in this way is cheaper than other forms.

It is particularly popular with petty vendors of certain types of food--fried bananas (*pisang goreng*), roasted rice flour (*surabi*), fried mixed vegetables and flour (*bala bala*)--as well as with poor households.

One woman with a family of eight reported that she never bought fuelwood but obtained it from the residues of factory construction and from the riverbank. She combines this free fuelwood with the purchase of at most three liters of kerosene per month to meet her total household energy needs.

It is very difficult, if not impossible, to measure the total energy value of construction residue, even for a single family. It is extremely variable both in volume and in types of wood.

4.2 Preferences for Wood Types

4.2.1 Charcoal

Almost any kind of wood can be used to make charcoal, but the quality will vary greatly depending on the type of wood used. Hard wood is said to produce a heavier charcoal that burns longer than charcoal made with soft wood ("light" charcoal). Heavy charcoal is preferred by both the industrial and the household sector. Heavy charcoal is usually made of wood obtained from the forest, specifically from certain kinds of trees that produce wood considered to be "good." These include *Neonuclea lanceolata*, *Lindera sp.*, *Altingia excelsa*, *Castanopsis argentea*, *Schima walichii*, *Quercus sp.*, *Acacia montana*, *Parinari corymbosa*, and others. Wood from each species may be considered to be either "first class" or "second class," depending on the age of the tree, with younger trees being "second class."

According to one charcoal producer, 0.6 m^3 of "heavy" wood will produce 70-80 kg of heavy charcoal, while the same amount of most non-forest wood will produce only about 40 kg of charcoal. Some non-forest woods from plantations and villages are also used to produce charcoal of good quality. Quinine, rubber, tamarind, and coffee trees fall into this category, as do *Albizia falcataria*, *Lansium domesticum*, and *Areca catechu.* Charcoal produced from non-forest wood is usually called "light," or "village" (*kampong*) charcoal. Although it is processed like the heavy charcoal, it produces only about half the amount that heavy wood does.

The wood used to make charcoal is often the residue from trees cut for timber to be used in construction. Most of the felled wood goes into construction, while branches, twigs, and scraps are either made into charcoal or used as fuelwood. If a tree is not large enough to yield timber, however, the entire tree will usually be used for making charcoal.

4.2.2 Fuelwood

Almost any kind of wood can be used as fuelwood, but most of the fuelwood used in Majalaya town comes from the forest. Fuelwood from villages--such as *Albizia falcata*, or coffee--is less valued. According to a man who deals in this type of wood, it cannot be marketed to Majalaya consumers, so he usually sells his wood to brick and tile industries located outside of Majalaya.

An inventory was conducted to determine which types of wood were marketed as fuelwood in Majalaya. Forest wood is heavily used. Common types found being sold in the Majalaya included: *Sloanea sigun*, *Quercus spp.*, *Podocarpus imbricatus*, *Michelia volutina*, *Altingia excelsia*, *Vernonia arborea*, *Neonuclea lanceolata*, *Omalanthus pulponeus*, *Manglietia glauca*, *Ilex sp.*, *Castanopsis argentea*, and *Pinus merkusii*. Some of these are now becoming somewhat scarce; i.e., *Castanopsis argentea*, *Mihelia volutina*, *Podocarpus imbricatus*, and *Quercus spp.*

According to one key informant, many years ago the forest was dense and fuelwood was easy to obtain. Then people used only fuelwood of high quality, hardwoods such as *Altingia excelsia*, *Castanopsis argentea*, *Schima walichii*, or *Quercus spp.* But now, as fuelwood becomes more difficult to obtain and the number of users keeps rising, people are beginning to use more low quality woods as fuel, such as *Chromolaena odorata* and *Lantana camara.* This type of wood still has only a small share of the market, however. Especially in dry weather, this wood is very fast burning and an inefficient source of energy. But people do collect such wood for meeting their own

household energy needs, and it is sold on the market at a low price and purchased by very low income consumers.

4.3 Availability of Wood

The availability of fuelwood varies from time to time. This variation is indicated by changes in the volume, size, and types of wood in use and the difficulty of obtaining wood as expressed in time lost or price paid.

4.3.1 Wood Availability Over Time

As mentioned above, fuelwood in Majalaya comes mostly from forests around the town. The protection (nature conservation) forest is under present forest policy regulations not supposed to be exploited for wood energy. The rest consists of production forests that are planted mostly in pine (*Pinus merkusii*), which is neither intended nor liked for use as fuelwood. So, the sustainability of wood fuel supply from forest areas to Majalaya is uncertain under the prevailing forest policy and management regimes.

There are already indications that it is becoming more difficult to obtain the preferred types of wood energy in the vicinity of Majalaya. People have to go further to find these species. As the raw material for making charcoal gets harder to obtain at nearby locations, higher transportation costs will lead to further increases in prices.

In some villages with many charcoal producers the nearest forest is nine kilometers away.

It was also noted that charcoal is limited in supply in Majalaya, and to meet the current demand charcoal is being imported from other regions (i.e., Pangalengan, Garut, and Gununghalu). In other places the village may be adjacent to the forest. But according to a key informant, even though one lives close to the forest, good sources of fuelwood can now be found only well into the forest, not along its edges.

Another indication of increasing scarcity of the preferred wood fuel species is that the size of fuelwood is decreasing. According to one trader, fuelwood length used to be about one meter, but it is now only about 40 to 70 cm. This is believed to be due to the difficulty of getting fuelwood, not because of transportation or storage factors. Although the size is decreasing, the price rises every year. In 1975 the price of one shoulder load of fuelwood was Rp. 500. Today it is up to Rp. 1,500 to Rp. 2,000 (US$1.08). Allowing for inflation, this represents an actual price increase of about 36 percent.

Also the types of wood used as fuelwood have changed in recent years. In previous decades people took only hardwood for fuel: *Quercus sp.*, *Altingia excelsa*, *Schima walichii*. But as the number of hardwood trees in the forest has decreased, people are increasingly turning to wood of lower quality as sources of wood energy.

Although the time spent and distance traveled to reach fuelwood sources is increasing, fuelwood collectors say they are still able to get ample fuelwood because both dry wood and living trees are still abundant deep in the Natural Reserve Forest. This is presently considered to be illegal.

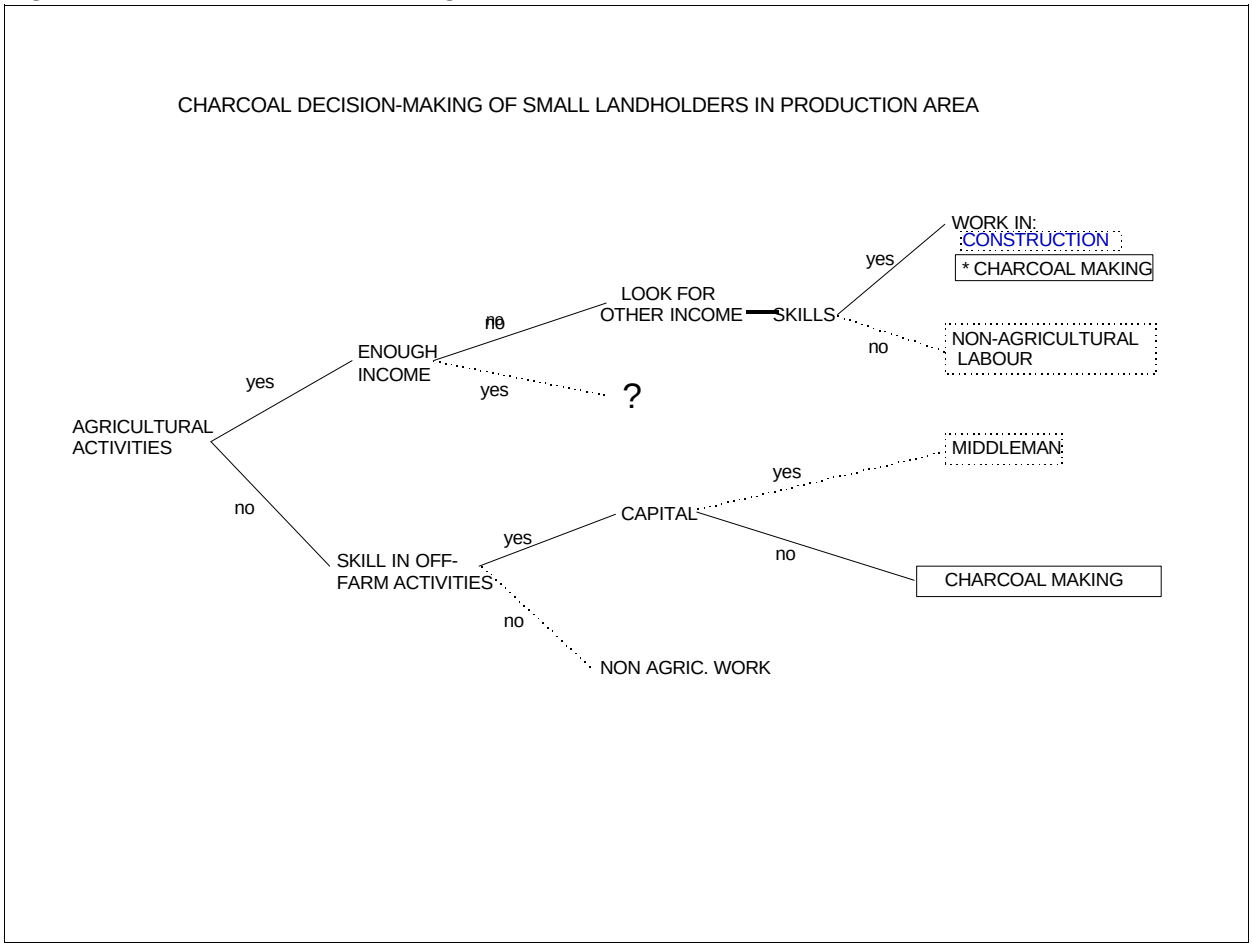
It may be expected that, without changes in policy and management regimes, the remaining preferred wood fuel sources will continue to be depleted and gradually replaced by the less preferred wood fuels from other sources in the Majalaya area, especially home gardens and agroforestry land (*kebun-talun*). Similarly to what has happened in other areas in Java, where such preferred wood fuels are not, or no longer available.

It would seem, however, that letting this happen would represent a foregone opportunity to combine sustainable wood fuel production, environmentally sound forest management and rural development. Hence we recommend to more seriously investigate the possibilities and modalities for "participatory management" of those forest areas in which the preferred wood fuels are still present.

4.4 Wood Energy Decision-Making

Many different kinds of people have to make a whole series of decisions about how to obtain, process, and use wood energy. Both producers and consumers have to weigh options. There are significant differences among socioeconomic classes and the situation for charcoal is not the same as that for fuelwood.

Figure 7 Charcoal Decision Making



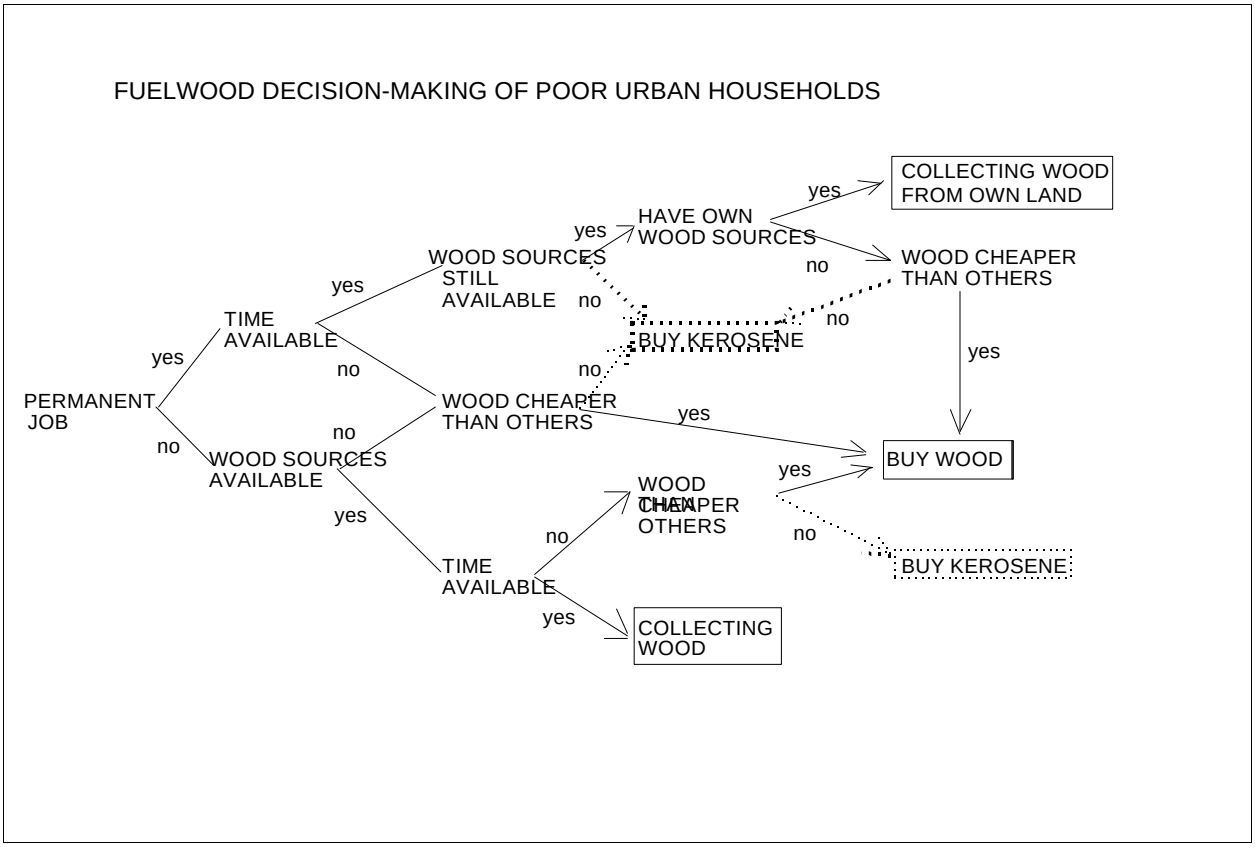
4.4.1 Charcoal Decision-Making

The series of decisions made by charcoal producers is shown in Figure 7. For some people with small landholdings in certain areas, charcoal provides an important source of income that is needed for subsistence. Charcoal-making is skilled work, so the wage is higher than for agricultural labor.

4.4.2 Fuelwood Decision-Making

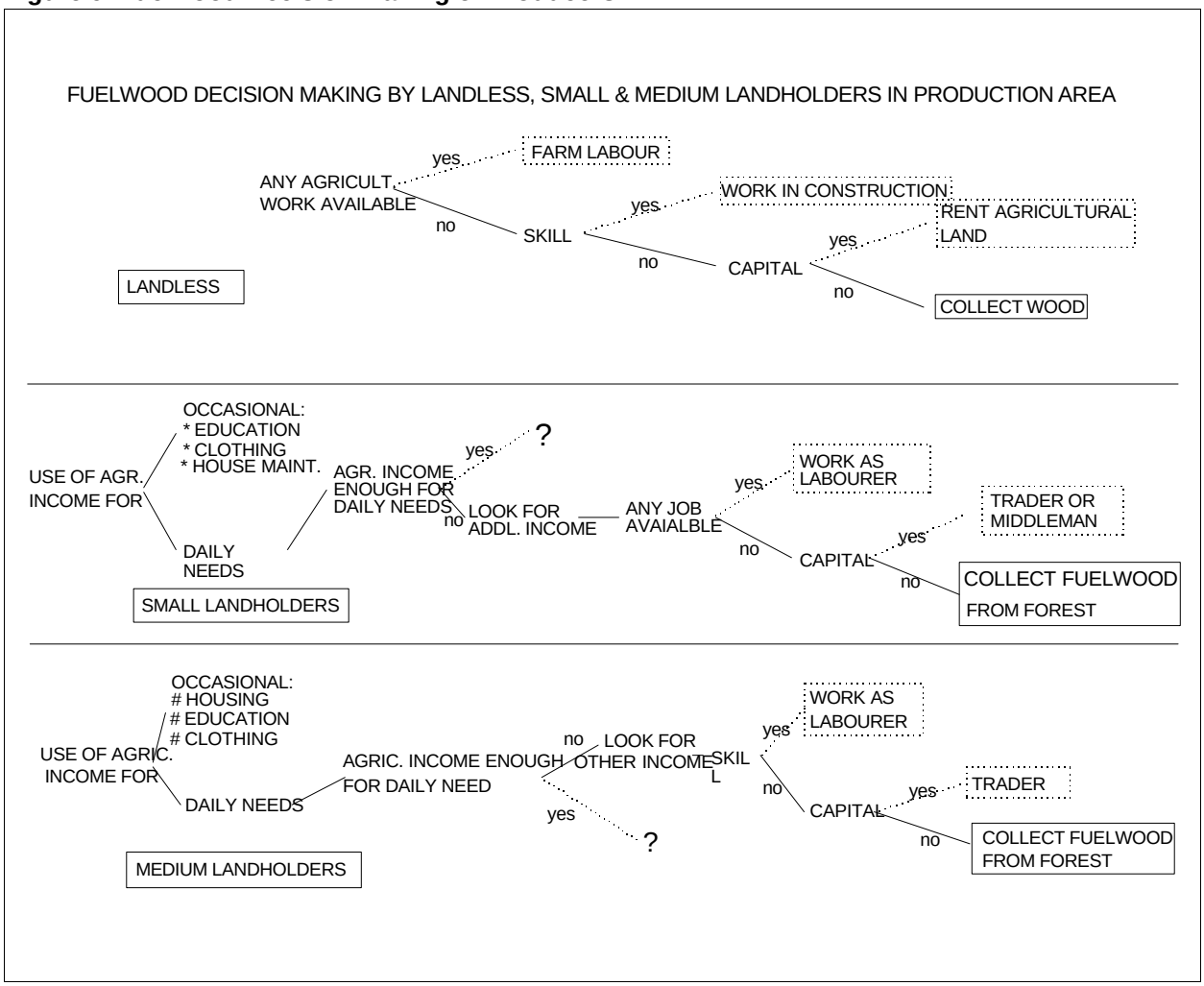
The series of decisions made by poor urban households regarding fuelwood use is shown in Figure 8. Some poor households in urban areas will use fuelwood as long as it is relatively easy to obtain. They will switch to kerosene only if wood becomes too difficult to obtain or if wood becomes more expensive than kerosene.

Figure 8 Fuelwood Decisions of Urban Users



For producers of fuelwood, their decisions depend upon their situation. For the landless, there is little choice. Collecting fuelwood is the only way to make enough money to live. For farmers with small and medium-sized landholdings in fuelwood producing areas, the income from farming provides much of what they need and some of what they desire, but collecting fuelwood can provide additional income that significantly raises their standard of living (Figure 9).

Figure 9 Fuelwood Decision Making of Producers



4.5 The Legal Context of Wood Energy Sources

The State Forest Corporation, Perum Perhutani, is the legal authority responsible for controlling the exploitation of forest land for commercial wood energy use. In the case of charcoal, the Forest Corporation is legally responsible for controlling the entire process of production until the charcoal is sold to middlemen.

According to an entrepreneur in the charcoal business, the Forest Company will announce when wood harvesting is scheduled to take place in some portion of the forest. Charcoal companies will then make tender offerings, applying for a concession to utilize raw materials available from this cutting, most of which will go to lumber. When such a concession is obtained, the company must make an advance payment of 80 percent of the fee, based upon an estimate of the total charcoal production to be realized from the operation. They will then be given a working instruction letter (SPK Certificate), authorizing them to take certain material from a certain area of land within a specified period.

But even more paperwork must be completed to make their operation legal. They must also obtain a legal certificate for trading (SIUP and HO), a tax registration certificate (NPWP), and permission to produce charcoal (SIPA). Similar steps must be taken to obtain raw materials from a plantation, whether the plantation is owned by the government or privately owned. Despite this extensive legal and administrative framework to control the exploitation of forest land, much wood energy is obtained illegally. For example, Datar kumeli in the Kamojang Natural Reserved Forest area is frequently used as a source of wood for charcoal production.

In villages adjacent to the forested area, many efforts have been made through local authorities to find alternative income-producing activities for people who take wood from the forest. But people usually find that these alternative activities provide less income than fuelwood collection, so they return to exploiting the forest. Wood collection is also the most flexible of activities. When other work that is more rewarding is available, people can stop collecting temporarily and then later resume collecting at any time.

According to village authorities, however, the problem goes even deeper than this. The efforts of some forestry officials to protect the forest are often not very serious. Villagers can often obtain permission to get wood from the forest rather easily in exchange for a small sum of money, about Rp. 3,000 (US$1.62) per vehicle. There have even been cases where forestry personnel were directly involved in the sale of wood. In the case of security for one project in the Kamojang area, such matters became very serious.

Often several different groups of people will work in the same area under control of the forestry service with different specialized purposes. Some make charcoal. Some gather fuelwood. Some specialize in producing construction materials.

Several years ago wood was carried out of the forest only on human shoulders, but now a good concrete road connects the Kamojang area with Majalaya and Garut, so motor vehicles are now used for transportation. People now steal wood from places that were never before accessible to exploitation of any kind, such as the Ciharus Lake area.

Before the Forest Conservation Office (PHPA) was established, the problem of wood theft could be tackled decisively by the hard-driving performance of the Forestry Supervisor. For example, as revealed in confidential village records, in 1957 a peasant was jailed three months for stealing one shoulderload of wood. If the same offense were discovered today, even if the perpetrator were caught and sent before the authorities, he would be released the next day.

The problem of wood theft is even more acute now than in the past for yet another reason, the use of the wedge. People used to use chain saws when they went after wood, but because the saw is time-consuming and easily detected, wood thieves now use wedges instead. The wedge is used to split tree trunks into sizes appropriate for construction purposes. This makes the act of stealing wood easier, faster, cheaper, and safer. But it also wastes much wood that might otherwise be put to good use. Forest workers who produce construction materials have been using the wedge for several years now.

When *Castinopsis argentea* was still plentiful, it was a preferred source of wood energy and lumber. As this species became scarce, people began to use *Distylium stellare*. Now, with good quality wood constituting less than five percent of the total supply, woods of low quality are routinely being cut to use in construction, to make charcoal, and for use as fuelwood.

The Kamojang forests are basically exploited by groups of specialists. There are groups who specialize in producing building materials, those who specialize in making charcoal, and those who specialize in fuelwood. Each person does one thing only and does not bother with other specialized functions. Thus, fuelwood collectors sell all the wood they get as fuelwood, even though some of it might be good for other purposes, such as construction. And those who produce construction materials abandon much scrap wood that would make good fuelwood.

5. THE ROLE OF WOOD ENERGY IN MEETING ENERGY NEEDS

5.1 Types of Energy Use

In the town of Majalaya energy is used mainly to meet household needs. It also is used to meet commercial needs and some other periodic needs for specific recurring activities. Households mainly need energy for cooking and ironing. Upper income level households, which use more energy for more purposes than other households, rely heavily upon LPG and electricity, supplemented by small amounts of kerosene. Middle income level households mainly use kerosene and LPG, supplemented by small amounts of electricity.

Poor people are dependent upon wood energy to meet their subsistence needs. They generally use fuelwood for cooking and charcoal for ironing. The very poor people cannot even afford to purchase all their fuelwood. They gather as many wood scraps of all kinds as they can find and try to use inexpensive agricultural wastes (i.e., rice husks) for cooking whenever possible. They buy only as much fuelwood as is necessary, and never buy kerosene unless no cheaper energy source is available. Most decisions involving household energy use are made on economic grounds, and poor people have few choices.

Commercial use of wood energy persists among small-scale vendors, small industries and home industries, and service enterprises. Purveyors of *sate* and roasted bread use only charcoal. Those who sell fried cakes, hot spiced drinks, and Chinese food prefer to use charcoal, but also use fuelwood and kerosene. Vendors of roasted rice flour use only fuelwood. In smoking fish and producing textiles, both charcoal and fuelwood are used, but nothing else. For curing tobacco only wood energy is used. Blacksmiths use only charcoal and tinkers feel they need charcoal for certain purposes.

Wood energy is also used by all income levels to prepare food for ceremonies and special occasions, such as weddings and circumcision celebrations. Even well-to-do people use wood energy for cooking large amounts of food on such occasions because the tantalizing aroma it produces is an indispensable part of the pleasure for them and for their guests.

5.2 Changes in Types of Energy Use (Energy Substitution)

Over time there has been some shift from wood energy to alternative forms of energy. For example, the textile industry once used wood energy but has now shifted to using petroleum. This is mainly attributed to the fact that wood energy has become difficult to obtain reliably in adequate amounts. Other wood energy consumers, such as vendors of hot spiced drinks, are also shifting from wood energy to petroleum products for practical reasons. As noted above, however, many other consumers of wood energy are reluctant or unable to shift to alternative fuels.

Electricity first became available in Majalaya in 1946. It was mainly used for lighting or to power radios. People used charcoal instead of electricity to iron because it was cheaper. It is estimated that about 30 percent of the households in Majalaya, mainly the poorer ones, still use charcoal for ironing, while 70 percent of the households now iron by means of electricity.

Petroleum products were introduced into Majalaya in 1954. A number of families soon began to use kerosene because they found it to be a clean and convenient source of energy. At that time, the price of a liter of kerosene was Rp. 0.15, while a shoulder load of fuelwood (about 62.5 kg) cost Rp. 0.25. A shoulder load of fuelwood amounts to about 0.2 m^3 of wood. Based on the experience of consumers, this amount of wood will last a household as long as five liters of kerosene. Shifting to the use of kerosene in place of fuelwood would appear to have doubled the household energy costs. Fuelwood is still much cheaper than kerosene, as attested to by the fact that low income households tend to use fuelwood while kerosene is used mainly by middle income level households.

5.3 Estimated Annual Wood Energy Use in Majalaya

An accurate estimate of annual wood energy use in Majalaya is beyond the scope of this study. Such estimates would have to consider many variables that affect the demand: the number and size of consumer households, frequency and types of usage, seasonality, and so on. If we were to assume that 10 % of all households depended entirely upon fuelwood for their subsistence needs, we could assume that about 5700 m^3 of fuelwood was consumed per year for this purpose. But we know that many people combine fuelwood with other sources of energy. We roughly estimate, therefore, that the actual use of fuelwood in Majalaya is about 2400 m^3 of wood per year (Tables 1 and 2).

Table 1 Fuelwood Use Estimates

COMMERCIAL FOOD PROCESSING				
Type	**Number**	**Days/Year**	**Use/Day**	**Use/Year**
Serabi	13	300	0.015	58.5
Warung Nasi	18	300	0.010	54
Bubur kacang	16	300	0.010	48
Pindang	5	96	0.010	4.8
Bandrek	17	300	0.005	25.5
Bandrosi	13	300	0.005	19.5
Leupeut	7	120	0.020	16.8
Commercial Food Processing Use per Year: 227.1 m^3				
HOUSEHOLDS				
Number	Use/Week	Use/Year		
421	0.1	2190 m^3		
ESTIMATED ANNUAL FUELWOOD USE: 2417 m^3				

The annual use of charcoal is estimated to be about 121 tons per year. Most of this is used by the 6 smithies in town. It is assumed that about 40 % of Majalaya households use charcoal for ironing. They are the second largest consumer category of charcoal (See Table 2).

Table 2 Estimated Annual Charcoal Use

Commercial Food Processing & Households				
Type	Number	Days/Year	Use/Day	Use/Year
Sate	12	300	2 kg	7200
Pindang	1	96	20 kg	1920
Patri	5	300	0.35 kg	525
Smithy	6	50	50 kg	90,000
Households	1685		0.25 kg/wk	21,905
ESTIMATED ANNUAL CHARCOAL USE: 121,550 Kg				

According to key informants, one m^3 of wood will provide about 100 kg of charcoal. So the charcoal being supplied to Majalaya requires about 1200 m^3 of wood per year. Based on the above figures, then, we can estimate that the current total use of wood energy in Majalaya would require a probable 3600 and maybe even 6000 m^3 of wood per year.

The increasing use of commercial energy sources that we observe in the Majalaya area, especially in urban areas, will probably continue to grow. But this does not mean that the people of Majalaya will completely cease to be dependent upon wood energy in the foreseeable future. Both households and businesses prefer wood energy for certain uses. There are any number of special activities for which no alternative energy source appears to be both a technically feasible and culturally acceptable substitute for wood energy.

Any further increase in the price of commercial energy sources will place more pressure upon forestland which is already shrinking and becoming degraded. As earlier stated, this would require more responsive and innovative management regimes, particularly if preferred wood fuels were to be produced on a sustainable basis.

6. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

6.1 Summary

6.1.1 Why Is Wood Energy Used?

People who live in villages, and in small cities like Majalaya, use wood energy because they are poor and it is inexpensive and because it is in accord with their habits, especially their cooking practices. Wood energy is cheaper than kerosene. To use kerosene requires not just the buying of the fuel, but also the purchase of a kerosene heater and other equipment, such as wicks. In rural areas there are many different kinds of biomass energy resources, compared with large urban centers, where a wider range of commercial sources of energy is available.

6.1.2 Who Is Involved in the Wood Energy System?

The wood fuel energy business in Majalaya involves both the lower and the middle socioeconomic levels. There is a chain of activity extending from the primary production processes through retail sales. The production level is located in rural areas and is dominated by economically weak groups, landless laborers and very small landholders. Members of the middle socioeconomic level of society participate in the wood energy system by providing capital and organizational skills. They usually reside in urban areas and act as middlemen or retailers.

6.1.3 Where and When Is Wood Energy Produced?

For professional workers, charcoal-making is not a seasonal activity, but activity levels do rise and fall. but according to the availability of wood, the basic raw material. Because charcoal is usually made deep in the forest, activity is more limited during the rainy season. But, regardless of season, if forestry officials decide to harvest some portion of the forest, charcoal entrepreneurs will apply for the rights to make charcoal from the wood that does not become construction material.

Especially in the making of light charcoal, activity levels go up as the intensity of seasonal farmwork goes down. For example, charcoal may be made by onion farmers between the work peaks of cultivation and harvesting.

6.1.4 Where Is Wood Energy Sent, and How?

Charcoal is usually produced in the forest or in rural villages and sent into urban areas. Sometimes charcoal made in small amounts in villages will be sold locally for local consumption. But charcoal made in the forest, which is to say much of the charcoal, is sent directly into urban areas.

Sometimes charcoal that is produced in the forest has to be carried by workers out of the forest to some place that can be reached by a four-wheel vehicle that will transport the charcoal into urban areas. But the lighter charcoal, which is produced in small amounts, is often carried by the small-scale producers themselves directly into the city for sale.

Fuelwood carried out of the forest for sale either goes to Majalaya or into the village where the fuelwood collector lives. We did not encounter any fuelwood carried out of the forest for sale into any rural villages other than the home village of the person who collected the wood. Fuelwood that comes from home gardens or agroforestry plots is usually carried by the owner for sale. But if fuelwood is to be sold in Majalaya, sometimes, if the amount of wood justifies the expense, people will pool their resources to hire a vehicle to carry their fuelwood to town.

6.1.5 When Is Wood Energy Used?

The use of wood energy is not seasonal, strictly speaking, but as noted above, it does vary at different times of the year. Fuelwood energy use increases during the rainy season and during months that have many celebrations and holidays (i.e., when there are many circumcision celebrations, marriages, and during the holy month of the Haj).

6.1.6 Who Uses Wood Energy In Urban Areas?

Wood energy is used by many households as well as by many commercial and industrial enterprises. Blacksmithing and the dye industry use wood energy, as do many small commercial ventures, such as sidewalk vendors and food processors.

6.2 Conclusions

Based upon our research, we reach the following conclusions:

1. Wood energy is still used in significant amounts in the town of Majalaya, both by households and by commercial users. Most households using wood energy on a regular basis have low incomes. In the commercial sector, small and home industries are still using wood energy.

2 Most of the wood energy used in Majalaya comes from the forest. The proportion of wood energy that originates on private farmland is very small. Much more comes from the protection forest or the production forest. Wood energy is also obtained from construction residue, packing residue, and from rivers.

3. Wood energy is still being obtained from illegal cutting in the forests. The limited job opportunities and low wages of available jobs compel some workers to work as fuelwood collectors, taking wood from the forest for commercial purposes.

4. Wood energy trading is profitable, so entrepreneurs will invest capital to employ low-income people as fuelwood collectors to maintain business profits.

5. The demand for wood energy for specific purposes will persist because it is based upon taste and perceived quality. The continuance of these activities will depend upon the availability of wood fuel, but as of now there is no regular management of resources to maintain a supply of wood energy to fulfill those needs.

6. The illegal nature of their activities encourages wood collectors to devise new methods of getting wood from the forests that are quicker and more difficult to detect, but are also wasteful.

7. The development and improved distribution of alternative energy sources (kerosene, electricity, and LPG), which are at present used only by the more privileged sectors of society, will reduce the number of wood energy producers and the volume of trade in wood energy products. While this may lessen the pressure on the forests, it may will also adversely affect the livelihood of wood energy producers, textile factory workers, and construction workers.

6.3 Recommendations

Based upon the above conclusions, the team makes the following recommendations:

1. Organizational and technical arrangements to improve the sustainability of the forest areas used as wood fuel sources, should be designed, field tested and adapted at a small scale prior to their dissemination to other areas;

2. In the design of such arrangements due attention should be paid to the possibilities for joint (villagers and forest authority) management, taking into account the innovations and lessons learnt in Indonesia and elsewhere in Asia, with such participatory forest management regimes;

3. Assisted natural regeneration and enrichment planting where necessary of the preferred woodfuel species identified in this study, should be tested as silvicultural strategies in participatory management regimes.

4. Based on experiences with the implementation of pilot activities as suggested above, the modalities of removing the illegal character of wood fuel activities (and therewith the negative side-effects of this illegality) should be designed and tested.

REFERENCES

Anonymous, 1980 dan 1981. Survai Energi Pedesaan (Rural Energy Survey) Direktorate Jendral Ketenagaan Departemen Pertambangan dan Energi Republik Indonesia. PT. Surya Jaya Utama Jakarta.

Khon Kaen University. 1987. Proceedings of the 1985 International Conference on Rapid Rural Appraisal. Khon Kaen, Thailand: Rural Systems Research and Farming Systems Research Projects.

Ellenbroek, W.E.T., 1988. The Wood Marketing System in Gunung Kidul Central Java, Indonesia. FONC Project Communication. Fakultas Kehutanan Universitas Gadjah Mada. Bulaksumur, Yogyakarta.

Hadi, Satyawati, Bubarman, Boen Purnama dan Martoyo, 1979. Penggunaan Kayu Bakar dan Limbah Pertanian di Indonesia.(Use of Fuelwood and Agricultural Residues in Indonesia) Kertas Kerja untuk Lokakarya Energi Komite Nasional Indonesia. Lembaga Penelitian Hasil Hutan. Bogor.

Smiet, A.C., 1990. Agroforestry-Based Fuelwood Production on Java. Farm Forestry News, Vol 4 No. 1. Arlington, USA.

Soesastro, Hadi, Raymond Atje, Nancy K. Suhut, Michael B. Soebagyo dan H. Sardjito, 1983. Energi dan Pemerataan.(Energy and Distribution) Yayasan Proklamasi. CSIS, Jakarta.

Appendix: Additional Urban Wood Energy Users

Bandrek seller (soft drink made of coconut, zingiber and palm sugar)

Serabi seller (food made of rice flour and coconut)

Bandros seller (food made of rice flour and coconut)

Bajigur seller (soft drink made of coconut milk and palm sugar

Patri (soldering)