ASIA-PACIFIC FORESTRY SECTOR OUTLOOK STUDY

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WOOD MATERIALS FROM NON-FOREST AREAS

by

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INFORMATION NOTE ON ASIA-PACIFIC FORESTRY SECTOR OUTLOOK STUDY

At its sixteenth session held in Yangon, Myanmar, in January 1996, the Asia-Pacific Forestry Commission, which has membership open to all governments in the Asia-Pacific region, decided to carry out an outlook study for forestry with horizon year 2010. The study is being coordinated by FAO through its regional office in Bangkok and its Headquarters in Rome, but is being implemented in close partnership with governments, many of which have nominated national focal points.

The scope of the study is to look at the main external and sectoral developments in policies, programmes and institutions that will affect the forestry sector and to assess from this the likely direction of its evolution and to present its likely situation in 2010. The study involves assessment of current status but also of trends from the past and the main forces which are shaping those trends and then builds on this to explore future prospects.

Working papers have been contributed or commissioned on a wide range of topics. They fall under the following categories: country profiles, selected in-depth country or sub-regional studies and thematic studies. Working papers are prepared by individual authors or groups of authors on their own professional responsibility; therefore, the opinions expressed in them do not necessarily reflect the views of their employers, the governments of the Asia-Pacific Forestry Commission or of the Food and Agriculture Organization. In preparing the substantive report to be presented at the next session of the Asia-Pacific Forestry Commission early in 1998, material from these working papers will be an important element but will be blended and interpreted alongside a lot of other material.

Working papers are being produced and issued as they arrive. Some effort at uniformity of presentation is being attempted but the contents are only minimally edited for style or clarity. FAO welcomes from readers any information which they feel would be useful to the study on the subject of any of the working papers or on any other subject that has importance for the Asia-Pacific forestry sector. Such material can be mailed to the contacts given below from whom further copies of these working papers, as well as more information on the Asia-Pacific Forestry Sector Study, can be obtained:

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EXECUTIVE SUMMARY

High population density (230 to 840 persons per sq km) and fast population expansion (1.2% to 2.9% per annum), coupled with accelerated economic growth, have placed heavy pressures on the forest resources of the Asia-Pacific region leading to their rapid shrinkage. In the decade of the 1980s, forests diminished by about 3.9 million ha yearly. Today only 0.19 ha of forests per capita of population remains in the region, compared to 0.64 ha per capita on a global basis. The remaining 566 million ha of forests seem incapable of satisfying the needs for wood energy as well as for industrial raw materials. Most of the countries will have to progressively rely on tree-bearing non-forest areas (NFAs) to fill the supply gap. NFAs with tree stands are apparently expanding as: (1) more areas are converted from forest to farms with non-forest trees; (2) areas originally devoted purely to annual crops are converted into agroforestry farms which integrate trees into the farming systems; (3) some degraded lands or wastelands are being put back to productive use with tree crops.

Outside of estate plantations of rubber, coconut, palm oil, coffee, cocoa and tea (which are outside the scope of this paper) farmers traditionally integrate trees in their farms as block plantations or as shelterbelts, live fences, boundary markers, nurse crops, and as line planting along roads, railways, canals and rivers. They are sources of food, fodder, green manure, fuelwood, poles for local construction, and small logs (pulpwood or sawlogs) for industrial use.

Fuelwood is the most important wood product in the region at present: about 92%, 73%, and 69% of all wood harvested in South Asia, Southeast Asia and East Asia subregions, respectively, are in this form. The second most valuable yield is small timber for pulpwood, sawlogs and electric transmission poles. Large logs are not usually grown in NFAs because farmers harvest tree crops that are still young to obtain early financial returns. Since these industrial wood assortments are of pulpwood size, they are collectively referred to as **Pulpwood**. Among the developing countries in the region, the ratio of fuelwood to pulpwood produced in NFAs is approximately 10 to 1. In the developed countries (Japan, Australia, New Zealand), on the other hand, the reverse is true.

Low wood supply in the face of escalating demand has pushed market prices for fuelwood and industrial wood up by over 100% from 1980s levels, thereby providing a strong motivation for farmers to grow more tree crops in non-forest areas. Many farmers in western India and in southern Philippines, for example, have shifted from food crops to tree crops for cash incomes. Moreover, a number of countries have adopted community-based forestry programmes for restoring tree stands and generating livelihood opportunities for low-income farmers. A desirable offshoot of community-based forestry is the production of more wood to complement the yields from the diminishing natural forests.

Of the total fuelwood and pulpwood outputs, about 46% emanate from forests while the other 54% are derived from NFAs. The proportion of wood outputs from natural forests are expected to further decline as more forest areas are withdrawn from production and set aside for biodiversity conservation, ecological protection and watershed use.

Table S-1 - Actual and Projected Wood Consumption, Asia-Pacific, 1993-2010

Country/Region	Fuelwood and Charcoal (1,000 M^3)		Industrial Roundwood (1,000 M^3)	
	1993	2010	1993	2010
SOUTH ASIA				
Bangladesh	31,774	35,012	739	852
Bhutan	1,364	1,575	127	110
India	262,782	302,387	24,930	28,258
Nepal	19,440	22,647	620	1,322
Pakistan	25,021	31,076	2,823	2,351
Sri Lanka	8,703	10,339	670	786
SOUTHEAST ASIA				
Brunei	79	39	217	244
Cambodia	5,880	7,790	759	721
Indonesia	149,063	180,146	38,409	44,486
Laos	4,254	4,278	614	690
Malaysia	9,375	8,523	35,457	31,092
Myanmar	19,156	23,227	2,219	2,468
Philippines	35,980	40,635	4,112	4,796
Thailand	35,313	39,735	3,811	7,830
Vietnam	28,984	37,030	4,419	5,098
EAST ASIA				
China	200,060	255,839	104,601	125,009
Japan	361	270	70,418	72,485
Korea (North)	4,230	4,854	503	614
Korea (South)	4,491	5,801	10,516	16,158
Mongolia	445	427	408	299
SOUTH PACIFIC				
Australia	2,898	*1,629	11,012	14,927
Fiji	37	41	115	236
New Zealand	50	*28	10,985	12,624
Papua New Guinea	5,533	6,008	727	324
Samoa	70	80	61	70
Solomons	138	144		134
Vanuatu	24	26		45

* Projections lower than present consumption of fuelwood and charcoal
Source: Forestry Statistics Today for Tomorrow, FAO, Rome, 1995; FAO 1997 Provisional Outlook to 2010.

The general upward trend of fuelwood and small timber consumption is heavily influenced by population growth. That is so because fuelwood is the dominant, if not the only, energy source available to the populations of developing countries. This suggests that as countries approach the limits of the carrying capacity of their forests and NFAs, they need to institute strong population control measures to reduce wood demands to manageable levels.

The jump in consumption of fuelwood and industrial roundwood (including pulpwood) over the 17-year period from 1993 to 2010 is shown in Table S-1. The largest rates of increase are projected for Bhutan and Nepal due to the fact that fuelwood is not just for cooking but for space heating as well. A happy note is shown by the declining trends in fuelwood consumption for South Korea, Malaysia and Thailand. The high per capita income in these

newly industrialized countries have enabled their citizens to move up from fuelwood to "clean" energy sources like electricity of gas.

1 BACKGROUND

1.1 Purpose

The purpose of this document is to examine the background and circumstances surrounding the production of wood materials from non-forest areas (NFAs) in the Asia-Pacific region; to assess the current situation and trends with respect to the extent, distribution, and yields of NFAs based on available records and complemented by professional judgement; and, in line with the trends that emerge from the assessment, to visualize the future prospects and the most likely scenario regarding the quantity and distribution of small-sized industrial raw materials and local wood supply contributed by NFAs to the national wood balance.

Since the forecast of the future of non-forest wood resources are based on a mix of often incomplete statistical information, analyses of influencing factors such as national forest policies and programmes, and exercise of professional judgement, the numbers arrived at are to be taken as indicative figures rather than precise data.

1.2 Economic Situation and Trends, Asia-Pacific Region

The Asia-Pacific region is today regarded as outstanding in many different ways. Economically, it is growing at a rapid pace. Most of its member countries are still classified as "developing," but five of them have attained yearly GDP growth rates exceeding 8% and 11 have economically expanded by more than 6% per annum. Furthermore, 15 nations have reached per capita GDP levels greater than US$2,000 per annum (Table 1, Annex).

In international trade, the region has developed into a significant trading partner. Its high endowments in natural resources and in productive but low-priced human resources have catapulted it to become a key source of industrial raw materials (e.g., roundlogs, mineral ores) as well as high-quality but competitively-priced manufactured goods (e.g., electronics, furniture, garments) for the export markets. At the same time, because of the rising prosperity and improved purchasing power of its huge population, it has become itself a huge and fast-growing market that absorbs an increasing proportion of the finished products, particularly durable and capital goods, exported from advanced countries. The growing importance of the Asia-Pacific market is further reflected in the aggressive competition among the exporting Western nations to supply that market and carve out larger market shares for themselves.

1.2.1 Demographic Situation

The region is saddled with a heavy population that is expanding at a very fast rate, ranging from 1.2% to a high 3.2% per annum. In certain cases, people pressure on land is now extreme: Bangladesh has about 840 persons per sq km. Others with high densities are India (314), Sri Lanka (282), Vietnam (232) and the Philippines (230) (Table 2, Annex). The region is now home to more than 3.1 billion people, or greater than half of the population of the

world (Rao, 1994).There exists a potential danger that population may rise to levels beyond the capacities of some nations to sustainably support ecologically and economically.

High population densities are, at times, aggravated by imbalanced distribution. For instance, Indonesia has a national density rate of only 109 persons per sq km but about 68% of its total population is concentrated on Java island which covers only 7% of the country's land area. The result is a very high concentration of over 814 persons per sq km on that island. Such uneven distribution generates other problems: the need to transfer and redistribute resources, products and social services from areas of light to those of heavy concentrations of people**.**

1.2.2 Impacts of Economic and Population Growth upon Forest Resources

The accelerated economic growth in the region, coupled with the rapid population expansion, has elevated the pressures on resources to unprecedented levels. In the forestry sector, such escalation is reflected in deforestation rates which, for the entire region, have risen from two million ha per year in the 1970s to 3.9 million ha per annum in the 1980s (Rao, 1994). Many countries are currently threatened with rapid loss of forests: the forests of Cambodia, Laos, Papua New Guinea and Vietnam are diminishing by more than 100 thousand ha yearly; India, Malaysia and the Philippines by over 300 thousand ha per annum; Myanmar by greater than 400 thousand ha per year; Thailand by some 515 thousand ha, and Indonesia by about 1.2 million ha per annum (Table 3, Annex).The proportion of land that remains under forests has declined to extremely low, possibly irreversible levels in some cases. For instance, ten countries in the region have lower than 30% forests, and four (including Bangladesh and Pakistan) are now below 10%. While the global figure today is 0.64 ha of remaining forests per capita of population, the Asia-Pacific rating is down to only 0.19 ha per person (Table 4, Annex).

1.2.3 Major Causes of Deforestation in the Asia-Pacific Region

Exploitation activities triggered by economic expansion and population growth have been the main causes of deforestation in the region: (1) timber harvesting that fill the increased raw material needs of growing industries, and (2) conversion of forests to agriculture and settlements to provide food and abodes for the expanding population.

Authorized logging, guided by appropriate forest management plans, is not a threat to the sustainability of forests since only mature trees are removed and the volume of yearly harvests do not exceed the annual growth of the stand. Similarly, well-planned conversion of forestlands with gentle topography, good soil quality and accessible location, into agricultural purposes means allocation of land to its "best use" so it is not be regarded as "deforestation" in the negative perspective from which it is often perceived.

Spontaneous, unplanned and unauthorized conversion of hilly forest areas into farms and human settlements is the greatest cause of deforestation in the region today. By sheer force of numbers, encroaching farmers equipped with light cutting tools and aided by fire may inflict more damage to the forest compared to the heavily-mechanized loggers. The destruction wrought by each individual farmer is minimal but their aggregate impact is extensive.

Ironically, areas set aside as permanent forests for sustained-yield management often attract more unauthorized settlers since access roads built for timber harvesting also provide easy access for them. Moreover, where the large and mature trees have been harvested, so the small residual trees left behind for future extraction are easier to cut and burn preparatory to cultivation.

1.3 The Growing Importance of Non-Forest Areas (NFAs)

As countries face expanding wood demand and shrinking forest resources, they exert efforts to strike a balance between wood supply and demand. In countries where demand far exceeds supply, the conventional approach to expand the wood supply is for government to reforest denuded forestlands. The other less known but increasingly important approach is to encourage the local people and communities to establish small-scale tree plantations in **non-forest areas** (NFAs) such as farmlots, agroforestry farms, and communal land areas. Small-scale block or line tree plantations in NFAs are rapidly proliferating because government is providing conducive policy and economic incentives, and because entrepreneurial tree farmers are drawn to it by wood prices that are escalating to attractive levels. Thus, it is anticipated that NFAs devoted to tree crops will further expand and will contribute an increasing share to the national wood supply.

1.3.1 The Nature of Non-Forest Areas

NFAs are either public or private cultivable lands outside the forest zone that can be, and are often used for growing small stands of trees (often multi-purpose tree species (MPTS)) for a variety of non-forestry purposes, such as windbreaks, shelterbelts, erosion-control hedges, nurse trees, shade trees, or live fences; for the production of non-wood goods, like fruits and nuts, fodder, green manure, or latex; or for the production of locally-needed wood materials like fuelwood, poles and small timber for local construction. When market opportunities arise, the trees may also be managed for industrial raw materials, such as pulpwood, small-diameter sawlogs and peeler logs, or posts and pilings.

Some NFAs are devoted purely to trees in small block plantations and are referred to as farm woodlots, tree farms, village forests or community woodlots. Others contain a combination of agricultural and tree crops and are known as agroforestry farms, homegardens, mixed plots, food gardens, integrated farms, etc. Agroforestry farms may include contour hedges, shelterbelts, firebreaks, boundary plantings, live tree fences, and trees on canalsides, roadsides, railwaysides, etc.

In Asia, NFAs are managed either by individual farmers or by communities. Community-managed NFAs are expanding rapidly because a number Asian countries are actively promoting community forestry after it had been clearly demonstrated that people's participation means more effective rehabilitation, management and protection of tree resources. In the South Pacific island countries, on the other hand, NFAs are generally controlled and managed by clan or tribal groups rather than by individuals since customary ownership of lands and other natural resources by such groups is the norm (Vergara, 1977).

1.3.2 Tree Species in Non-Forest Areas

Trees grown in NFAs generally fall under two species groups:

1. Those that emerge as **natural regeneration** after removal of the original forest vegetation. They may be further divided into two subgroups:
   a) the fast-growing **pioneer species** such as *Trema orientalis, Albizia procera, Albizia falcataria, Anthocephalus chinensis,* or *Endospermum peltatum* that often arise after logging in Southeast Asia. These pioneers generally have wind-borne or bird-disseminated seeds for quick and wide dispersal, and are capable of germinating quickly, growing rapidly and competing effectively with other plants. Regarded at first as "weed species," many were eventually found suitable for a wide variety of commercial products, such as pulp, paper, core veneer, chipboards, matchsticks, toothpick and laminated corestock for blockboards, so farmers started managing them as non-timber forest products from NFAs.
   b) the slower-growing **climax species** that eventually overtop the pioneer vegetation and take over the area towards the later part of the vegetative succession. These are usually high-value hardwood trees, such as *Dalbergia* in South Asia, *Tectona* in northern Southeast Asia, or *Dipterocarps* in southern Southeast Asia. Because of their commercial value, they are often favoured and cared for by farmers once they emerge, but their capacity to establish themselves is heavily dependent upon the presence of good mother trees.
2. Those selected and **planted** in NFAs by farmers or communities. Most NFAs today contain planted rather than natural-regeneration trees. In general, the planted trees are chosen because they have traditionally filled the wood needs of local people, are in demand in the local markets, are suited to the local soil and climate, and are compatible with the other crops raised by the farmers. In addition, they are usually fast-growing to satisfy the minimum-resource farmers' expectations of early harvests and incomes. Since many non-indigenous species satisfy these criteria, it is not surprising to find many NFAs stocked with such fast growing timber species as *Leucaena leucocephala, Gmelina arborea, Eucalyptus camaldulensis, Populus deltoides, Acacia mangium, Albizia falcataria*, etc. However, it is also clear that there are some NFA farmers who prefer indigenous species whose slower growth is compensated by their high values - such as *Tectona grandis* in Myanmar and Thailand and *Dipterocarp* and *Pterocarpus species* in Indonesia and the Philippines.

Other woody species with valuable non-wood products, such as Para Rubber for latex, Palm Oil and Coconut for vegetable oil, are also extensively planted in NFAs. When their non-wood yields decline below acceptable levels, they are cut down and their contribution to the wood supply are substantial. However, they are included under "Estate Plantations," not in this document.

1.3.3 Ecological and Socio-economic Effects of Trees in Non-Forest Areas

1.3.3.1 Ecological Effects

Tree planting in NFAs has some positive ecological effects: (1) Woody perennials, either in pure stands or in agroforestry mixtures, help minimize soil erosion and nutrient loss on sloping sites and, thus, contribute to the maintenance of productivity; (2) Nitrogen-fixing trees intercropped with annuals help improve site fertility and productivity. (3) The diverse species mixtures in agroforestry farms significantly reduce the ecological risks associated with monoculture ecosystems.

However, there could also be negative ecological impacts of trees in NFAs: (1) Untested exotic species that replace or supplement indigenous farm crops sometimes lead to species/site mismatches or species mix incompatibilities that in turn result in low yields or even crop failures. (2) Monocultures are easier to manage and, therefore, often preferred by forest farmers, but they are vulnerable to insect infestation and disease attack. (3) The high growth rate of fast-growing species (FGS) leads to higher frequency of biomass harvest and, thus, to more rapid nutrient depletion and reduction of site productivity.

1.3.3.2 Socio-economic Impacts

Positive socio-economic impacts of trees in NFAs have also been noted: (1) tree/annual crop combinations in “land-hungry” countries (e.g., Bangladesh) lead to more intensive use of land and, therefore, usually higher returns per hectare per year compared to single-crop systems. (2) Trees interplanted with food crops stand to benefit from the care, fertilizer and irrigation inputs intended for the latter. As a result, they grow faster, hasten wood production and increase wood supply. (3) Tree crops in heavily-populated upland areas provide alternative employment and supplemental incomes during the “dry and lean” months when rainfed annual crops are not feasible.

Adverse socio-economic effects may, however, be encountered in managing NFA tree crops: (1) Extraction of grown nurse trees in agroforestry systems sometimes inflicts damage to the valuable main crops such a Coffee or Cacao. (2) The small size and wide dispersal of NFAs cause difficulties in collecting and assembling the products. (3) The location of NFAs in remote and relatively inaccessible sites lead to high farm-to- market transport costs that could render the undertaking economically non-viable. In such cases, trees planted in NFAs could function well for environmental protection and conservation but may not be viable as a sustainable source of wood supply; especially for industrial use.

2 CURRENT SITUATION AND FUTURE PROSPECTS IN NON-FOREST AREAS

2.1 The Extent of Non-Forest Areas in the Asia-Pacific

Field observations have confirmed that trees are very often grown under non-forest situations in the Asia-Pacific Region. The linear planting along canals, rivers, roads, railroads and farm boundaries in China, India and Pakistan; the small block plantations in villages and communities in Indonesia, Philippines and Thailand; and the nurse-tree plantations over commercial crops in Malaysia and Indonesia, are excellent examples of wood production outside the forests. However, it is difficult to obtain precise data on the extent of such tree-bearing NFAs because: (1) They are numerous, small-sized, widely dispersed and, therefore, not easy to inventory. (2) Large-scale Fuelwood, Forest and Estate Plantations have been classified separately from NFAs but it is often not easy to tell where those three categories end and the NFA tree cropping begins.

Nevertheless, data were gleaned from partially-available records on tree farms, village woodlots, and farm boundary/canalside/roadside planting of such species as *Paulownia* in China, *Dalbergia* and *Populus* in South Asia, *Gmelina*, *Albizia* and *Eucalyptus* in Southeast Asia, and *Pinus* in the South Pacific. Where possible, these figures are complemented by information on area of commercial tree crops like Coffee, Cacao and Tea which have nurse tree components at a certain density per hectare. Such nurse trees are considered NFA tree crops which also yield fuelwood, pulpwood or small sawlogs. The most difficult to account for are the trees in traditional agroforestry farms since they are widely scattered, highly diversified, and have no specific spatial patterns or definite ratios between tree crops and annual crops. The agroforestry farms supported by government programmes can be more readily accounted for since records of their operations are generally available.

There are clear indications that the extent of tree-bearing NFAs will increase in the future because (1) the conversion of forests to non-forest uses is continuing; (2) integration of trees with other crops is gaining an increasing number of adherents and practitioners; and (3) governments are promoting tree growing in farmlands and village areas as a means for relieving the extreme pressure on the remaining forests.

2.2 Wood Products from Non-Forest Areas

A wide range of wood products could be, and are now being derived from non-forest areas. However, for purposes of this paper, they are grouped into only two major outputs, ***fuelwood*** and ***pulpwood***, for the following reasons**:**

1. **Fuelwood** for cooking and heating is the most important wood product in the Asia-Pacific region. Of all wood harvested, 92% in South Asia, 73% in Southeast Asia, and 69% in East Asia (China) are used for fuelwood, and this huge quantity consumed will continue to rise with population since it is the most affordable and readily available energy source in the developing countries (Table A).

Table A - Share of Fuelwood in Total Wood Harvests, Asia

Sub-region	Total Wood Output	Fuelwood Output	% Fuelwood
	(000 cu m)-		
South Asia	371,263	342,051	92
Southeast Asia	372,630	273,200	73
East Asia (China)	296,560	203,800	69
ASIA	**1,040,453**	**819,051**	**79**

Source: FAO/RWEDP Wood Energy News, Vol. 11, No. 2, June 1996

2. NFA managers are usually low-income farmers or communities whose need for early returns and benefits forces them to harvest tree crops when still young, thereby producing mainly small-sized roundwood suited mainly to the manufacture of reconstituted products, such as pulp and paper, fibreboard, particle board, chipboard, etc. For convenience, these are lumped together as **Pulpwood** since they are of pulping size, even if it is clear that they can also be made into other products.

2.3 Wood Supply From Non-Forest Areas

Three important types of data are required to provide reliable information on the supply of wood from NFAs: (1) area of NFAs for each country; (2) average volume per hectare of NFA stand; and (3) annual growth rate of NFA stands. When multiplied together, these data should indicate the available wood supply from NFAs for a given country. Unfortunately, these data are either incomplete or non-existent - mostly the latter.

Since wood can only be consumed if its supply is available, an alternative path to supply estimation is by summing up all NFA-derived wood that are consumed per year in each country. But stumbling blocks are present here as well. Wood derived from NFAs have generally remained unrecorded for two main reasons: (1) majority of the outputs, such as fuelwood, poles and local construction timber are subsistence commodities consumed by the producers themselves and, therefore, not registered in the cash economy; (2) the quantity of wood products drawn from each farm is generally of small quantity and, therefore, often ignored or overlooked in national statistics. Thus, while the wood consumed from NFAs is intuitively known to be substantial, the exact quantity is not known so it cannot satisfactorily serve as a basis for estimating wood supply.

A third option for supply estimation (based on consumption figures) may be availed of by using average per capita wood consumption and multiplying it with the recorded population. While this approach may give some gross figure of wood supply, it runs into another problem: how to determine which portion comes from the forest and which is from the NFAs. This approach may be used, at least in some countries such as India, that have figures indicating that about 54% of the wood supply are contributed by NFAs (Table E).

These difficulties in arriving at reliable estimates of wood supply from NFAs are outlined as a way of forewarning readers about the lack of precision in the NFA-derived wood supply figures used herewith.

As indicated above, industrial wood derived from NFAs are usually harvested early. Young trees yield small-diameter logs suited to pulp and paper or other reconstituted products. The 1992 pulpwood outputs that were likely to have been harvested from NFAs are the pulpwood from India (1.2 million tons) and from China (7.9 million tons) where numerous farm woodlots have been established by farmers. The other countries are "small players" and their annual pulpwood production are way below one million tons each (Table 6, Annex).

2.3.1 Subregion 1: SOUTH ASIA

The countries of South Asia have three characteristics in common: (1) large and fast-expanding populations; (2) huge and quickly-rising demand for wood, particularly for fuelwood and materials for local construction; and (3) limited and rapidly shrinking forest resources. With wood supply getting scarcer in relation to the escalating demand, and government forest resources on a steep decline, NFAs are becoming increasingly important as sources of wood materials for both household and industrial uses.

In the dozen years between 1981 and 1992, the production of pulpwood has been relatively constant for most of the developing countries in the region. In the case of fuelwood, on the other hand, production increases were substantial, ranging from 17.2% to 41.8% rise during the 12-year period (Table B).

Table B. - Trends in Fuelwood & Pulpwood Output, South Asia (000 cu m)

Country	Product	1981	1985	1990	1992	1995
Bangladesh	Pulpwood	63	76	68	69	69
	Fuelwood	23,852	26,224	29,557	31,011	3,130
India	Pulpwood	1,208	1,208	1,208	1,208	1,208
	Fuelwood	190,645	207,685	229,233	238,269	274,272
Nepal	Pulpwood	n.a.				
	Fuelwood	13,884	15,566	17,778	18,691	20,450
Pakistan	Pulpwood	n.a.				
	Fuelwood	16,334	18,685	21,923	23,157	28,116
Sri Lanka	Pulpwood	31	31	75	75	75
	Fuelwood	7,308	7,808	8,345	8,562	8,925

Source: FAO, Forest Products Yearbook 1992, 1995.

Bangladesh

(a) Current Situation

Only a little over one million ha or just 8% of the country's land area is forested, and these meagre forests have very low yields, averaging only from 0.5 to 2.5 cu m/ha/yr. Furthermore, the 66% of the population that are "functionally landless" (average of less than 0.2 ha of land for each household), encroach heavily upon state forests for subsistence. Thus, it is virtually impossible for the country to rely on government forests alone to fill the nation's wood requirements. NFAs will have to play a larger role.

However, since private lands have to be largely devoted to intensive food production to feed the immense population, potential NFA sites are necessarily limited. Village forests amount to only 270,000 ha (1.9% of the total forest area). Nevertheless, they play substantial roles in the country's wood balance: NFAs' wood share rose from 33% (1966) to 65% (1975) and settled at 55% in 1977 (Table C).

Table C. -Share of Homesteads (NFAs) in Wood Output, Bangladesh

Year	Forests	Homesteads	Total	% Homesteads Share
	(Wood Output in 000 cu m)			
1966	719	360	1,079	33
1970	532	360	892	40
1975	214	400	614	65
1976	217	360	577	62
1977	290	360	650	55

Source: FAO, 1981. Forest Resources of Tropical Asia

After the 1980s, NFAs gained further importance by contributing 60% of the total wood supply, 70% of the fuelwood demand, and 80% of all the bamboo consumption of the country (Bangladesh Forestry Master Plan, 1992). While the extent of NFAs increased only minimally, the rising%age of farms placed under integrated tree-crop combination, and the escalation of the number of trees per hectare in agroforestry farms have resulted in the boosted NFA share in total wood supply.

The limited-resource farmers of Bangladesh have been traditional practitioners of agroforestry. While primarily geared towards food production, the mixed farms generally included multipurpose trees that also yielded wood products. Of the five tree-based agroforestry systems found in Bangladesh, three are based on timber-bearing trees (FAO/APAN, 1996):

(1) *Artocarpus heterophylla* - based system - This multipurpose tree is extremely valuable to Bangladesh farmers: its leaves serve as fodder, young fruits are cooked as vegetables, while the sweet ripe ones are either eaten fresh or sun-dried for future consumption. The mature seeds are boiled or roasted for food. Lopped branches serve as fuelwood while the mature stems are widely used for local construction. This seems to be the most extensive and most important local agroforestry system.

(2) *Acacia nilotica* -based system - This multipurpose tree species is a beneficial intercrop for fixing nitrogen and improving the soil. Farmers usually interplant 50 to 60 *Acacias* per ha of sugar cane but reduce the number to 20 to 50 trees per ha when planted in paddies since rice, like most grain crops, is intolerant of shade. This tree species also yields fodder, fuelwood and timber.

(3) *Dalbergia sissoo*-based system - this MPTS is called "Rosewood" because of its beautiful colour and woodgrain that are highly valued in furniture and panel manufacture. Its leaves are good for fodder, while its lopped branches serve as fuelwood. It is tolerant of water logging and thrives well in rice paddies. When planted in blocks in woodlots, the usual density ranges from 1,000 to 1,600 trees per hectare. On the other hand, when integrated

with sun-demanding grain crops, they are planted along the bunds at 2 to 3-m intervals to minimize shading. That spacing can accommodate about 120 to 160 trees per hectare.

(b) Future Prospects

The aggregate fuelwood production in 1993 amounted to some 31.8 million cu m and comprised 97% of all wood outputs of the country. With the population rising at the rate of 2.2% per year, fuelwood consumption may rise at the same rate to 46 million cu m, which greatly exceeds the FAO forecast of 35.0 million cu m (Table 11, Annex) for the same target year.

Community forestry programmes launched with substantial external donor assistance in the early 1990s are making steady progress and could fill a significant portion of the anticipated increase in energy demands. However, due to severe land limitations and keen competition with food cropping, the area of NFAs for wood production could expand only minimally as government can make available to community forestry projects only limited portions of degraded forest areas for rehabilitation. Further intensification of existing NFAs with fast-growing, high-yielding tree species can proceed since many of these small landholdings are only lightly covered with perennial crops and can accommodate additional trees. For example, in 1982, some 1.12 million ha of NHAs had crown cover ranging from only 5% to 25% (Table D).

Table D. - NHAs Available for Intensified Tree Planting, Bangladesh

Tree Crown Cover		Area of NHAs (000 ha)	% of Total Homesteads
Category	Intensity (%)		
Very light	5	19	2.0
Light	15	153	15.9
Medium	25	362	37.5
Dense	35	431	44.7

Source: FAO, 1981. Forest Resources of Tropical Asia

Considering the feasibility of increasing the tree populations in NFAs, it would be reasonable to expect that the production of fuelwood can expand by 1.5% to 40.9 million cu m by Year 2010. This is nearly 6 million cu m higher than the FAO forecast of consumption. It seems realistic in spite of limitations in land. In the event of a shortfall, needs may be partly made up by resorting to other biomass energy substitutes such as agricultural residues.

India

(a) Current situation

About 22% (approximately 65 million ha) of India's total land is under forest cover. Because of its large population of 934 million, its forest resource base is simply inadequate to fill local needs, particularly the demand for fuelwood which accounts for about 66% of all non-commercial energy consumed in the country. Even this figure is misleading, however; about 22% of local energy consumption comes from cow dung, indicating that there is that much portion of the energy demand that could be filled by fuelwood if only more of it were available (Agarwal, et al, 1991).

Unlike those of its neighbours, India's forest laws are generally stringent and place the highest priority on long-term conservation and environmental stability rather than on short-term economic benefits. They ban the conversion of forestlands to non-forest uses such as estate plantation and agricultural cropping. Even in the implementation of the enlightened programme of "Joint Forest Management" which allows villagers access to some forest products such as fuelwood and forage in return for forest protection services, the participant farmers are not allowed to undertake agricultural or agroforestry activities inside the forest.

The laws do not encourage conversion of agricultural land to forest plantations either, and as an added disincentive, trees grown on private lands can only be harvested and transported after the owner has obtained government permission (FAO/APAN, 1996). On paper, therefore, forest areas neither expand nor contract and their area should remain constant indefinitely. In reality, however, because of the heavy population pressure (only 0.08 ha of remaining forest per person) it is extremely difficult to keep out encroachers from state forestlands, and to prevent people from using portions of their own agricultural lands for tree farming or agroforestry farming. Thus, on a *de facto* basis, there have arisen considerable areas of NFAs used for tree growing. For instance, many farmers who raise cereals and pulses integrate about 50 to 100 trees per hectare, including species like *Prosopis cineria*, *Acacia nilotica, Albizia lebbeck*, *Azadirachta indica* and others. By doing so, they not only improve the aggregate yield of their fields but also assure themselves a good supply of fuelwood, poles and pulpwood as well.

(b) Future Prospects

India's huge population of 933.9 million consumed a total of 262.8 million cu m of fuelwood in 1993. This translates to about 0.29 cu m per capita per year, an understandably low figure in light of the fact that fuelwood fills only 66% of all non-commercial energy needs. If the population growth rate of 2.1% is used as basis, the projected fuelwood consumption to Year 2010 runs up to over 374 million cu m, or about 72 million cu m higher than the FAO provisional estimate of 302.4 million cu m.

With the ongoing economic reforms in India, the economy is improving rapidly, as indicated by the GDP annual growth rate of 6.2% (Table 1, Annex.) This would mean a significant enlargement of the middle class and the increase of households that would shift to more convenient non-wood energy sources (e.g., electricity), thereby reducing the rate of increase in demand for fuelwood by over half a%age point to 1.5% per year. If this rate is used, the

projected fuelwood consumption on the target year would be about 338.5 million cu m, or about 36 million cu m higher than the FAO projection for Year 2010.

NFAs will continue to play a large role in filling non-commercial wood need of India. Some 54% of fuelwood and small timber outputs come from non-forest areas, as shown in Table E.

Table E. Source of Fuelwood and Small Timber, India

Source	Million Tons	Percent Share
Forest	44	46
Non-forest	51.5	54

Source: FAO RWEDP, 1982

It is a fact that some existing policies in India serve as disincentives that bar the path to substantial wood production expansion. As pointed out above, agroforestry activities on forest lands are allowed by other countries but are banned in India; establishment of tree plantations on productive private agricultural land is likewise prohibited. Considering these obstacles, NFA-based wood production will be confined to less productive, degraded non-forest state lands; to private lands where woodlots, tree farms and agroforestry farms already exist; and to commercial tree crop areas. For example, tree species planted by farmers, like *Acacia, Albizia*, *Dalbergia* and *Grevillea* serve as nurse trees to extensive commercial crops like Coffee (156,000 ha) and Cardamom (94,000 ha.) Based on a conservative estimate of 50 trees per ha of mixed crops, there would be roughly 12.5 million trees which can be used as fuelwood or industrial raw materials when they reach age 10. If only one tenth of these are harvested each year (to insure sustainability), and if each 10-year-old tree has a volume conservatively estimated at 0.3 cu m, these nurse trees could contribute a significant amount of almost 400 thousand cu m of fuelwood and industrial wood yearly, as shown in the table below.

Table F. - Wood Supply from Nurse Trees, India

Estate Crop	Area (000 ha)	Nurse Tree Density (Trees per ha)	Total No. Of Nurse Trees (000 trees)*	Yearly Wood Yield (000 cu m)+
Coffee	156	50-60	7,500 to 9,360	257
Cardamom	94	50	4,700	141

*Nurse species are: Acacia, Albizia, Dalbergia, Leaucaena & Grevillea
+Based on a 10-year rotation; 1/10 of nurse trees are harvested each year; ave. volume of 0.3 cu m per 10-year old tree.
Source: FAO/APAN, 1996

Moreover, some government programmes are have been formulated to counteract to a certain extent these policies: the 6th (1980 to 1985) and the 7th (1985 to 1990) Five Year Plans have expanded government sponsorship of tree planting activities in community and private lands. In addition, non-government organizations (NGOs) at the local, state and national levels have participated actively in initiating people-supported rehabilitation of the extensive wastelands of India. Furthermore**,** substantive government support and encouragement have been extended to boost wood production in NFAs. These were given in three forms, namely:

(1) **Credit**: Government mobilized some 47,000 branches of rural banks and 82,500 agricultural credit societies that provided over US$5.5 billion easy credit to tree growers in 1994-1995.
(2) **Cooperatives**: through government encouragement, about 175,000 farmers have become members of agricultural cooperatives which were provided about US$25 billion capital, and given assistance in breaking into local and export markets for NFA products;
(3) Wood Processing **Research**: government research facilities were harnessed to provide guidance in wood processing such that juvenile and soft woods of fast-growing species (FGS) can be converted into high-quality and high-value furniture, plywood and other wood-based products.

With these government support, it is expected that the NFAs on rehabilitated state wastelands and on community and private lands could expand to help satisfy the expected Year 2010 demand of 338.5 million cu m of fuelwood and some needs for industrial wood.

Nepal

(a) Current situation

Annually**,** Nepal produces 19.59 million cu m of roundtimber from all sources (Table 5, Annex). As a reflection of the degree of importance of fuelwood to the economy of the country, 97% of that output, or 18.97 million cu m, are in the form of woodfuel (fuelwood and charcoal). This is understandable since fuelwood is used not only for cooking but also for heating homes in the temperate Himalayan climate. Furthermore, many of the existing enterprises, such as brick-making, pottery, baking, food processing and others are heavily dependent on fuelwood for energy, requiring about 3 million tons of fuelwood per annum (Sharma, 1992).

About 75% of all the country's woodfuels, or roughly 14.23 million cu m are extracted from the forests, which means that the balance of some 4.74 million cu m (25%) are drawn from small woodlots and agroforestry farms. This may not seem much but in light of the limited arable area (only 2.35 million ha or 17% of total land) in which the NFAs are located in this mountainous country, it means that the contribution per ha of NFA is quite large. It further indicates that agroforestry systems have been employed by farmers in Nepal much more intensively than recognized earlier and have been contributing wood products, in addition to food, fodder and medicine, much more substantially.

Various agroforestry systems have been in place in the Nepalese countryside. In the low-altitude Terai, a high value multipurpose tree like *Dalbergia* is generally planted by farmers among bananas, pineapple, chilli and turmeric. On the other hand, in the high hills, farmers have raised *Ficus* species largely for fodder. In the predominantly Hindu culture of Nepal, cattle figure prominently in the farming systems, so fodder is an important product to support the large cattle population.

In the limited areas of irrigated flatlands, paddy farmers maximize output by minimizing shady trees that reduce grain yields. However, in the rainfed terraces or degraded fields, they plant anywhere from 15 to 60 trees per ha consisting of *Dalbergia*, *Bauhinia*, *Artocarpus*, or *Sesbania* for fuelwood and fodder. Planting commercial crops under trees is also common in Nepal. *Albizia falcataria* is the usual nurse crop for Tea and Coffee; *Alnus nepalensis* for

Cardamom; *Eucalyptus*, *Dalbergia* and *Cassia siamea* for Ginger and Turmeric. Many communities manage woodlots on ridgetops and streambanks both for economic reasons (production of fuelwood, fodder and timber) and ecological purposes (minimization of erosion and maintenance of streamflows.)

Nepal possesses one of the more enlightened and people-friendly forest policies in the developing world. Government is busily engaged in developing the capacities of village "user groups" to formulate and implement sustainable forest management plans for forest areas close to these communities. When convinced that the user groups are ready, Government turns over to them the management and control of designated forests so that they will be fully responsible for forest protection, conservation and sustainable management. In exchange, the communities are allowed to draw benefits from these forests in the form of fuelwood, fodder, timber etc. With this form of empowerment of the villagers, government expects better conservation of the forest base and more sustained product outputs therefrom.

(b) Future prospects

Stimulated by a population growth of 2.3% and by a similar GDP growth rate, Nepal's aggregate demand for fuelwood could possibly jump from 19.4 million cu m in 1993 to a high of 28.6 million cu m by Year 2010. This is almost 6 million cu m larger than the FAO provisional figure of 22.6 million cu m (FAO, 1997(b)). One reason for the expected high consumption is because Nepal, with its high elevation and low temperatures, requires fuelwood not only for cooking but for home heating as well, and because local industries like brick-making are also dependent on fuelwood.

At present, even with only 37% of the land under forest, a high three quarters of all fuelwood is extracted from these forests. It might not be feasible to expect additional fuelwood from that source without resorting to a wasteful diversion of some merchantable logs to energy use. It is, thus, anticipated that the bulk of the additional output of wood to fill the expanded energy demand will have to come from new NFA tree plantations and from old NFAs which can be placed under more intensive management.

Intensification of wood production in NFAs seems to be a reasonable option considering that policies that are designed to increase people's participation in wood production are in place and operational. For instance, the transfer to "Forest Users' Groups" of the major responsibility for the protection and management of community forest areas will go a long way towards motivating the farmers to improve the wood productivity of their NFA's for their own benefit. Moreover, they can integrate utilization to efficient levels by, for example, seeing to it that in the extraction of timber, the tops and branches are simultaneously collected as pulpwood or fuelwood**.**

Nepal's current base figures of 56 thousand ha of small-scale tree plantations and 672 thousand ha of other wooded lands (including woodlots and other non-forest tree plantations), or an aggregate of 728 thousand ha of NFAs would probably expand only minimally in order not to compete with food crops and jeopardize efforts to elevate food production. What will most likely happen is the improvement of wood production technology through the more widespread use of high-yielding, fast-growing tree species, such as *Eucalyptus and Dalbergia* which have been planted extensively in woodlots, agroforestry plots, bunds, canalsides and roadsides in the lowland Terai.

The aggregate effect of these approaches, while able to significantly elevate the NFA wood productivity, could probably enable only a 2% rise on woodfuel production to 25 million cu m by Year 2010 (Table 12, Annex). This is about 2.4 million cu m higher than the FAO projection. Since the border problems with India have been settled, fossil fuels imported through that country are flowing again into landlocked Nepal, and these could possibly be partly used for heating as fuelwood supplements.

Pakistan

(a) Current situation

Forestry has been low in the national programme priority rating of Pakistan. As a consequence, its public forests amount to a mere 2.023 million ha (only 3% of total land) (Table 4, Annex) and yields only 1.7% of the total wood consumed in the country. It has to depend heavily on farms and other non-forest areas for its wood supply. In fact, of the 16.6 million cu m of fuelwood harvested per year, only 9.6% are drawn from the national forests; the huge majority of 90.4% are harvested from farms. Furthermore, 60 % of its timber requirements are likewise derived from farmlands (FAO/APAN, 1996).

Pakistan's lowlands are fertile and extensive but unproductive because of their arid condition. As a remedy, the country developed one of the most extensive irrigation canal systems in the world, running to about 62,300 km. With irrigation, the lowlands have been transformed into highly productive areas not only for food production but for wood as well. To make up for the lack of forests, government set aside in 1962 about 10% of irrigable lands for block tree plantations. Moreover, provincial forest offices were given responsibility for and control over tree planting along canals and on roadsides. This move has resulted in avenue tree plantations that are equivalent to about 17,000 ha of forests. In the Northwest Frontier Province alone, for instance, an estimated 80 million trees have been planted in the farmlands: 67% in irrigated fields and the other 33% in rainfed fields. On the average, 72 trees are planted per ha in irrigated fields and 27 trees per ha in the rainfed areas. Recent estimates placed the standing volume of these non-forest plantations at 14 million cu m. In 1989, some 11 million trees from NFAs were harvested, yielding an aggregate volume of 2.9 million cu m.

Four of the most preferred species for farmland planting comprise 63.4% of all trees planted in private lands: *Acacia nilotica* (21.8%); *Dalbergia sisoo* (18.3%); *Citrus* (12.9%) and *Populus deltoides* (10.4%). Despite the fact that it only ranks fourth, *Populus deltoides* has been found to be the most productive of the tree species planted in irrigated fields. Ten-year old Poplars average about 25 cm dbh and yield approximately 0.425 cu m per tree. The wood has a wide range of industrial uses and is suited to fill Pakistan's substantial industrial demand, such as: 163,000 tons of raw wood per year for matchwood; 90,000 tons for chipboard; 35,000 tons for hardboards; and 25,000 tons for veneer and plywood. For these reasons, *Populus* is now getting to be one of the most widely planted tree species in irrigated NFAs of Pakistan.

The most preferred species today, *Acacia nilotica*, now covers about 10,000 ha planted for fuelwood production both for household and industrial use. Over 100,000 cu m of fuelwood is required by the brick-making industry alone. Household demand for fuelwood is so large and

supply is so limited that, as in India, cow dung and agricultural residue also supplement fuelwood.

(b) Future prospects

At 2.9%, Pakistan's annual population growth rate is one of the highest in the region. And as a forest-deficit country (only 3% forested land) that has placed a low priority of forestry programmes, its fuelwood consumption of 25 million cu m in 1993 exerts a heavy stress on its limited forest resources. FAO's projected fuelwood needs by Year 2010 comes up to some 31.1 million cu m (FAO, 1997(b)). Pakistan will have to further expand the wood-producing roles of its non-forest areas if it is to fill these huge needs.

Formulation and firm implementation of appropriate policies and programmes seem to be what government is relying upon to achieve target outputs that can fill forecasted demands. For instance, the Pakistan Forestry Master Plan envisages the enlargement of agroforestry areas to 1.75 million ha so that they can produce about 13 million cu m of wood by 2008, and almost double that to 3 million ha to produce about 26 million cu m by 2018. There is also the policy goal to expand the forest base by about seven times, from 3% of the total land (2.02 million ha) to 20% (15.4 million ha) over the same period. Another approach, the National Conservation Strategy of 1992, prescribes the planting of 100 trees per ha along farm boundaries. And under the Social Forestry Programme, there is another plan to establish some 2,600 ha of block plantations in woodlots and 14,800 ha equivalent of linear planting.

The question arises as to whether a developing country like Pakistan can implement these gigantic programmes and achieve the lofty forestry objectives. The answer tends to be in the affirmative. Previous achievements tend to support this view. The conversion of vast areas of arid and idle valleys into lush and productive fields by constructing the most extensive irrigation canal system in the world, and the development of a nuclear capability nearly at par with some of the more developed countries are track records indicating that Pakistan has the political will, technological skills and human resources to carry out large undertakings such as the planned forestry programmes. However, since part of the expanded wood production is expected to be absorbed by industry, it will be realistic to assume that the fuelwood output would be able to expand by only 2.0% to 35 million cu m by Year 2010 (Table 12, Annex).

Sri Lanka

(a) Current situation

This small island-nation has only 1.89 million ha of primary forest (29% of total land). Forest plantations additionally account for about 139 thousand ha. Fortunately, the tradition of perennial agricultural cropping is quite extensive (aggregate of about 765,500 ha) and contributes substantial amounts of NFA-derived wood to the total supply. The different types of perennial agricultural crops and the wood-bearing nurse trees associated with them are:

(1) Tea plantations with *Grevillea, Erythrina, and Sesbania* nurse trees - 228,000 ha
(2) Coffee with *Albizia*, *Gliricidia* and *Acacia* nurse trees - 8,000 ha
(3) Cacao with nurse trees similar to those in Coffee plantations - 8,000 ha
(4) Cinnamon plantations - 8,900 ha
(5) Other perennials - 54,700 ha.

The nurse trees for Tea, Coffee and Cacao are periodically pruned to keep shading to optimum levels. In the process, they generate fuelwood from the branches (about 0.5 cu m per ha per yr), and fodder, mulching and organic fertilizer from the leaves. At intervals of about 5 years, the *Gliricidia*, *Sesbania* and other small tree species are mature enough to be harvested as fuelwood or poles; the larger species like *Grevillea* and *Albizia* may be harvested as timber at about age 10 or more (average growth of 0.95 cu m per ha per year)

Home gardens with tree components are quite extensive in Sri Lanka. In 1992, the aggregate area of these gardens amounted to some 918 thousand ha, even if each holding ranged from only 0.4 to 2.0 ha. In addition, over 15,300 km of tarred roads have trees planted alongside at the rate of 25 trees per km or an aggregate of about 380,000 trees.

(b) Future Prospects

Compared to the other countries in the South Asia subregion, Sri Lanka has the advantages of having a relatively large forest resource of 29% of total land (Table 4, Annex), a lower population growth rate of only 1.2% and a high GDP growth rate of 5.6% per annum (Table 1, Annex). What these mean is that the rise in fuelwood demand may only be moderate since the relatively higher incomes would enable many of the people to upgrade to other forms of energy such as LPG or electricity. Thus, a modest 1.5% increase in wood consumption would be more likely, which is in the neighbourhood of 9.95 million cu m by 2010 (about 0.40 million cu m below the FAO provisional forecast). This seems like an easy target to achieve in light of the feasibility to intensify tree cropping techniques in the existing 140 thousand ha of small-scale block tree plantations, 918 thousand ha of home gardens and some 765 thousand ha of estate plantations that contain nurse trees of *Grevillea*, *Albizzia*, *Gliricidia*, *Sesbania* and *Acacia* that also yield significant volumes of wood for fuel, domestic use and, to some extent, for industrial use.

The overwhelming importance of fuelwood in relation to other wood products in the whole of South Asia is reflected in the quantity and rate of increase of the production (and consumption) of that product as shown in Table G. The “high” projected fuelwood consumption for the Year 2010 is directly related to the current population. The “low”

projection**,** on the other hand, has been adjusted considering the limitations in land devoted to NFAs, population control measures instituted by government (as reflected in lowered birth rates), and in the search for non-wood energy substitutes.

Table G. - Actual and Projected Wood Consumption, South Asia (million cu m)

Country	Fuelwood and Charcoal				Industrial Roundwood	
	1993	2010			1993	2010
		FAO	High*	Low*		
Bangladesh	31.77	35.0	46.01	40.92	0.74	1.24
Bhutan	1.36	1.57	n.a.	n.a.	0.13	1.53
India	262.78	302.4	347.20	338.50	24.93	34.20
Nepal	19.44	22.6	28.60	25.00	0.62	1.32
Pakistan	25.02	31.1	40.68	35.00	2.82	2.88
Sri Lanka	8.70	10.3	10.66	10.66	0.67	1.43

Source: FAO, 1995. Forestry Statistics Today for Tomorrow (for 1993 data); FAO 1997(b) for 2010 (other than author's estimates).
* Author's estimates.

2.3.2 Subregion 2: SOUTHEAST ASIA (SEA)

The Southeast Asian region is in a much better situation compared to South Asia. Its aggregate forest area is almost three times, while its population is just over a third compared to those of the latter. On average, about 50% of SEA lands are still forested, vs less than a fifth (18%) of South Asia. The per capita forest is almost half a hectare in SEA, compared to only 0.06 ha per head in the latter (Table 4, Annex). Moreover, Southeast Asia is endowed with a favourable climate: sufficient precipitation and perpetual summer-like temperatures that lead to higher vegetative growth that generate greater wood yields per ha per year.

The rising trend in fuelwood production (and consumption) in the SEA region is shown clearly in Table H below. The escalation is deemed to be largely caused by rapid population expansion as indicated in Table 1, Annex.

Of the total 372 million cu m of roundwood extracted from SEA forests, over 273 million cu m or almost three quarters (73%) are used as fuelwood. This ranges from a low of 79% (Indonesia) to a high of 93% (Thailand). An aberration is Malaysia, with only 17% of its total wood harvest used as wood energy. This can possibly be explained by the relative wealth of Malaysians (per capita GDP of US$8,700 in 1996) that enables them to shift to "clean" energy sources such as electricity of liquified gas.

Farmers' initiatives in setting up small-scale tree plantations mixed with food or cash crops is widespread among farmlots in the subregion. In addition, policy and economic incentives in Indonesia, Philippines and Thailand have led to wider community forestry activities, thus further expanding the area of NFAs and enlarging their roles in filling the large requirements for fuelwood and small-sized industrial wood.

Table H. - Trends in Fuelwood and Pulpwood Output, SEA Region (000 cu m)

Country	Product	1981	1985	1990	1992	1995
Cambodia	Pulpwood	n.a.				
	Fuelwood	4,261	4,764	5,421	6,141	6,725
Indonesia	Pulpwood	468	200	200	1,208	1,208
	Fuelwood	117,302	127,339	140,239	145,392	151,228
Laos	Pulpwood	n.a.				
	Fuelwood	2,465	2,716	3,175	4,133	4,511
Malaysia	Pulpwood	613	613	613	613	788
	Fuelwood	4,984	5,537	6,319	9,167	9,819
Myanmar	Pulpwood	n.a.				
	Fuelwood	14,733	16,019	17,846	18,750	20,450
Philippines	Pulpwood	496	368	335	382	136
	Fuelwood	26,737	29,652	33,422	34,310	36,540
Thailand	Pulpwood	n.a.				
	Fuelwood	26,442	28,378	30,312	35,382	36,502
Vietnam	Pulpwood	n.a.				
	Fuelwood	19,880	21,686	24,147	28,510	30,470

Source: FAO, Forest Products Yearbook, 1992, 1995.

Indonesia

(a) Current situation

Indonesia has the largest land mass (181 million ha), the largest forest area (115.7 million ha) , and the largest population (197.6 million) among the SEA nations (Tables 1, 2 and 4, Annex). It may also have the largest aggregate area of non-forest plantations that contribute wood to the national supply. For instance, over and above the coconut and rubber estate plantations (which are not covered by this paper), it has over 3.18 million ha of commercial tree crops, such as Coffee, Cocoa and Tea. When they become over-mature and less productive, these non-forest crops are cut and made into reconstituted wood products (e.g., chipboard, fibreboard, pulp & paper) or used as fuelwood, thus contributing some share to the country's wood balance.

Beyond their own wood yields, these commercial tree crops, as indicated earlier, are closely associated with nurse trees that contribute much more wood products per ha. For instance, *Leucaena leucocephala* as shade trees for Coffee are usually spaced at 5 x 6 m, or 330 trees per ha, and yield about 30 cu m per ha at age 5 years. Tea requires lesser shading than Coffee: only 10 *Albizia* or *Grevillea* trees per ha are needed. Depending on the site quality, *Albizia* grows to approximately 30 to 35 cm dbh and 15 m in height at age 10, thereby averaging some 0.5 cu m per tree. It is estimated that the nurse trees in all of the commercial tree crop areas in Indonesia, are capable of yielding, on an annual basis, the following volumes: *Leucaena* - 1,080 thousand cu m; *Albizia* - 60 thousand; Others - 600 thousand cu m (Tarp, 1989), or an aggregate of 1.76 million cu m per year. It is further estimated that a similar volume is harvested as fuelwood and small poles from the scattered agroforestry farms in the country.

(b) Future prospects

Notwithstanding the fact that this country has the largest forest area in the subregion, it has experienced "localized timber famine" especially on the island of Java because of uneven and mismatched distribution of forest resources and population which even the Transmigration Programme has not been able to remedy. The great proportion of forest resources are in Kalimantan but the majority of the consumers (68% of the total population) are concentrated in Java. The cost of moving the products from wood-surplus Kalimantan to wood-deficit Java is almost as high as the wood transport cost to Japan and Korea. Thus, wood importation from Kalimantan to Java was rarely, if ever, resorted to. It was in response to this type of localized wood crises that Indonesia has developed policies and programmes for establishing and managing tree plantations in NFAs to supply the bulk of wood needs of the large population centres.

Indonesia's population control programme has succeeded in keeping the population growth rate down to only 1.6%, one of the lowest in the region. Despite that demographic success, its fuelwood demand could still escalate to 195.3 million cu m by Year 2010. It is estimated, however, that the country's rapid economic development (indicated by its impressive 8.1% GDP growth) will create a larger urban middle class who will most likely shift to non-wood energy sources and pull down the growth rate of fuelwood demand, particularly in urbanized Java, to only about 1%. In that event, the Indonesian fuelwood consumption will probably rise to only about 176.5 million cu m by 2010 (Table 12, Annex). That is about 3.6 million cu m lower than the FAO provisional forecasts (FAO, 1997(b)). It is deemed that this level of demand can be readily met, for several reasons:

(1) estate plantations and the fuelwood-producing nurse tree crops associated with them have been expanding, and could contribute more to the wood supply.
(2) social forestry programmes are similarly increasing in extent and will continue to generate significant additions to the wood supply;
(3) buffer forest plantations designed to absorb the impact of encroachers upon protected forest zones have become important sources of fuelwood;
(4) the world-renowned home gardens of Indonesia continue to yield considerable volumes of wood that are suitable for fuel;
(5) much of the areas previously allotted to the Transmigration Programme generate fuelwood volumes in the process of opening up, and are suited for conversion to wood producing NFAs afterwards.
(6) Indonesia is an oil producing country, so wood energy shortfalls can be filled by oil products.

Laos

(a) Current situation

With only 15% of Laos' total land area (all state-owned) classified as lowlands, into which 60% of its total population is crammed, people pressure on arable land has been relatively heavy. This has led to unavoidable spill-over and encroachment into neighbouring forest areas. The estimated deforestation rate from shifting cultivation, burning and illegal logging run up to about 129,000 ha per annum. Rehabilitation efforts are puny by comparison: as of 1990, only 4,000 ha of forest plantations had been established (Table 3, Annex).

This is not to say that non-forest areas are not a potential producer of wood in Laos. To start with, shifting cultivators continue to harvest small poles and fuelwood from their slash-and-burn farms, indicating that raising non-forest trees on the farmlots is going on. Secondly, farming systems that integrate annual crops with perennials are in place, showing that agroforestry farms can also effectively serve as wood-producing areas. The total fuelwood output of 3.37 million cu m in 1992 appear to have been largely derived from these non-forest areas. Based roughly on the Indonesian experience of harvesting about 30 cu m of fuelwood per ha from nurse trees at 5-year rotation, it could mean that the extent of agroforestry type of NFAs which could produce that 3.37 million cu m of fuelwood on a sustainable basis would be as much as 562 thousand ha.

Despite state ownership of all lands, a new liberal policy now allows the "Traditional Users' Rule" to apply, i.e., the farmer who clears the forest "owns" the land. This one policy has probably been responsible for motivating many farmers in the crowded arable sites to move to the forest to carve out farmlots for themselves. The productivity of these upland farm sites can be best maintained when trees are incorporated among the annual or biennial agricultural crops to form agroforestry farms, thereby creating additional wood-producing non-forest areas.

(b) Future prospects

Laos' total population is just under five million, but it has a high annual growth rate of 2.9% (Table 1, Annex). Furthermore, it seems that it has been positively affected by the rapid economic development in neighbouring Thailand; in 1996, it also posted an impressive GDP growth rate of 7.4%. For these reasons, its modest fuelwood consumption of 4.3 million cu m (1993) could climb to as high as 6.9 million cu m by 2010 (FAO, 1995(c) although later estimates suggest stability.

With a forest of over 13 million ha and a high proportion (57%) of total land still under forest cover, Laos seems capable of filling its wood needs without being overly dependent upon NFAs. It seems possible to derive all of its wood requirements, including fuelwood, from the forest. However, since 60% of the population is concentrated in the lowlands which comprise only 15% of the total land, much of the needs could not be readily filled with wood extracted from distant and remote forests located on mountainous sites. An alternative course of action, therefore, is to increase the wood contribution of NFAs that are proximate to population centres.

It is fortunate that certain government policies are in place that could induce more people to expand wood-yielding NFAs. For instance, Decree 169 of 1993 recognizes traditional tenurial rights over forest areas, while Decree, No. 186 of 1994, encourages tree planting, protection and rehabilitation by village people and by enterprises. To further promote sound NFA management, government exempts from taxes those tree plantations that are fully stocked and well managed. Furthermore, it does not collect taxes from incomes generated by forestry activities if the outputs are earmarked for local consumption (FAO/APAN, 1996). Government has also set aside Village forests which are granted to the local communities for protection, management and harvesting of both wood and non-wood products. Under the Third 5-year Plan, government plans to resettle on suitable sites some 80 thousand families (about 500 thousand persons) currently engaged in upland shifting cultivation. At about three hectares granted to each resettled family, a total of almost a quarter million (240 thousand ha)

would be converted to agroforestry-based NFAs**.** All these have the combined effects of enlarging the areas allocated to NFAs, and of inducing more farmers to take part in wood production in non-forest areas.

Despite all these incentives, however, the fact remains that NFAs could not expand much since the potential areas for that type of land use are part of the small 15% of the total land area which is now intensively cultivated for food. Thus, NFAs' share of the total fuelwood output could be constrained.

Based on the foregoing, it would seem that the more realistic base for forecasting Laos' fuelwood and small-timber production by 2010 is 1.5% rather than 2.9%, thereby amounting to a more reasonable 5.47 million cu m of output (Table 12, Annex).

Malaysia

(a) Current situation

With a total land of 32.86 million ha and a low population of 20.3 million, Malaysia has a comparatively light people pressure of only 62 persons per sq km (Table 2, Annex). A high per capita GDP of over $8,700 indicates that many Malaysians are well above the poverty line so that their farmers are not driven to encroach upon public forests for destructive slash-and-burn subsistence farming. Despite these favourable statistics, however, its deforestation rate is a high 396 thousand ha per annum (Table 3, Annex). A closer scrutiny shows that the on-going deforestation is actually part of a well-planned conversion of natural forests into estate plantations. Malaysia has a well-established tradition of estate plantations that dates back to colonial days when the British broke the Brazilian monopoly of natural rubber by establishing *Hevea braziliensis* plantations in peninsular Malaysia. The rubber plantations are now vast, the wood volume is substantial, and the utility value of rubber wood for furniture, lumber, and dissolving pulp have evolved to high levels. Malaysia considers such plantations as part of the forest resource base - the first such action by a country in the region. This is one important reason why the country has a high rate of forest cover - 54% of its total land area is under forest (Table 4, Annex).

Subsequently, Malaysia also embarked on vegetable oil production and converted forest areas of good topography, such as the Jenka Triangle, to large plantations of Oil Palm. Other tree plantations followed, such as Cacao with either Coconut, Oil Palm, *Gliricidia* or *Albizia* as nurse trees. In short, Malaysia has become the quintessential advocate of tree plantations in non-forest areas.

By 1990, Malaysia's natural forests stood at 17.58 million ha located mostly in Sabah and Sarawak and remains one of the few countries in Asia with over 50% of its land still covered with forests. Despite that, it has continued to develop plantations in non-forest areas (referred to in forestry statistics as "other wooded lands") that now amount to some 4.58 million ha. Its forest plantations, on the other hand, are limited, running up to only 81 thousand ha, including the *Acacia mangium* plantations in Sabah (Table 3, Annex).

It speaks well of the astute planning, futuristic view and political will that the country has persisted in developing estate plantations despite the fact that it is a forest surplus nation that continues to export both primary (roundwood) and value added products (sawnwood, veneer

and plywood) to developed countries. In the 50s and 60s, when fossil oil was cheap, oil-based synthetic rubber almost wiped out the natural rubber industry. Some countries cut down their rubber plantations in favour of other estate crops. Malaysia limited the cutting of rubber trees to the over-mature plantations which generated incomes when sold as pulpwood or processed into high-value furniture. When crude oil prices rose meteorically due to machinations of the OPEC countries in the 70s, Malaysia was strategically positioned to fill the huge demand for latex-based automotive tires and health-related products.

Fuelwood output in Malaysia rose from 4.98 million cu m in 1981 to 6.64 million cu m in 1992 (FAO, 1992). Despite this rise, however, fuelwood comprises only 13% of the total roundwood output of the country, compared to neighbouring Indonesia where fuelwood comprises 79% of the total wood harvested. These comparative figures reflect the degree of economic development of Malaysia, and the capacity of its wealthy populace to move up to more expensive and more sophisticated energy sources such as gas or electricity.

(b) Future prospects

Malaysia's population of 20.3 million is expanding at an annual rate of 2.4%. Its GDP, on the other hand, is growing at 8.8% per year, so its citizens are relatively wealthier than those of its ASEAN neighbours. All these tend to indicate that the 9.4 million cu m of fuelwood consumed in 1993 will not necessarily rise with the population and income. Since Malaysia now has the status of a newly industrialized country (NIC), its people are also upgrading their lifestyles. Fuelwood, an inferior energy source, may now be replaced with "clean" ones like LPG or electricity, and this will be reflected in an actual decline in fuelwood use, as was forecasted also by FAO. In fact, the FAO provisional projection for Year 2010 is 8.5 million cu m, or approximately one million cu m lower than that of 1993. As fuelwood consumption diminishes over the years, the wood harvested from NFAs and estate plantations can be diverted to higher-value industrial uses such as pulp, fibreboard or particleboard.

Myanmar

(a) Current situation

Due to the earlier isolationist policies of Myanmar, information about forestry, in general, and about the extent of NFAs and the quantity of wood products that they have contributed to the national wood balance, in particular, have not been readily available. Nevertheless, it is known that of the 65.8 million ha total land, some 28.86 million ha (44%) are forested (Tables 2 and 4, Annex), and that about 50% or 33.85 million ha provide the entire fuelwood supply (19.2 million cu m) for the country on a sustainable basis. What is not clear is how much of that fuelwood supply actually comes from the forest, and how much from non-forest areas.

(b) Future prospects

With 35.1 million ha of natural forests, including 235 thousand ha of forest plantations, Myanmar still enjoys the luxury of having 50.9% of its total land area under forest cover (Saw Hun, 1995). It is for this reason that, on balance, the country seems to be self-sufficient in wood products for both industrial use and fuelwood. But as in the case of Indonesia, Myanmar's wood supply problem is not caused by an overall deficit but by the fact that the concentration of population is not on the same location as the concentration of wood supply. For instance, the heavily-populated Central Dry Zone has the least amount of remaining

forest. Thus, it is necessary to establish plantations in the proximity of wood-deficit population centres in order to provide wood without incurring the high costs of transporting them over long distances. In short, notwithstanding the presence of extensive forests, Myanmar would still be dependent to a significant extent upon NFA-produced wood.

In 1993, the recorded fuelwood production of Myanmar amounted to 19.2 million cu m (FAO, 1995(c)). Most likely, these came from widely dispersed NFAs and demonstrate just how important non-forests are as a source of fuelwood. If the aggregate fuelwood consumption rises to about 27.3 million cu m by Year 2010 in accord with the population growth rate of 2.1% (Table 12, Annex), the NFAs and forest plantations will have to be expanded and managed more intensively to fill the projected demand.

Fortunately, political developments in the country seem to make these possible. For example, in 1988, Myanmar ended its 25-year period of self-isolation and Centralized Planning. As part of the decentralization move, the Forestry Legislation of 1992 provided wide opportunities for local participation in forestry development, particularly in the establishment of multipurpose tree plantations operating on a usufruct basis, i.e., based on a tenure that is as long as the "lifetime" of the participating farmer. Since many of the local people have adopted agroforestry and farm forestry as principal land use systems, the expansion of wood outputs from non-forest areas to fill the new level of demand can be expected.

Philippines

(a) Current situation

Owing to the high population density in the Philippines, landless settlers have spilled over into upland areas for subsistence farming. It is estimated that the upland population is about 17.8 million persons (or about 3.18 million households) and is growing at a high rate of 2.6% per year (UAP, 1994). Shifting agriculture involves about 6 to 7 million farmers who have carved out from the forests about 1.8 million ha of upland farms.

In response to this growing threat to forestry stability, government formulated several people-oriented programmes to redirect the energies of rural dwellers from deforestation towards forest rehabilitation and development. Thus were born the Integrated Social Forestry Programme (ISFP), the Community Forestry Programme (CFP), and the Industrial Forest Management Programme (IFMP).

One important common feature of these programmes is the granting of long term tenure over public forestlands to farmer-participants: 25 years, renewable for another 25 years if management and productivity of the sites are maintained. All these people-oriented programmes are designed to convert degraded and ecologically-vulnerable upland sites into permanent sustained-yield integrated farms. Thus, the upland farms have been made into wood-producing non-forest areas.

The programmes started only in the 1980s, but they have already chalked up some impressive records. The ISF Programme now covers over half a million ha involving the participation of over eight thousand upland farmers. CF Programmes have been set up in over 50 organized and trained upland communities thus far, covering over 100 thousand ha. The IFM Programme which consists of small woodlots of not more than 2,000 ha each, are planted

largely to fast-growing species (FGS) for industrial purposes, such as pulp and paper, chipboard and other reconstituted wood products.

In addition to these programmes are the spontaneous establishment by farmer-entrepreneurs of commercial tree crops. About 148 thousand ha of Coffee plantations have been set up and interplanted with wood-producing nurse trees like *Albizia falcataria* and *Leucaena leucocephala*. Based on the Indonesian average of 300 nurse trees per ha, all the Coffee plantations would have over 446 million nurse trees that are potential NFA contributors to the wood supply. Cacao plantations in the Philippines are smaller in extent compared to Coffee: only about 15 thousand ha. Their nurse trees, *Albizia falcataria* or *Gliricidia sepium*, likewise contribute to the wood supply.

Markets as stimulants to NFA tree planting is clearly demonstrated in the Philippines. A large pulp and paper plant in Eastern Mindanao became an attractive market that induced many small settlers and farmers into growing *Albizia falcataria* and *Eucalyptus deglupta* for pulpwood at 8-year rotation. Similarly, when sawmills in the same region ran out of raw materials from the receding natural forests, they shifted to plantation-grown stock, thereby starting a wave of planting *Gmelina arborea* in NFAs.

Tree-bearing NFAs are now also found in the intensively cultivated flood plains. Farmers often plant trees along paddy bunds as windbreaks, boundary markers, shade for people and work animals, and as sources of fuelwood. In homelots, tree species with coppicing capabilities, such as *Albizia saman* and *Leucaena leucocephala* are chosen for fuelwood production because of their ability to coppice after harvest, thereby eliminating the need to replant.

(b) Future prospects

The role of non-forest areas in supplying wood materials to the country's economy is expected to expand substantially, as reflected in the following developments: (1) the natural forest resources have shrunk drastically to only 15.86 million ha or 27% of the total land; (2) the volume of timber harvest from natural forests has been down-sized through the reduction of firms licensed to harvest logs; (3) the forest policy has been dramatically reoriented towards small-scale community-based (as opposed to large-scale corporate-based) forestry programmes for the rehabilitation, protection and development of degraded uplands and non-forest areas.

Two government-supported people-oriented programmes that could further expand NFAs are being accelerated: the Community Forestry Programme (CFP) and the Industrial Forest Management Programme (IFMP). The CFP plans to increase the number of organized communities engaged in a combination of agroforestry farming, woodlot establishment and rehabilitation of logged-over and degraded areas for the production of small timber and fuelwood. The target is to expand the community-managed NFA areas to a total of about three million ha country-wide. Similarly, the IFMP is inducing new small-sized wood-based enterprises as well as old logging firms to reforest small sections (not over 2,000 ha each) of logged-over and degraded forest sites with suitable fast-growing species for the production of small-sized timber. It is expected that from 2 to 3 million ha can be upgraded into productive NFAs under this programme.

These programmes, combined with the existing NFAs, such as the 148 thousand ha of Coffee plantations and 15 thousand ha of Cacao plantations, with their wood-producing nurse trees, should be able to supply a substantial portion of the wood requirements of the country which, in 1992, amounted to 38 million cu m of fuelwood and 382 thousand cu m of pulpwood (Tables 5 and 6, Annex) and expected to rise to 43.1 million cu m by Year 2010.

Thailand

(a) Current situation

As a result of the continuing population pressure, Thailand, like the Philippines, now has only about a quarter (13.7 million ha) of its total land area under the remaining forest cover. Extensive degraded forestlands amount to over 16 million ha; these may be regarded as potential NFAs from which wood for fuel, local construction and commercial use may be derived.

Fruit orchards and village woodlots in block plantations are quite extensive in Thailand: over 3.125 million ha of these are found all over the country. Because of the heavy demand for fuelwood, charcoal, poles for propping up fruit-laden trees, and for scaffolding in the urban construction industry, many entrepreneurs have established woodlots that use *Casuarina equisitifolia, Eucalyptus camaldulensis*, and *Acacia mangium* in Northeast and Central Thailand. Also in the Northeast region, many farmers have maintained in their farmlots remnant Dipterocarp species whose branches are lopped periodically to produce fuelwood and to reduce shading of the rice crops.

(b) Future prospects

Thailand is now a forest-deficit country. Its huge aggregate wood demand had been toned down a bit when it succeeded in holding down its population growth at a low rate of 1.5%. However, its GDP has been rising at an impressive rate of 8.5%, making the country one of the NICs (newly-industrialized countries) in Asia and raising the demand for industrial wood (as opposed to fuelwood) materials. With its present economic prosperity, it can now afford to fund programmes designed to expand wood production in NFAs in order to either minimize or eliminate the deficit in the national wood balance. All the earlier tree-planting programmes, such as the Village Forests, Homegardens, Community Woodlots and Crop-Forest complexes are being maintained and, whenever possible, expanded. In addition, two new programmes are being implemented in an accelerated manner: (1) the Private Tree Farming Promotion Programme (PTFPP) and (2) the Improvement of Agricultural Systems Programme (IASP), both of which are spearheaded by the Royal Forestry Department, with other relevant government departments as collaborators.

The PTFPP encourages farmers to plant multi-purpose tree species (MPTS) on private farms. Incentives are provided in the form of a grant of US$120/rai (US$750/ha) for the farmers to plant over a 5-year period at least 200 trees/rai (1,250 trees/ha). With this attractive incentive, farmers are flocking to the programme and it is anticipated that about 800 thousand ha of private farms will be converted into wood-producing NFAs over the five-year programme period. When the programme is fully achieved, the expected number of trees in the participating private farms will amount to about 1.36 million trees, assuming an 85% survival rate.

Under the IASP, the incentives are non-monetary, but the result is expected to be similar. Government will identify private farms whose productivity is low, or whose crops are in low demand and, therefore, not yielding reasonable incomes for the owners. The identified farmers are subsidized in the form of 2,750 tree seedlings per ha (50% allowance has been made for mortality) and 125 kg of fertilizer per ha. These materials are given free provided the landowners use them for developing agroforestry farms on the designated lots. No target area has been set for this programme but considering the extent of marginal or near-marginal farmlands in Northeast Thailand, it is anticipated that many participants will join to bring the NFA area under the programme to about the same size (800,000 ha and 1 billion trees) as in the PTFPP.

In addition to government incentives, some economic events have further boosted the above tree-planting programmes. For instance, the total ban on logging in Thailand has created an artificial wood shortage that triggered meteoric increases in wood prices. Furthermore, the keen competition among the 21 pulp and paper companies has driven the price of woodchips to US$24 or even $32 per green weight ton. These escalating prices could trigger a frenzy of tree-planting activities among farmers in non-forest areas.

The combined effects of these programmes would be a quantum jump in the availability of wood supply in the next five to 10 years, such that the provisional FAO projected fuelwood needs (Table 12) amounting to 39.7 million cu m by Year 2010 (higher by only 4.4 million cu m compared to 1993 because of the expected shift of the wealthier Thai society to “superior” energy substitutes) could be readily be satisfied.

Vietnam

(a) Current situation

Over 66% of Vietnam is mountainous, and slightly over half of the total land is considered forest although about 9.7 million ha of these forest areas are now degraded through slash and burn cultivation and over-exploitation. Each year, over 100 thousand ha of forests are lost through shifting cultivation, forest fires and poor harvesting methods (Vietnamese Ministry of Forestry, 1995).

State owned commercial tree crops that require nurse trees abound in Vietnam. For instance, there are about 60,000 ha of Tea plantations and another 60,000 ha of Coffee plantations in which nurse trees like *Pinus merkusii*, *Leucaena leucocephala*, *Gliricidia sepium*, and *Cassia siamea* have been interplanted. The density of the nurse trees have not been indicated in the reports, but if the Indonesian experience is once more applied as a basis for estimation (300 nurse trees per ha of Coffee; 10 nurse trees per ha of Tea) it would mean about 600 thousand nurse trees in the Tea plantations and 18 million nurse trees in the Coffee plantations. And, based further on the average of 1,600 trees per hectare in normal block planting, it means that all the nurse trees in these estate plantations would be equivalent to about 11.6 thousand ha of block tree plantations.

The year 1986 is considered a milestone in Vietnam policy on land use: the radical change made at that time has been the **decollectivization** of farms to individual farmers. Over the decade since the policy change has been implemented, the motivation among farmers to plant

more trees are starting to show. For instance, orchard crops like Mango, Cashew, and Jackfruit have been established and interplanted with shade-tolerant annual food crops and spices like Ginger and Pepper. In addition, the Taungya system has been adopted where tree plantations of *Tectona*, *Hopea*, *Dipterocarpus* and *Anisoptera* are established by local people who, in turn, are allowed, while the trees are still young and small, to interplant with food crops like Rice, Corn, Cassava, Sweet potato, etc. All the agricultural products accrue as benefits to the local people in exchange for their services in planting and protecting the trees (FAO/APAN, 1996).

(b) Future prospects

In line with the shift in emphasis from forest exploitation to forest resource restoration and expansion, Vietnam formulated three important policies designed to accelerate the establishment of more tree plantations in forest and non-forest areas:

(1) **Decollectivization** of farms to individuals starting in 1986 - this policy has provided greater farmer motivation in planting trees in their farms in response to recognized market demands for fuelwood and other wood products. The annual consumption of fuelwood that runs to over 28 million cu m per year (1993) to satisfy about 75% of domestic or household energy needs would be a strong "magnet" that will draw entrepreneurial farmers into fuelwood production activities.

(2) **Long-term leases** for farms allocated to farmers - Since 1988, government has been granting long-term leases to individual farmers, as follows: maximum of 20-year leases for farms used for annual crops; 30 to 50-year leases for lands devoted to tree crops; 50-year leases for bare and degraded lands to be converted to forest plantations. These lengthened tenures now serve as strong incentives that encourage farmers to embark on tree-growing enterprises since they are assured sufficient opportunity to reap the financial benefits from these long-term projects. Over one million ha have been allocated to 800 thousand households which are participating in agroforestry and farm forestry programmes.

(3) Increase in the **prices** of wood products - High wood product prices arising from the huge and expanding demand will lure farmers into allocating more land, labour, capital and other resources to the business of tree growing as they strive for greater incomes and profits. In the process, much of the sites degraded through slash-and-burn cultivation could be rehabilitated by conversion to agroforestry farms and farm woodlots within non-forest areas.

The impacts of the above combination of factors and programmes could be discerned in the increase in area devoted to wood-yielding NFAs to meet the aggregate requirements of the population that is rising at the rate of 2.3% annually. The forest plantations that now amount to 1.47 million ha would probably expand by about 2% per year to reach about 1.7 million ha by year 2010. If this eventuates, the current fuelwood needs of 28.9 million cu m (1993), which is forecasted to rise to 37 million cu m by Year 2010 (Table 12, Annex), could possibly be satisfied.

As shown in Table 5, Annex, only about 27% of the total wood output in SEA consists of industrial roundwood (including pulpwood). The other 73% is used as fuelwood. Table I

shows how the fuelwood consumption, expected to be filled mostly by products from NFAs, rises to high levels in response to large population-triggered demand. The "low" projection of fuelwood consumption for Year 2010 reflects two important facts about the SEA region: (1) governmental action to promote birth control; (2) rising economic prosperity of nations in the region, enabling their citizens to shift to non-wood energy substitutes.

Table I. - Actual and Projected Wood Consumption, SEA Region (million cu m)

Country	Fuelwood and Charcoal				Industrial Roundwood	
	1993*	2010			1993*	2010
		FAO	High**	Low**		
Indonesia	149.06	180.1	195.27	176.50	38.91	48.03
Laos	4.25	4.3	6.91	5.95	0.61	0.84
Malaysia	9.38	8.5	14.04	11.10	35.46	32.04
Myanmar	19.16	23.2	27.28	24.70	2.22	4.10
Philippines	35.98	40.6	52.96	46.30	4.11	7.76
Thailand	35.31	39.7	45.48	41.80	3.81	11.02
Vietnam	28.98	37.0	42.66	34.30	4.42	7.46

Source: FAO, 1995. Forestry Statistics Today for Tomorrow (for 1993 data); FAO 1997(b) for 2010 (other than author's estimates).
* Actual; ** Author's estimates.

2.3.3 Subregion 3: EAST ASIA

China, Mongolia, Japan and the two Koreas (North and South) comprise the East Asian subregion. North Korea's forestry information cannot be accessed, South Korea is now a NIC which imports huge quantities of wood to feed its industries, and Japan is an "economic superpower" whose forests are virtually untouched while it imports enormous quantities of industrial wood from the rest of the world. That leaves only China and Mongolia under the coverage of this topic.

Historical production figures from 1981 to 1992 indicate that while pulpwood output rose by about 5.8% per year, fuelwood increased by only 2.4% annually, or just enough to cover population growth. The tree species planted extensively in China's NFAs can be used as either pulpwood or fuelwood. The more rapid escalation of pulpwood outputs compared to fuelwood, as shown in Table J below, seems to reflect the rapid industrialization going on in that country. The flattening of the demand curve for fuelwood is normal for societies going through accelerated economic development whose people switch from "inferior" wood energy to better substitutes.

Table J. - Trends in the Production of Fuelwood and Pulpwood, East Asia (000 cu m)

Country	Product	1981	1985	1990	1992	1995
China	Pulpwood	4,652	6,610	7,997	7,887	7,718
	Fuelwood	93,872	101,602	112,171	196,152	204,059
Mongolia	Pulpwood	n.a.				
	Fuelwood	135	135	135	361	376

Source: FAO, Forest Products Yearbook, 1992, 1995.

China

(a) Current situation

The immensity of China is illustrated by its gigantic land area of 932.64 million ha, its correspondingly huge population of 1,215.5 million people, and a large GDP of US$3,172 billion (Tables 1 & 2, Annex).

China has dramatically turned itself from a timber-deficit country to a seemingly wood-surplus one in the span of less than two decades. In the second forest inventory (1977-81), the forest cover was only 12% of total land, and the timber deficit amounted to 18.78 million cu m. The third inventory (1984-88) showed an increase in forest cover to 12.98% and the timber deficit shrunk by over three million to 15.37 million cu m; the fourth forest resource inventory (1989-93) showed that the total forest area had expanded to a total of 133.7 million ha or almost 14% of total land. By that time, the accumulated standing timber amounted to 11.79 billion cu m, with an annual volume increment 419 million cu m. Since the wood consumption per annum is only 320 million cu m, China has now achieved, through sheer political will and perseverance, a "timber-surplus" status (Li Jinru, 1995). Three major thrusts have contributed to the forestry achievements of the country:

(1) Afforestation: over 4 million ha are reforested annually. The total area planted now stands at 33.79 million ha, reputedly the largest in the world.
(2) Forest Protection: Damage to and reduction of forest areas by forest fires, insect attacks and indiscriminate logging have been significantly reduced through intensified protection measures.
(3) Improved Forest Resource Administration: Timber extraction is now better planned and supervised, so uncontrolled exploitation has been reduced.

The above programmes have been carried out at a large scale under government sponsorship. The forests thus established do not fall under the category of non-forest plantations that are the main subject of this document, but they are nevertheless shown here to show the dramatic national efforts to turn around forestry into a self-sufficient sector.

(b) Future prospects

The momentous 1993 decision of China to adopt a "socialist market economy" has had dramatic effects in the way productive activities are carried out. Under this system, enterprises continue to be state-owned but they operate in an open market, and incomes are distributed on a "to-each-according-to-his-work" principle, with priority given to efficiency and equity. This major policy reform has been reinforced by other favourable policy shifts, such as the following: (1) Land previously owned and managed by single "production brigades" have been broken up and allocated to separate corporations that consist of collective groups of households or individuals; (2) Publicly-owned lands can now be contracted for reforestation by a collective or individual; (3) The collective or individual reforestation contractor will own the trees that they have planted; (4) Trees planted by contractors can be inherited by heirs or sold as standing trees to other collectives or individuals; (5) Afforestation contracts can also either be sold or transferred; (6) State forestry enterprises have been transformed into independent forestry producers; (7) Forestry enterprises are now free to sell their outputs at prices set by themselves rather than by the state; (8) Earnings from forestry production

activities are not taxable (Li 1995). As expected, these reforms have made forestry enterprises a lot more aggressive and efficient, and their wood outputs have increased significantly.

The three large tree-planting projects on non-forest areas, such as (1) the Three-North Shelterbelt Development Programme (target: 35.07 million ha in the North, Northeast and Northwest regions); (2) the Coastal Shelterbelt Programme (target: 3.56 million ha of multi-functional shelterbelts among 11 provinces along the coast); and (3) the Plain Farmland Shelterbelt Project (target: 3.24 million ha in lowland farm areas) enjoy great support by the various local enterprises and by the people because of the new policies and incentives. Add to these the "compulsory tree planting" programme that enjoins all citizens to plant trees around homelots, farmlots, roadsides and canalsides, and the China that emerges is one with a high potential for achieving wood production targets. In short, with the new policies and the strong political will demonstrated by China thus far can go a long way towards meeting the anticipated demand for fuelwood and for small-sized timber for industry.

Mongolia

(a) Current situation

Of Mongolia's 156.4 million ha of land, only 15.2 million ha (9.7%) are designated as forest lands, out of which only 11.3 million ha are actually under forest cover with a total timber stock estimated at 1.3 billion cu m (Hijaba, 1995).

Between 1975 and 1990, about 37.8 million cu m of logs were harvested, or an average of about 2.5 million cu m per year. This rate of extraction is below the sustainable yield from the Mongolian forests which had been computed in 1975 at 9.3 million cu m per year. These 37.8 million cu m were harvested from a total area of 394 thousand ha, representing an extraction of about 95 cu m per ha.

The raw material demand of the domestic wood-based industry exceeds the annual wood harvest. In 1993, the roundwood deficit was placed at 200 thousand cu m; between 1990 and 1993, the production of lumber, furniture and pulp declined by 55-76%.

Mongolia was transformed into a "parliamentary democracy" in 1990. Since then, reforms have been implemented, many of which affect the forestry sector. For instance, all production units in the forest industries have been privatized and reorganized into small stock companies. Forest resources management has been decentralized so that planning, financing, reporting and monitoring systems have been modified accordingly.

These reforms have been implemented in phases, and some initial difficulties have been encountered in the process. Sudden removal of central controls have led to irresponsibility, disorganization, unemployment and recession. In short, before the benefits of the reforms can be felt, transitional difficulties will be first experienced.

(b) Future prospects

Mongolia is a large country with a small population of only 2.5 million people but growing at a high rate of 2.7% yearly. Its forest area of 15.2 million ha is only 9.7% of the total land; a

huge 77% is covered by pastures. The livestock sector is large and continues to encroach upon the limited forest areas.

The 1990 political transformation of Mongolia has led to corresponding economic reforms that have profound impacts upon the forestry sector. All state enterprises, including livestock and forestry, have been privatized. At first glance, this may seem positive in providing greater incentives to production. In reality, it increases the risks for the forestry sector since the livestock population is expected to increase rapidly and further compete with forests for land. The use of natural resources, including forests, for profit-driven activities, such as logging, will be intensified.

The fuelwood and industrial wood demand is predicted to expand from the current level of 450 thousand cu m per year to about 0.7 million cu m by Year 2010 (FAO, 1997(b)). However, because of the limited existing forest base and minimal reforestation programmes (the ratio is only 1 ha reforested for every 8.5 ha logged), the fuelwood output may have difficulty to rise even by only 2.0% to about 620 thousand cu m by the target year.

The combined effects of overgrazing, encroachment into forest areas, forest fires, insect infestation and excessive logging have reduced the commercial forest area to only about 2.4 million ha today, down from 5.7 million ha in 1975. At a re-calculated increment of only 0.82 cu m per ha per year, the sustainable yield is a mere 1.96 million cu m annually (Hijaba, 1995). This means that over 30% of timber harvested from the forests may have to be used as fuelwood since there are no separate fuelwood plantations in non-forest areas to speak of.

The patterns of supply (and consumption) of fuelwood and pulpwood in China and Mongolia are shown in Table K below. It is clear that in both countries, the projected rise in the output of industrial roundwood (including pulpwood) is much sharper compared to that of fuelwood, for reasons that were explained above.

Table K. - Actual and Projected Wood Consumption, China & Mongolia (million cu m)

Country	Fuelwood and Charcoal				Industrial Roundwood	
	1993	2010*			1993	2010*
		FAO	High**	Low**		
China	200.06	255.84	245.07	236.90	104.60	170.10
Mongolia	0.45	0.43	0.70	0.62	408.00	0.30

Source: FAO, 1995. Forestry Statistics Today for Tomorrow (for 1993 data); FAO 1997(b) for 2010 (other than author's estimates).
* Projections based on policies, programmes and populations; ** Author's estimates.

2.3.4 Subregion 4: SOUTH PACIFIC

An important common characteristic of the South Pacific countries (except Australia and New Zealand) is the customary ownership of lands, including forest resources. In Fiji, for instance, 84% of all forests are owned by communal groups; Papua New Guinea - 85% owned by clan groups; Solomons - 87% owned by tribes; Vanuatu - over 80%. Ironically, despite this form of tenure, the communal owners seldom, if ever, get involved in forest harvesting and in the

rehabilitation of the logged forests. They just wait for the timber royalty payments and rely on government and private corporations to carry out timber extraction.

For reasons that are not clear, the communities generally do not plough back any portion of their timber royalty incomes towards reforestation of their logged land. And since tribal groups do not normally allow either government or private firms to plant long-term crops on their lands for fear that ownership will pass on to the planter/owner of the trees, the logged areas remain unproductive, especially at the early stages of the vegetative cycle. It also means that if the logged forest is not replanted and natural regeneration is not successful, there will be a progressive reduction of the forest resources of the countries in the subregion.

Government advisory and regulatory roles are recognized by landowners during their negotiations with private loggers, and in the enforcement of logging and management procedures. However, once these activities are completed, the land reverts to the landowners' complete control and no government intervention, including reforestation and management, is accepted. For these reasons, the trend for fuelwood and pulpwood production among the developing countries in the South Pacific is rather flat, as shown in Table L.

Table L. - Trends in Fuelwood and Pulpwood Production, South Pacific (000 cu m)

Country	Product	1981	1985	1990	1992	1995
Australia	Pulpwood	6,411	7,419	8,032	7,923	9,383
	Fuelwood	1,280	2,100	2,100	2,892	2,898
Fiji	Pulpwood	n.a.	n.a.	n.a.	n.a.	306
	Fuelwood	28	37	37	37	37
New Zealand	Pulpwood	3,766	3,645	4,523	5,533	4,402
	Fuelwood	25	25	25	50	50
Papua New Guinea	Pulpwood	n.a.	n.a.	n.a.	175	175
	Fuelwood	5,533	5,533	5,533	5,533	5,533
Solomons	Pulpwood	n.a.	n.a.	n.a.	n.a.	n.a.
	Fuelwood	106	122	136	138	138

Source: FAO, Forest Products Yearbook.

Another point clearly shown by Table L is that in the developed economies (Australia and New Zealand), the dominant wood product is industrial wood rather than fuelwood, while among the developing ones, the exact opposite is the case.

Fiji

(a) Current situation

This country of over 300 islands covers a total land area of only 1.839 million ha, 44% (809,000 ha) of which is still under natural forest. About 680,000 ha (84%) of these forests are owned by communal groups.

Present government policy aims to gradually phase out logging from the natural forests and rely increasingly upon plantations to fill both domestic as well as export demands. As of 1995, some 87,000 ha of Pine and Mahogany plantations had been established, and these are planned to be expanded by 10,000 ha per annum to reach a total of 185,000 ha by year 2005.

However, these are government plantations established under forestry conditions. The only small-scale reforestation that can be considered non-forest area plantations are the 16,000 ha of Pine woodlots owned, established and managed by communal land owners following promotional support, training assistance and technical advice provided at first by government, and later by the Fiji Pine Ltd.(FPL).

Private non-forest areas are expected to expand by 700 ha per year, with assistance from government and FPL. An integrated sawmill-chipmill operation in which FPL holds 74% interest has the capacity to absorb all the wood outputs of private plantations and, therefore, serves as a market that encourages landowners to embark upon community forest plantations.

No statistics on the extent of other wood-producing non-forest areas are available. Nevertheless, it is known that small-scale traditional agroforestry farms abound in Fiji, and their tree components are the major sources of fuelwood for domestic use. About 3,700 cu m of fuelwood, mostly from tops and branches left after logging, were collected from pine and hardwood forests in 1993 (Swarup, 1996), but in the same year, a total of 45,000 cu m of fuelwood was used in the whole country (FAO, 1995(c)). The difference of 41,300 cu m must have been collected from the non-forest areas[1], such as agroforestry farms and woodlots since Fiji does not import any fuelwood. Residues from the wood processing mills are not available for fuel since they are recovered and made into particle boards and chipboards.

(b) Future prospects

While no statistical records are readily available as regards the extent of, and wood production from, non-forest areas in Fiji, it can nevertheless be deduced that the fuelwood volume over and above those procured from natural as well as plantation forests must have been derived from non-forest areas such as agroforestry farms, farm woodlots, homesteads and other similar sources like coconut plantations. This inference seems logical since no fuelwood imports into Fiji have been recorded, and yet no sharp fuelwood shortages like those known in South Asia have arisen. It would seem possible to increase the current fuelwood output by 1.5% (to match the population growth rate) to a total of 47 thousand cu m by Year 2010 if the planned expansion of forest plantations (target: 10,000 ha per year) and the private non-forest plantations (target: 700 ha per year) can generate sufficient logging residue to be used for energy to supplement the fuelwood outputs from agroforestry farms and farm woodlots.

New Zealand

(a) Current situation

New Zealand, with just over a quarter (28%) of its land under forest, is a classic example of a country that has chosen plantation forests as a means for achieving wood sufficiency. Its natural forests of 6.23 million ha are not looked upon as a wood supply base since a full 87% of it is locked up in national parks and protected reserves, while the other 13% are non-commercial in nature. Thus, the 1.23 million ha of plantation forest is almost the sole source

[1] Unrecorded collection from natural forests could be an alternative source (Editor).

of wood supply. It is expected that almost the entire 28 million cu m of timber to be harvested by year 2005 will come from plantation forests (NZ Ministry of Forests, 1996).

Some 80% of all forest plantations in New Zealand are privately owned. However, unlike in the developing countries in Asia, the private plantation owners here are large corporations rather than individuals or communities. In fact, three of the largest firms own an aggregate of 700 thousand ha or over one half of all plantations. What this ownership pattern indicates is that these are forest plantations rather than the usual small-scale non-forest woodlots or agroforestry farms seen in Asia. Even fuelwood is harvested from the forest, not from non-forest areas. The quantity of fuelwood harvest, in the form of plantation thinnings and logging residue, is about 80 thousand cu m per annum, more than enough to cover the meagre amount of 50,000 cu m consumed by the country per year (FAO, 1996(c)). This further shows that little, if any, non-forest plantations exist as fuelwood sources in that country.

The close similarity between New Zealand and Australia in terms of forest policy, penchant for forest plantations, scale of forestry operations, economic status and lifestyles of its populace seem to point to a similar absence of small-scale non-forestry plantations in Australia.

(b) Future prospects

Like most developed nations, New Zealand has a low population growth rate of only 1.0% per year. Since, to begin with, its total population is only 3.5 million, its fuelwood requirements are correspondingly low: only 50 thousand cu m per annum. In parallel with the population growth of 1.0%, this demand may rise to about 59 thousand cu m by Year 2010 (Table 12, Annex). In fact, fuelwood consumption could decline instead of expand since fuelwood is an "inferior good" that could readily be discarded by the wealthy and sophisticated populace in favour of "clean" energy sources like gas and electricity. In short, no fuelwood and small-sized timber shortages are expected in New Zealand since the present and planned forest plantations are expected to be sufficient to fill the expected low demand.

Papua New Guinea

(a) Current situation

With a total land area of approximately 46 million ha, Papua New Guinea (PNG) is a giant relative to the neighbouring island countries in the South Pacific. Its forest resources, which are almost entirely under traditional communal ownership, cover some 39.4 million ha (86% of total land.) Today, PNG is preoccupied with efforts to place all the forest resources under sustainable management.

As expected in a country awash with natural forest wealth, minimal attention is paid to forest plantations. As of 1995, the total plantation areas amounted to only 53.8 thousand ha: 23.9 thousand ha under state control and 29.8 thousand ha in private possession. All these plantations were initiated by government but because of limited manpower and other resources, and due to land ownership problems, they are now under a sad state of neglect. Clan landowners generally refuse to allow government or private firms to set up tree plantations on their land. Under the traditional land tenure system, plant tenure often develops

into land tenure. Thus tribal land owners are extremely reluctant to allow non-tribal groups to establish any plantations on their property.

Clan landowners are also reluctant to invest their royalty incomes in long-term tree crops since natural forests from which they derive royalty incomes are still plentiful. Thus, about the only wood-producing non-forest areas are those found in traditional agroforestry farms, woodlots or food gardens. These are mostly in the form of *Albizia* or *Leucaena* nurse crops for Coffee in the middle hills, *Leucaena* or *Gliricidia* nurse trees for Cacao in the lower elevations, and emergent natural regeneration in slash-and-burn farms. Because of the non-merchantable nature of the species and the small sizes of logs generated by these agroforestry activities, most of the wood produced in the non-forest areas end up as fuelwood for home consumption. It was estimated that the 1993 fuelwood consumed by the population of 4.3 million amounted to about 5.53 million cu m (FAO, 1996(c)).

Undeveloped infrastructure, remote locations, mountainous topography and communal land ownership have combined to create difficulties in harvesting PNG's vast timber resources. To develop a viable wood-based industry, government is planning to establish substantial forest plantations in accessible sites close to population centres to serve as sustainable raw material bases. To overcome the difficult tenure problem that serves as an obstacle to plantation establishment, government plans to involve the private landowners more actively in replanting and managing their own land properties. The involvement of numerous clan groups in the reforestation of many small-scale community woodlots and tree farms would enable non-forest areas to emerge as a major wood supplier for both household and industrial needs.

(b) Future prospects

PNG's small population of 4.3 million is growing at a high rate of 2.3% annually. Since, as a developing country, its people use fuelwood as the principal household energy source, its current wood energy demand is expected to reach 6.01 million cu m by Year 2010 (FAO, 1997(b)) due mostly to population growth.

As a forest-surplus country, PNG should have little difficulty in filling the fuelwood and commercial wood requirements. Localized shortages may be felt in the two heavily-populated coastal cities (Port Moresby and Lae) and in the densely inhabited Highlands, but the forest frontiers are still close enough to enable relatively easy fuelwood collection. However, the wood supply will most likely be derived largely from natural forests and from natural regrowth in traditional agroforestry farms rather than from tree plantations in non-forest areas.

Solomons

(a) Current situation

The Solomons has about 2.83 million ha of total land, with 87% (2.47 million ha) under customary ownership. Government owns a mere 283 thousand ha. Some 95% (2.69 million ha) of the land is under forest vegetation but only about 600 thousand ha are considered suitable for commercial exploitation. The rest are either sparsely timbered, degraded or inaccessible. The estimated sustainable level of harvest is about 325 thousand cu m but because of attractive prices that motivated logging firms to harvest more, the log exports in 1994 rose to some 680 thousand cu m, and in 1995, to about 700 thousand cu m. With only

about 12 million cu m of harvestable timber stand, it is feared that it will take only a little over 16 years to exploit and exhaust the forest capital. This threat has prompted government to set up a policy of banning log exports by year 2000 to reduce the timber drain and to encourage domestic processing that could generate more jobs and increase value added.

Clan ownership of 87% of the land presents excellent opportunities for the development of community woodlots in non-forest areas to supplement the wood supply from the natural forests. However, despite the obvious importance of such activities, there seems to be no established tradition of tree planting in the country. Up till now, only 25 thousand ha of forest plantations have been established, and these are almost all on the limited areas of government land rather than in the vast clan-owned degraded and deforested land that needs rehabilitation. In spite of government extension efforts to motivate local people to embark on plantation activities, tree plantations established and managed by the local residents are almost non-existent. The new strategy being developed by government is to promote joint venture reforestation where clans provide land and labour while forestry corporations will provide capital and expertise. If this approach succeeds, supplemental wood supply from plantations may become available. Nevertheless, because of corporate involvement, the resulting plantations will be medium to large scale forest estates rather than small-sized woodlots or tree farms in non-forest areas. The traditional agroforestry farms and the residue from logging will most likely continue to be the source of fuelwood which, as estimated by FAO, runs up to about 138 thousand cu m per annum (FAO, 1995(c)).

(b) Future prospects

Like Papua New Guinea, the Solomons is a sparsely populated country with a relatively large forest resource base that is almost completely controlled by clan or tribal groups. And like PNG, the Solomons is lulled into complacency by its current forest-surplus situation and, therefore, has not paid serious attention to reforestation to replace the forest areas that have been severely logged or over-exploited. Thus, outside of its traditional agroforestry farms, there is very little wood-producing non-forest area that could be relied upon as fuelwood, pulpwood or sawlog sources.

The small population of 320 thousand consumes less than 140 thousand cu m of fuelwood per year. For this reason, even when the population expands at its present rate of 2.0% yearly, the expected consumption would rise marginally to only about 144 thousand cu m by Year 2010 (Table 12, Annex). The Solomons could still comfortably cover that demand although, considering the limited tree plantations in non-forest areas, almost all of the fuelwood will have to be extracted from the all-aged natural forest in “thinning-from-below” cutting, from logging residues generated by timber harvesting operations, and from natural regrowth in the traditional agroforestry farms.

Vanuatu

(a) Current situation

The country’s total area of 1.23 million ha is only 35% (439 thousand ha) forested. However, non-forest areas, like woodlands, thickets and scrublands come up to about 479 thousand ha or 39% of the total land. These are potential sites for customary non-forest tree plantations to produce added wood supply for the country. Establishment of non-forest plantations may be

necessary since the limited standing timber resource of 13 million cu m has a sustainable yield of only 50 thousand cu m per year while, for some inexplicable reasons, the combined volume authorized for removal through the licensing process amounts to 226 thousand cu m per year, or four times the sustainable level of harvest. Fortunately, because of low operational capabilities, the licensed loggers have not reached their maximum log harvest allotment so over-cutting has been avoided. In 1994, the aggregate timber removals amounted to only 44 thousand cu m.

While the basic forest policy of Vanuatu is to achieve sustainable forest management, thus far there has been no deliberate effort to reforest logged areas. Most forests in the country appear to regenerate well, as most tropical rainforests generally do when protected from further damage after primary timber extraction. However, no detailed research knowledge exists regarding the survival and growth of natural regeneration after logging.

Extension efforts to encourage local people to develop community forests and to deliberately integrate trees in their farming systems are still in the early stages and, therefore, have very limited area coverage. The trees found in traditional farms are usually spontaneous regrowth and are often not the most desired ones for fuelwood or industrial purposes.

Government is capitalizing on the fact that in many localities, people pressure have pushed the forest frontiers further away, and the local populace are now experiencing scarcities in fuelwood and local construction materials. This scarcity will drive up the local prices of wood materials, thereby creating a strong economic incentive for farmers and tribal groups to develop their own non-forest plantations to fill local wood markets. As added incentives and assistance, government provides subsidies "in kind," such as free seedlings and technical advice on the selection of species suited to the production of fuelwood and local building materials. These fledgling efforts are still far from bearing tangible results. In the meantime, the annual consumption of fuelwood amounting to about 24 thousand cu m (FAO, 1995(c)), is probably being filled with wood collected from traditional agroforestry farms and woodlots, and from logging residue.

(b) Future prospects

Unlike its forest-surplus neighbours, Vanuatu has only over one third (35%) of its total land under forest cover (439 thousand ha.) Non-forest areas (scrub, thickets, woodland) are greater in extent (39% or 479 thousand ha) and are potential sites for NFA development. However, since reforestation achievements have been minimal despite government support and extension efforts, none of these scrublands have been transformed into productive fuelwood or industrial wood plantations thus far.

The population of 150 thousand people, growing at 2.0% annually, currently consumes about 24 thousand cu m of fuelwood per year (FAO, 1995(c)). In the absence of up-to-date data, it is presumed that the fuelwood is derived from the natural forests and, to a much lesser degree, from the sparse trees of non-forest areas, as well as from the spontaneous regrowth in traditional swidden farms. If, in accordance with the population expansion, the demand for fuelwood rises to around 26 thousand cu m by Year 2010 (Table 12, Annex) Vanuatu may still be able to cover it by using wood extracted from forests and woodlands. If small trees from natural forests are extracted for energy use (similar to "thinning-from-below" operations) and a conservative estimate of 5 cu m is harvested from each hectare of forest, only some 6.8

thousand ha out of the total forest of 439 thousand ha need to be "thinned" each year. This rate is feasible and will not be considered an excessive level of extraction.

Not saddled with the extreme population pressures on limited resources that are being experienced in South Asia and Southeast Asia, the developing South Pacific countries can get by with low extraction from their relatively large remaining resources. And because of the vast reservoir of natural forests, the people are not driven towards expansion and intensification of NFAs for raising limited-scale, man-made forest plantations.

The future of production (and consumption) of NFA-based wood products is not very promising for the reasons pointed out above, and as shown in Table M.

Table M. - Actual and Projected Output of Wood, South Pacific (million cu m)

Country	Fuelwood and Charcoal				Industrial Roundwood	
	1993	2010			1993	2010
		FAO	High*	Low*		
Fiji	0.04	0.04	0.04	0.04	0.12	0.21
New Zealand	0.05	0.03	0.06	0.06	10.99	13.16
P.N. Guinea	5.53	6.01	8.16	7.70	0.73	0.32
Solomons	0.14	0.14	0.18	0.18	n.a.	0.13
Vanuatu	0.02	0.03	0.04	0.03	n.a.	0.04

Source: FAO, 1995. Forestry Statistics Today for Tomorrow (for 1993 data); FAO 1997(b) for 2010 (other than author's estimates).
* Author's estimates.

3 THE FUTURE WOOD SUPPLY FROM NON-FOREST AREAS

It has been noted that in the developing countries in the region, fuelwood is generally in short supply in relation to the need for it. Thus, all fuelwood produced is consumed. For this reason, in forestry statistics, the quantity produced is often equated with the quantity consumed, i.e., the consumption and production figures are sometimes used interchangeably.

In the projection of the country fuelwood production (consumption) to Year 2010, three figures appear in this document and in Table 12: (a) FAO projections (from "Statistics Today for Tomorrow," 1995) based on what FAO refers to as "the relation between population and the economy"; (b) projections based on the country population growth rates; and (c) "Adjusted" projections based on the combined influence of population growth, economic development and government forest policies and programmes.

3.1 Trends in Wood Production in Non-Forest Areas

From the review of previous events and current situations in the forestry sector of selected countries in the region, three trends have clearly emerged:

(1) The aggregate demand for wood products (fuelwood as well as pulpwood and other small-sized wood products) continues to rise by 1.5% to over 3% annually as a result of population growth and industrial expansion.

(2) On the other hand, forest resources are rapidly shrinking by about 3.1 million ha per year due to continuing forest exploitation and escalating pressures on land by competing users, such as agriculture, housing, infrastructure and industry.
(3) The widening wood supply-demand gap has inevitably led to steep rise in wood prices, more than doubling the value of fuelwood and industrial roundwood during the decade from the 1980s to the 1990s.
(4) In response to the attractive wood prices, many farmers have established small-scale tree plantations in non-forest areas (NFAs) such as agroforestry plots, tree farms and community woodlots.
(5) Today, NFAs continue to expand in area and escalate in importance in terms of rising contribution to the aggregate supply of fuelwood and small-sized industrial woods.

3.1.1 Other Factors Influencing the Trends

Apart from the influence of population and income upon the demand for (and supply of) wood products, as indicated above, the future extent of NFAs and the magnitude of their roles in filling basic needs of the people and the raw material requirements of industry are further affected by three other important factors, namely: (1) **forest land use policies;** (2) **incentives and subsidies** made available to NFA operators, and (3) **improved market access** for NFA products**.**

3.1.1.1 Forest Land Use Policies

In previous decades, classical forest policy dictated that forestlands are used strictly for forestry purposes, to the exclusion of agriculture. Since forest management and development were deemed to be better carried out in massive operations in order to benefit from economies of scale, and since farmers were deemed incapable of large scale and long-term operations, forestry became almost the absolute domain of large enterprises and government. Forests were considered out of bounds to local people and small firms.

A profound land use policy shift among many developing countries was triggered by the 8th World Forestry Congress held in Indonesia in 1978 which had for its theme “Forests for People.” It established the basic tenet that forests are managed, perpetuated and harvested primarily for the benefit of people and that, therefore, the people must be actively involved in decision-making and implementation of forestry programmes. Using food-producing agroforestry systems as an entry point, governments gradually encouraged and increased the participation of local people until agroforestry (for individuals) and community forestry (for communal groups) became the flagship forestry programmes on government lands for several countries in the region. These programmes have resulted in the expansion of people-oriented and community-managed non-forest areas on degraded public lands in Asian countries.

3.1.1.2 Incentives and Subsidies

Farmers have been so used to being banned from forest areas that when government tried to involve them in forestry projects, they were initially suspicious and reluctant. Incentives had to be employed to win them over. One of the most effective incentives is the grant of long term tenurial arrangements covering government forestlands (ranging from 50 years in some countries like the Philippines, to lifetime tenures in others, such as Thailand). These have

effectively overcome the problems of insecure tenure that previously discouraged farmer-cooperators from community forestry programmes.

Other effective incentives that have induced greater farmer participation in forestry programmes are (1) provision of free technical advice by government extension agents; (2) availability of easy credit to forestry entrepreneurs; and (3) subsidies in the form of seeds and seedlings of desired tree species.

3.1.1.3 Improved Access to Markets

Farmers managing non-forest plantations usually turn into bitter critics when their bountiful harvest of government-recommended wood products cannot be marketed and anticipated revenues are not realized. In some cases, government has been able to turn these problems into opportunities. For example, government policies in some Asian and Pacific countries, designed to encourage small and medium enterprises, have led to the establishment of small businesses such as portable sawmills, furniture and handicraft shops and particleboard plants which effectively serve as market outlets for community forestry outputs. This creation of markets for small plantation products have generated alternative livelihood opportunities for rural communities and, in turn, have encouraged more tree plantation activities in non-forest areas.

Another important government marketing assistance is in the form of building or upgrading farm-to-market access roads either which facilitate the entry of wood buyers into NFA territories, or hasten the farmers' transportation of their wood products to market.

4 CONCLUSIONS

The foregoing assessments of selected countries in the region, while not leading to precise figures on the area of NFAs, or on the volume of NFA-based wood production, could point to broad conclusions which can be summarized as follows:

(1) Natural forest areas are declining and will continue to decrease because of rising people pressure and intensifying competition with other land uses.

(2) The magnitude of wood harvests from the natural forest will correspondingly decline not only because of the reduction of the forest base but also because increasing portions of the remaining forests are withdrawn by government from productive use and set aside for ecological conservation, biodiversity maintenance, parks and recreation and watershed conservation and protection in support of lowland agriculture and hydropower generation.

(3) Shrinkage of natural forest areas could be arrested and reversed if: (i) strong political will is exercised to establish and fully protect permanent forest reserves for production, watershed and other environmental purposes; (ii) parallel measures are put in place to reduce excessive population growth rates; (iii) strong programmes are formulated to provide alternative livelihood for the upland dwellers.

(4) Non-forest areas will continue to increase in area and NFA-derived wood outputs will rise as private tree plantations are established by entrepreneurial farmers and as government-

supported, community-managed, people-oriented forestry programmes expand to fill the widening gap between available wood resources and escalating wood requirements.

(5) The broad outlook for the next dozen years up to 2010 are as follows: (i) Countries in the region with exceptionally heavy population densities (e.g., India, Bangladesh), limited land areas and limited forests will face severe fuelwood and small-timber shortages which can be alleviated by increased wood production in NFAs; (ii) other countries will be able to produce sufficient fuelwood and small-sized industrial wood through a combination of sustainable production from the remaining natural forests and intensified production from expanded non-forest areas.

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6 ANNEX

Table 1.- Population and Gross Domestic Product (GDP), Asia-Pacific Countries, 1996

Country	Population (Million)	Population Growth (%)	GDP(US$ Billion)	GDP Growth (%)	Per Capita GDP (US$)
SOUTH ASIA					
Bangladesh	122.7	2.2	159.0	4.1	1,350
Bhutan	0.7	2.3	1.0	5.5	1,475
India	933.9	2.1	1,180.0	6.2	1,280
Nepal	21.7	2.3	2.5	2.3	1,165
Pakistan	132.2	2.9	282.0	4.7	2,235
Sri Lanka	18.2	1.2	53.0	5.6	3,030
SOUTH EAST ASIA					
Brunei	0.3	3.2	5.9	1.8	21,065
Cambodia	10.2	2.5	12.0	7.5	1,266
Indonesia	197.6	1.6	709.0	8.1	3,690
Laos	4.8	2.9	9.7	7.4	2,071
Malaysia	20.3	2.4	171.0	8.8	8,763
Myanmar	47.2	2.1	31.0	7.5	676
Philippines	68.5	2.3	185.0	4.5	2,800
Thailand	61.0	1.5	408.0	8.5	6,870
Vietnam	75.5	2.3	93.0	9.5	1,216
EAST ASIA					
China	1,215.5	1.2	3,172.0	10.2	2,660
Japan	125.6	0.3	2,668.0	2.5	21,350
Korea (South)	45.2	0.9	468.0	6.8	10,534
Mongolia	2.5	2.7	5.3	6.3	2,115
SOUTH PACIFIC					
Australia	18.2	1.2	340.0	3.1	19,007
Fiji	0.8	1.5	4.3	2.2	5,590
New Zealand	3.5	1.0	60.0	3.2	17,045
Papua New Guinea	4.3	2.3	10.0	-4.8	2,470

Source: Asiaweek Magazine. June 1996.

Table 2. - Land and Population, Asia-Pacific, 1996.

Country	Total Land Area (Million Ha)	Total Population (Million Persons)	Land Per Capita (Ha/Person)	Population Density (Persons/Sq. Km.)
SOUTH ASIA	**409.15**	**1,228.7**	**0.33**	**300**
Bangladesh	14.60	122.7	0.12	840
India	297.32	933.90	0.32	314
Nepal	13.68	21.70	0.63	159
Pakistan	77.09	132.20	0.58	171
Sri Lanka	6.46	18.20	0.35	282
SOUTH EAST ASIA	**434.07**	**485.1**	**0.89**	**112**
Cambodia	17.65	10.20	1.73	58
Indonesia	181.16	197.60	0.92	109
Laos	23.08	4.80	4.81	21
Malaysia	32.86	20.30	1.62	62
Myanmar	65.80	47.20	1.39	72
Philippines	29.82	68.50	0.44	230
Thailand	51.09	61.00	0.83	119
Vietnam	32.55	75.50	0.43	232
EAST ASIA	**1,089.28**	**1,218.0**	**0.89**	**112**
China	932.64	1,215.50	0.77	130
SOUTH PACIFIC	**51.33**	**5.73**	**8.96**	**11**
Fiji	1.83	0.80	2.28	44
Papua New Guinea	45.29	4.30	10.53	9
Solomons	2.80	0.32	8.75	11
Vanuatu	1.13	0.15	7.53	13
Western Samoa	0.28	0.16	1.75	57

Sources: National Forestry Action Programmes, Update No. 32, July 1995, FAO, Rome. Asiaweek, June 1996.

Table 3. - Deforestation and Reforestation Rates, Selected Asia-Pacific Countries, 1990.(1,000 Ha)

Region /Country	Annual Deforestation	Annual Reforestation	Total Forest Plantations	Other Wooded Lands
SOUTH ASIA				
Bangladesh	38	12.3	235	468
Bhutan	16	0.2	4	355
India	339	1,009.0	13,320	17,689
Nepal	54	4.3	56	672
Pakistan	77	4.2	168	1,105
Sri Lanka	27	6.0	139	2,113
SOUTH EAST ASIA				
Cambodia	131	331.8	7	1,554
Indonesia	1,212	0.1	6,125	29,434
Laos	129		4	8,259
Malaysia	396	6.3	81	4,584
Myanmar	401	19.6	235	20,683
Philippines	316		203	5,606
Thailand	515	29.4	529	1,704
Vietnam	137	49.0	49	13,171
EAST ASIA				
Mongolia	60			4,335
SOUTH PACIFIC				
Fiji	4	5.0	78	6
Papua New Guinea	113	1.5	30	6,085
Solomons	5	0.3	16	45
Vanuatu	8	0.4	7	0
Western Samoa	2	0.5	9	31

Source: National Forestry Action Programmes, Update No. 32, July 1995, FAO, Rome.

Table 4. - Forest Resources of Selected Asia-Pacific

Country	Natural Forest (1,000 ha)	Forest Plantations (1,000 ha)	Total Forest (1,000 ha)	Proportion of Land Forested (%)	Forest Per Capita (Ha/Person)
WORLD			**3,442,369**	**27**	**0.64**
ASIA PACIFIC		**56,057**	**565,724**	**19**	**0.19**
SOUTH ASIA	**61,122**	**13,828**	**74,950**	**18**	**0.06**
Bangladesh	769	235	1,004	8	0.01
India	51,729	13,230	64,959	22	0.08
Nepal	5,023	56	5,079	37	0.27
Pakistan	1,855	168	2,023	3	0.02
Sri Lanka	1,746	139	1,885	29	0.11
SOUTH EAST ASIA	**210,202**	**8,654**	**218,856**	**50**	**0.45**
Cambodia	12,163	7	12,170	69	1.48
Indonesia	109,549	6,125	115,674	64	0.64
Laos	13,173	4	13,177	57	3.24
Malaysia	17,583	81	17,664	54	1.02
Myanmar	28,856	235	29,091	44	0.70
Philippines	7,831	203	8,034	27	0.13
Thailand	12,735	529	13,264	26	0.24
Vietnam	8,312	1,470	9,782	30	0.15
EAST ASIA			**179,824**	**16**	**0.12**
China	101,968	31,968	133,799	14	0.12
Korea (North)	4,700	1,470	6,170	51	0.28
Korea (South)	6,291	n. a.	6,291	64	0.15
Japan	n. a.	n. a.	24,158	66	0.20
Mongolia	9,406	n. a.	9,406	6	4.29
SOUTH PACIFIC					
Australia	n. a.	n. a.	39,837	5	2.33
Fiji	775	78	853	47	1.17
New Zealand	n. a.	n. a.	7,472	28	2.23
Papua New Guinea	36,000	30	36,030	80	8.98
Samoa (West)	124	9	133	47	0.84
Solomons	2,394	16	2,410	86	7.53

Source: Forest Resources Assessment 1990: Global Synthesis, FAO, Rome, 1995.

Table 5. - Roundwood and Woodfuel Production, Selected Asian Countries, 1992.(1,000M^3)

Country	Total Roundwood Production (including fuelwood)	Total Woodfuel Production*	Share of Woodfuel (%)
TOTAL	**1,040,453**	**819,051**	**79**
SOUTH ASIA	**371,263**	**342,051**	**92**
Bangladesh	31,907	31,014	97
Bhutan	1,610	1,332	83
India	282,359	257,789	91
Nepal	19,591	18,971	97
Pakistan	26,567	24,379	92
Sri Lanka	9,229	8,566	93
SOUTHEAST ASIA	**372,630**	**273,200**	**73**
Indonesia	185,630	146,300	79
Laos	4,400	4,100	93
Malaysia	54,010	9,200	17
Myanmar	22,730	18,600	82
Philippines	38,650	35,000	90
Thailand	37,590	34,800	93
Vietnam	29,620	25,200	85
EAST ASIA			
China	296,560	203,800	69

* Combines fuelwood and charcoalSource: RWEDP Wood Energy News, Vol. 11, No. 2, June 1996, FAO/RAP, Bangkok.

Table 6. - Trends in Pulpwood Production, Selected Asia-Pacific Countries.(1,000M^3)

Countries	1981	1985	1990	1992	1995
SOUTH ASIA					
Bangladesh	63	76	69	69	69
India	1,208	1,208	1,208	1,208	1,208
Sri Lanka	31	31	75	75	75
SOUTH EAST ASIA					
Indonesia	468	200	200	200	200
Malaysia	613	613	613	613	788
Philippines	496	368	335	487	136
EAST ASIA					
China	4,652	6,610	7,997	7,887	7,718
Japan	10,188	12,721	10,313	9,050	5,971
Korea, Rep.	289	293	410	463	463
SOUTH PACIFIC					
Australia	6,411	7,419	8,032	7,925	9,383
New Zealand	3,766	3,645	4,581	4,586	4,402
Papua New Guinea	218	218	175	175	175

Source: Forest Products Yearbook, FAO, Rome, 1992, 1995.

Table 7. - Trends in Fuelwood Production, Selected Asia-Pacific Countries. (1,000M^3)

Country	1981	1985	1990	1992	1995
SOUTH ASIA					
Bangladesh	23,582	26,224	29,557	29,300	31,310
India	190,645	207,685	229,233	259,233	274,272
Nepal	13,884	15,566	17,778	18,700	20,202
Pakistan	16,334	18,685	21,923	25,609	28,116
Sri Lanka	7,308	7,808	8,345	8,607	8,925
SOUTH EAST ASIA					
Cambodia	4,261	4,764	5,421	6,141	6,725
Indonesia	117,302	127,339	140,239	144,392	151,228
Laos	2,465	2,716	3,175	4,133	4,511
Malaysia	4,984	5,537	6,319	9,164	9,819
Myanmar	14,733	16,019	17,846	18,750	20,450
Philippines	26,737	29,652	33,422	34,310	36,540
Thailand	26,442	28,378	30,312	35,382	36,502
Vietnam	19,880	21,689	24,147	28,510	30,470
EAST ASIA					
China	93,872	101,602	112,171	196,152	204,059
Japan	383	325	103	384	360
Korea (South)	2,081	1,492	1,492	1,492	4491
Mongolia	135	135	135	361	376
SOUTH PACIFIC					
Australia	1,280	2,100	2,100	2,892	2,898
Fiji	28	37	37	37	37
New Zealand	50	50	50	50	50
Papua New Guinea	5,533	5,533	5,533	5,533	5,533
Solomons	106	122	138	138	138

Source: Forest Products Yearbook, FAO, Rome, 1992, 1995.

Table 8. - Quantity and Value of Fuelwood Consumed, Selected Asian Countries, 1991.

Country	Fuelwood Consumed (million tons)	Value (million US$)*
Bangladesh	7.7	306
Bhutan	0.9	37
China	233.0	9,320
India	227.0	9,080
Indonesia	57.9	2,317
Laos	2.2	88
Malaysia	0.8	31
Maldives	0.1	3
Myanmar	22.9	914
Nepal	11.7	469
Pakistan	33.0	1,318
Philippines	15.5	618
Sri Lanka	10.9	436
Thailand	10.8	432
Vietnam	28.5	1,139
Totals	662.9	26,506

*Ave. value = US$40/TonAdapted from RWEDP Wood Energy News, Vol. 11, No. 2, June 1996, FAO/RAP, Bangkok.

Table 9. - Trends in Biomass Energy Consumption in Asia.(In Peta Joules = 10^{15} Joules)

Country	Consumption		% Increase
	1981	1991	
Bangladesh	243	277	14.0
Bhutan	7	12	71.4
China	1,541	2,018	31.0
India	2,165	2,824	30.4
Indonesia	1,181	1,465	24.0
Laos	29	39	34.5
Malaysia	69	90	30.4
Myanmar	156	193	23.7
Nepal	113	206	82.3
Pakistan	192	296	54.2
Philippines	308	382	24.0
Sri Lanka	70	89	27.1
Thailand	484	526	8.7
Vietnam	197	251	27.4
Total	6,755	8,666	28.3

Adapted from: WRI, 1995, as cited in RWEDP Wood Energy News, Vol. 11, No. 2, June 1996, FAO/RAP, Bangkok.

Table 10. - Trends in Roundwood Production Selected Asia-Pacific Countries, 1981 to 1995(1, 000M^3)

Country	1981	1985	1990	1992	1995
SOUTH ASIA					
Bangladesh	24,472	27,069	30,434	30,011	32,044
Bhutan	1,326	1,418	1,550	1,387	1,399
India	208,783	228,853	250,846	283,831	299,163
Nepal	14,424	16,106	18,328	19,320	20,822
Pakistan	16,919	19,770	24,102	28,259	29,665
Sri Lanka	7,951	8,493	9,008	9,271	9,625
SOUTH EAST ASIA					
Brunei	281	293	294	294	295
Cambodia	4,823	5,326	6,018	6,876	7,765
Indonesia	143,025	153,432	175,095	183,130	185,894
Laos	2,639	3,053	3,570	4,490	5,508
Malaysia	36,798	35,397	47,279	54,204	45,573
Myanmar	18,497	19,215	21,513	22,850	23,281
Philippines	34,515	35,365	38,415	38,140	39,857
Thailand	30,472	32,648	33,362	38,167	39,288
Vietnam	22,755	25,898	28,640	32,977	34,913
EAST ASIA					
China	122,223	136,778	144,979	288,944	300,360
Japan	11,612	12,711	9,854	27,498	23,257
Korea (South)	2,759	2,072	2,064	6,485	6,485
Mongolia	185	185	185	487	541
SOUTH PACIFIC					
Australia	12,768	13,161	12,365	19,546	22,458
Fiji	224	219	210	307	598
New Caledonia	11	11	11	6	5
New Zealand	293	174	192	15,065	17,155
Papua New Guinea	6,935	7,589	8,124	7,997	8,772
Samoa	131	131	131	131	131
Solomons	458	542	468	468	872
Vanuatu	33	45	58	63	63

Source: FAO Yearbook, 1991, 1992, 1994, 1995.

Table 11. - Actual and Projected Wood Consumption, Asia-Pacific, 1993-2010.

Country/Region	Fuelwood and Charcoal (1,000 M^3)		Industrial Roundwood (1,000 M^3)	
	1993	2010	1993	2010
SOUTH ASIA				
Bangladesh	31,774	35,012	739	1,196
Bhutan	1,364	1,575	127	167
India	262,782	302,387	24,930	44,123
Nepal	19,440	22,647	620	830
Pakistan	25,021	31,076	2,823	3,885
Sri Lanka	8,703	10,339	670	1,414
SOUTHEAST ASIA				
Brunei	79	39	217	269
Cambodia	5,880	7,790	759	1,266
Indonesia	149,063	180,146	38,409	73,519
Laos	4,254	4,278	614	656
Malaysia	9,375	*8,523	35,457	77,875
Myanmar	19,156	23,227	2,219	5,199
Philippines	35,980	40,635	4,112	8,141
Thailand	35,313	39,735	3,811	6,197
Vietnam	28,984	37,030	4,419	8,293
EAST ASIA				
China	200,060	255,839	104,601	193,587
Japan	361	*270	70,418	82,724
Korea (North)	4,230	4,854	503	890
Korea (South)	4,491	5,801	10,516	7,814
Mongolia	445	*427	408	952
SOUTH PACIFIC				
Australia	2,898	*1,629	11,012	22,686
Fiji	37	41	115	412
New Zealand	50	28	10,985	16,832
Papua New Guinea	5,533	6,008	727	3,522
Samoa	70	80	61	76
Solomons	138	144		399
Vanuatu	24	26		54

* Projections lower than actual consumption of fuelwood and charcoal

Source: Forestry Statistics Today for Tomorrow, FAO, Rome, 1995 (for 1993); FAO Provisional Outlook to 2010 (1997) for FAO 2010 (scenario 2)..

Table 12. - Projected Fuelwood Consumption/Production, Selected Asia-Pacific Countries

.

Country	Population	Population	Fuelwood Consumption - million cu m			
	1996 [1]	Growth [1]	Actual	Projected Year 2010		
	(million)	(%)	1993 [2]	FAO [2]	High* [3]	Low* [4]
SOUTH ASIA						
Bangladesh	122.7	2.2	31.77	35.01	46.01	40.92
India	933.9	2.1	262.78	302.39	347.20	338.50
Nepal	21.7	2.3	19.44	22.65	28.60	25.00
Pakistan	132.2	2.9	25.02	31.08	40.68	35.00
Sri Lanka	18.2	1.2	8.70	10.34	10.66	10.70
SOUTH EAST ASIA						
Indonesia	197.6	1.6	49.06	180.15	195.27	176.50
Laos	4.8	2.9	4.25	4.28	6.91	5.95
Malaysia	20.3	2.4	9.38	8.52	14.04	11.10
Myanmar	47.2	2.1	19.16	23.23	27.28	24.70
Philippines	68.5	2.3	35.98	40.63	52.96	46.30
Thailand	61.0	1.5	35.31	39.73	45.48	41.80
Vietnam	75.5	2.3	28.98	37.03	42.66	34.30
EAST ASIA						
China	1,215.5	1.2	200.06	255.84	245.07	236.90
Mongolia	2.5	2.7	0.45	0.43	0.70	0.62
SOUTH PACIFIC						
Fiji	0.8	1.5	0.37	0.04	0.05	0.05
New Zealand	3.5	1.0	0.05	0.03	0.06	0.06
Papua New Guinea	4.3	2.3	5.53	6.01	8.14	7.7
Solomons	0.32		0.14	0.14		0.19
Vanuatu	0.15		0.02	0.03		0.03

* Author's estimates.

[1] Source: Asiaweek, June 6, 1996.

[2] FAO, 1995. Statistics Today for Tomorrow; FAO 1997: Provisional Outlook to 2010 (for FAO 2010 scenario 2)..

[3] Based on Population Growth

[4] Influenced by: population, income, government policies

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