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FOREWORD

In the recent past it has become abundantly clear that for most developing countries sustained growth and development can be achieved only through involving the mass of the population who live in the rural areas. Development must mean the mobilization of the energies of rural people and of the resources of the rural areas. Development strategies must therefore be directed to enabling rural people to escape from their present poverty.

This increasing focus on rural development has heightened understanding among governments and planners as well as foresters - of the importance of the contributions of forests and forest outputs to the rural sector, and to its development. However, this has also drawn attention to the need for changes in the way forests are controlled and managed. Strategies must be developed within the forest sector which add a social objective to the traditional production and protection objectives. The satisfaction of the needs of local people should have equal status with that of the production of timber for industry and the conservation of environmental stability. The practice of forestry has to be organized in such a way as to involve rural people as fully as possible. The aim must be fully integrated management of the forest resource.

The forestry profession has reacted energetically to this challenge. Over the past few years much has been learnt about what has to be done. The present paper is intended to provide a review of the present situation and state of knowledge. It describes the linkages between the forest sub-sector and the rural sector as a whole, the problems and constraints to be overcome, the fresh approaches being explored which indicate how the potential of forestry can be realized, and the needs for action.

The paper was prepared for, and first appeared in, FAO's annual report "The State of Food and Agriculture, 1979". It is therefore primarily addressed to the wide audience of persons concerned with development who draw upon that publication. It is being reproduced now in FAO's Forestry Paper series in order to make it more widely and easily available to a forestry audience as well. The paper has been prepared by staff of FAO's Forestry Department together with P. Stewart of the Commonwealth Forestry Institute, Oxford.

M.A. Flores Rodas
Assistant Director-General
and
Head of the Forestry Department

TABLE OF CONTENTS

LIST OF TABLES

FORESTRY AND RURAL DEVELOPMENT

INTRODUCTION

Until recently, rural development was generally considered from the point of view of food and agricultural production. Forestry tended to be regarded as a separate and isolated sector of interest only if it were possible to promote wood production for export or domestic industry or necessary to regulate water supply or control erosion. Attention was focused on the control of dense forests or on the creation of large plantations. Forest resources were treated as unutilized capital to be mobilized mostly for investment in other sectors of the economy. The harvesting and sale of commercial timber grew rapidly but the net flow of capital into producing countries was much less impressive. Most timber was exported, and continues to be exported, as roundwood raw material so that no potential added value was retained in the country. Mechanized harvesting methods required considerable amounts of imported equipment and other inputs, and in some cases a large part of the profits accrued to foreign owners or partners 1/. The local people frequently lost access to the land taken over for forest estates or plantations but which had formerly enabled them to meet their own needs. As they could not adopt the new technology because of its complexity and expense, most of them were worse off than before. Indeed, there was a tendency to regard them almost as enemies from whom the trees had to be protected. On the other hand, in areas where wood was in great demand but trees were scarce, foresters were not to be found though their advice and assistance could have been invaluable.

The overall development policy had favoured industries and urban areas, leaving the basic rural problems unresolved. The influx of rural migrants seeking better jobs has been far greater than the numbers that could be absorbed so that immense burdens were imposed on the economic and social fabric of the urban areas. At the same time the emphasis on urban development left untouched the problems of poverty in rural areas where the majority of the people in developing countries live.

There is now increasing effort to solve some of these problems through a comprehensive rural development approach. In the words of President Nyerere of Tanzania at the World Conference on Agrarian Reform and Rural Development in July 1979: "A policy of rural development is a policy of national development. You cannot have 'rural development' as an extra, tagged on to the other policies of Government. That would be a continuation of what we have been doing until now. Rural Development must be a description of the whole strategy of growth - the approach to development, and the prism through which all policies are seen, judged, and given priority".

At the same Conference it was recognized that "diversification of rural economic activities, including integrated crop-livestock development, fisheries and aquaculture and integrated forestry development, is essential for broadbased rural development" 2/.

This new approach has some major policy implications for forestry. The advantages of wood as a renewable resource, the presence in forests of some 90% of continental biomass and 60% of continental primary production 3/, and the absence of sustainable alternative uses for many soils make forestry an essential element in development.

1/ Hansjürg Steinlin. The role of forestry in rural development, Applied Sciences and development, 13, 1979, p. 11.

2/ FAO. World Conference on Agrarian Reform and Rural Development, Rome 12-20 July 1979, Report, Rome, 1979, p. 3.

3/ H. Lieth and R.H. Whitaker (ed.), Primary Productivity of the Biosphere, Springer Verlad, Berlin, 1973.

The Jakarta Declaration, adopted in 1978 by the Eighth World Forestry Congress (the theme of which was "Forest for People"), states that "the Congress paid particular attention to the role which forests can play in improving the conditions for agricultural and livestock production, for instance through shelterbelts, regulation of waterflow, erosion control, as well as a source of supplementary animal fodder in dry periods". 4/ None of these contributions is a new discovery. The novelty lies in a more widespread recognition of the potential of forestry support for agriculture, especially as regards the small farmer. The availability of hitherto little known species with high growth rates and multiple uses bring results far earlier than seemed possible before.

In the past, priority for the policing of marketable forests and for the establishment of industrial plantations has resulted in insufficient attention to the protection of commercially less valuable woodlands and of trees outside forests. Recent FAO studies 5/ indicated that the world is currently losing about 7 million ha a year of closed tropical forest, out of a total of more than 1,100 million ha. Considerable areas of open woodland are also being deforested, and it is these open areas that are closest to rural populations. Lack of healthy relations between foresters and forest neighbours (agriculturists) has added to the difficulty of safeguarding resources, and the compartmentalized sectoral division of forestry and agricultural services has hindered collaboration in promoting integrated forms of land use where the production of trees, annual crops and livestock are combined.

There are many political, economic, institutional and technical problems to be overcome before all wood-hungry communities can be helped to produce trees, before agriculture and forestry can reach their appropriate level of integration, and before all those lands that are or should be forested can be protected and managed. These activities are, however, complementary. The economic and social development of farming people will take much of the pressure off forests, and the improvement of forestry will contribute directly or indirectly to the well-being of the whole nation.

The next section of this chapter analyzes some of the principal benefits that forestry can provide and the threat to the future if appropriate national forest policies are not adopted. The elements required in a new balanced development are then described with examples of successful activities that could be more widely diffused in the future. A framework is outlined for action that could lead to a fuller contribution of forestry to rural development.

HISTORICAL CONTEXT

In earliest times when both density and rate of growth of population were very low the forests were a ready source of food, fuel and materials for mankind. However, as population grew and society became more industrialized and urbanized, the situation also increased in complexity.

In the developed countries the forests have become primarily suppliers of wood to industry, and providers of secondary benefits as recreation areas for the urban population. Agriculture has become heavily dependent on non-renewable energy-intensive inputs, such as chemical fertilizers and farm machinery, and the use of forest products by the rural population is little more than that by the urban population. The competition for land use does not appear to be acute any more. In western Europe, for example, the area under forests has increased by about 10% during the last 15 years and it seems that there are seldom any major conflicts with other potential users of the land.

4/ FAO "Jakarta Declaration". Final Document, 8th World Forestry Congress, Rome, p. 1 (para. 5).

5/ J.P. Lanly and J. Clément. Present and Future Forest and Plantation Areas in the Tropics, FO: Misc/79/1, FAO, Rome, January 1979.

In the developing countries the situation is quite different. Over half the population still live in rural areas and are primarily engaged in agriculture. In some places the high density of population is leading to a shortage of available land for cultivation and the forests are being cleared increasingly rapidly. Where the search for land has been pushed into areas with steep slopes or shallow top soils, erosion and soil degradation had nearly always been the inevitable result. Furthermore, increasing quantities of tropical timber are being extracted for export and for use in local industrial undertakings. It has frequently happened that neither the logging companies nor the forest authorities have ensured regeneration or replanting. Furthermore, forest services are usually insufficiently funded and staffed to cope with these problems. The potential supply of forest products to which rural people have been accustomed, and especially the fuelwood which is their main source of energy, has consequently been greatly reduced.

It is unproductive to try to apportion blame for what has gone wrong in the past. What is important now is that the progressive deterioration of land caused by deforestation should be arrested andthat the potential contribution of forestry to development should be fully exploited. The fact is that the essential role of forestry in integrated rural development has not yet been sufficiently understood.

THE ROLE OF FORESTS

There are three main ways in which forestry contributes to rural development:

- maintaining its ecological balances,
- increasing the supply of products for local consumption, and
- improving the benefits from industrial uses of timber.

These are illustrated in Figure 1 and apply as much to developed as to developing countries, though this chapter is concerned with their implications for developing countries unless specifically stated otherwise.

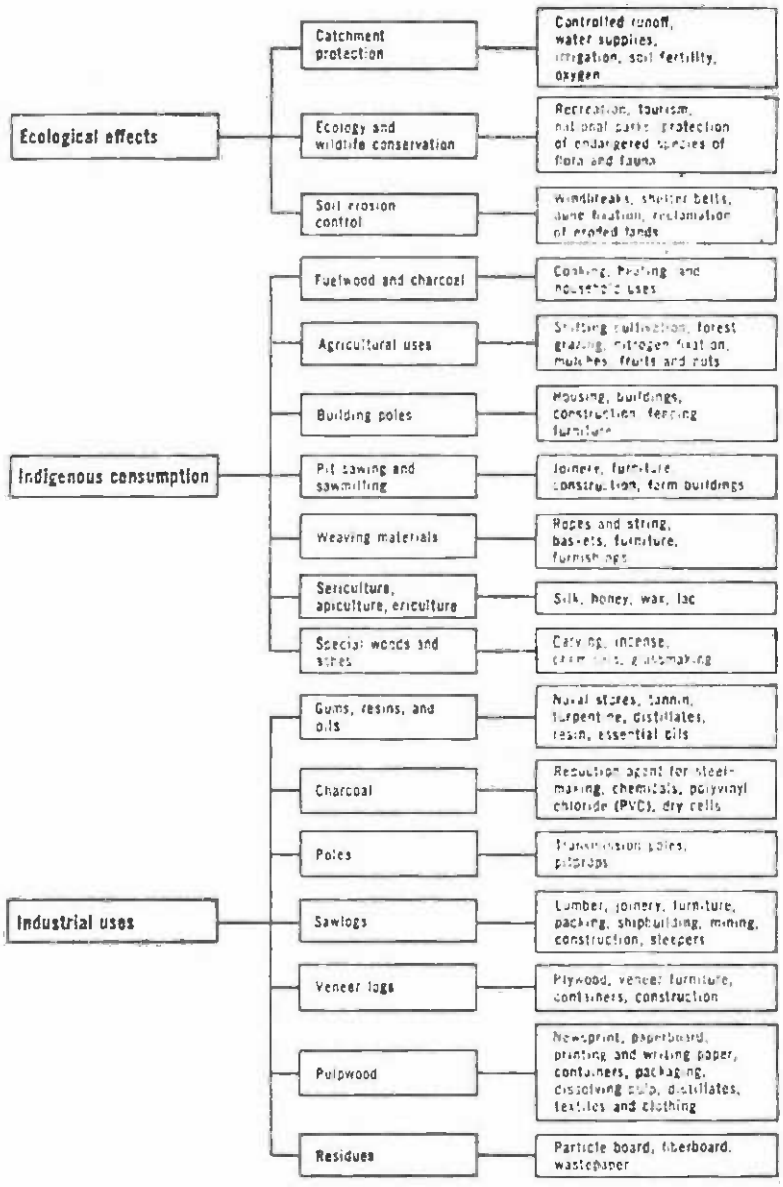
Under "ecological effects" are included some of the major conservation measures necessary to ensure catchment protection, soil erosion control and the maintenance and safeguarding of supplies of usual species of flora and fauna. All these factors are of concern to the maintenance of a viable farming system, the products of which are included under "indigenous consumption". The supply of fuelwood and charcoal is the main source of energy for the rural population and is also important in many places to the urban communities. Local supplies of forest products are the principal sources of building materials, fencing and furniture in rural areas; and in some places other products such as honey, silk and wood for carving are major sources of income.

How far trees which can be used for industrial purposes can bring an income to the rural dwellers depends in part on the employment possibilities in felling and extraction. More importantly, it depends on the economies of location of the processing plant and in particular whether the costs of transport of the logs are greater than the costs of transporting the finished product.

FORESTRY AND AGRICULTURE

The ecological effects of forestry are of vital importance to rural development in general and agricultural development in particular. Because of their sheer size, trees have a major role to play in the cycle by which nutrients pass from the soil through plants and animals back to the soil. The slow removal of nutrients through leaching by rainwater is compensated by the steady release of minerals through the weathering of the underlying rock. Tree roots reach far down, bringing up water and nutrients from depths that few smaller plants can reach. In addition, many tropical species of trees belong to the family of Leguminosae whose roots harbour bacteria that enable nitrogen to be fixed from the atmosphere. The canopy of foliage protects the soil from the direct impact of sun, rain and wind, and the falling leaves and fruit provide a regular flow of nutrients.

Figure 1. The role of forests



Source: World Bank. Forestry: Sector Policy Paper, Washington, D.C. February 1978, p. 16.

Forest vegetation also strongly influences the stream flows on watersheds by intercepting rainfall so that it reaches the forest floor more gently and does not cause compaction. The presence of litter and humus further enhances the infiltration into the soil, which is a key hydrological property affecting surface run-off. Deep and large root nets, both living and decayed, act as underground storage which maintains the yield and quality of water, thus shortening the dry season and attenuating its damage. The reduction of surface water run-off also means fewer and less violent floods.

The establishment of agriculture tends to break this cycle. Scarce nutrients are concentrated in the very parts of crop plants that are removed for human consumption, and the transfer of elements from deeper layers to the top-soil is reduced. The surface is laid bare between harvest and sowing, often when the sun is hottest or storms most violent. Forest exploitation, unless very intensive, is quite different in its effects, for wood is precisely that part of the tree in which nutrients are least abundant. The drain on the system can be further reduced if not only leaves and small branches but also the nutrient-rich bark is removed from logs before transport. The baring of the soil is much less frequent and less complete than in agriculture.

The oldest known system for restoring the fertility of agricultural soil is non-continuous cultivation. After two or three years of cropping, the site is abandoned and natural vegetation returns. Under moist tropical conditions forest rapidly re-establishes itself and the nutrient cycles are restored, making it possible to clear the trees and plant new crops after 10 to 20 years. In temperate regions the return of the forest is slower, but it is not necessary to wait so long before recultivating, because the rate at which nutrients are lost under agriculture is slower in a mild climate. Before the introduction of crop rotations and manuring, temperate zone farmers therefore practised a short fallow which did not revert to forest, and which they were able to use for low intensity grazing.

It has been estimated that between 1957 and 1977 the number of people living by non-continuous cultivation in tropical forests increased from about 200 million to about 240 million people, or some 30% of the total population of the zone. 6/ The density of settlement varies greatly from locality to locality according to population pressure and to soil and rainfall, from about 3 to 300 persons per km^2.

Increasing demand for food has been met partly by moving into new areas of forest, and partly by shortening the fallow period, or even eliminating it and going over to continuous cultivation. Both processes lead to a decline in productivity. Newly cleared sites were often not used before precisely because they were less suitable, and existing sites yield less as the fallow is reduced. The process is further aggravated by the tendency to cultivate the soil for longer periods and more thoroughly, before releasing it to fallow. Tree roots, suckers and seeds are thus destroyed, permitting weeds rather than forest to colonize the area. In this manner tens of millions of hectares of forest land in southeast Asia have been lost to alang-alang grass. The expansion of such waste lands together with falling productivity, increases the demand for fresh land in a vicious circle of deforestation and site deterioration.

In more arid zones, grazing rather than cultivation is the principal use to which forest land is transferred. At a low intensity, the introduction of animals into forests is not harmful, and may even confer benefits by stimulating the nitrogen cycle and preventing ground vegetation from building up to become a fire hazard. Increasing grazing pressure, however, prevents the regeneration of woody species, and causes the slow conversion of forest to savanna or grassland. The process is often speeded up by deliberate firing to obtain a short-lived burst of grass production. This is a very ancient phenomenon and has long since reduced the forests of arid regions to mere relics.

6/ UNESCO. Tropical Forest Ecosystems, Natural Resources Research XIV, Paris, 1978, p. 469.

The removal of forests for crop or livestock production has in many cases been disastrous, exposing the soil to destruction by rain, wind and sun. Unintercepted rain reaches the soil faster, and as a bare surface absorbs rain more slowly, more water runs off, carrying soil particles which in turn add to the water's erosive power. Erosion is worst where there is a pronounced dry season, where people or grazing animals trample the ground, where there are mountains, and where there is heavy precipitation in a short period. These conditions are often combined in the developing countries, particularly those with a monsoon climate. In the driest lands, similar destruction is effected by wind erosion.

Erosion not only destroys the soil that has been cleared, but also inflicts grave damage on land, crops and structures downstream or downwind. Irrigation and drainage channels may become choked and dams blocked with silt. Much water is lost to both farming and forestry by runoff to the sea or to underground deposits instead of being stored in the soil for slow release. Likewise, sand and dust storms can cover farmland with sheets or dunes.

Erosion is not the only process that robs soil of its fertility. Rain leaches nutrients down from surface layers and, if they are not speedily taken up by roots and returned to the surface in the form of plant and animal debris, they are removed from the system by groundwater.

Though large amounts of forest are being transferred to agriculture, much agricultural land is at the same time being lost through erosion and soil degradation. Reliable statistics are not available, but many experienced people believe that the net effect has been to reduce the total potential world farming area. There are, of course, cases in which one country's loss has been another's gain, for example the Nile Valley's former fertilization by silt from east Africa, but such examples are exceptional.

Though it has not been proved that deforestation has a substantial local effect on rainfall, there is evidence that the cumulative effect on the global atmospheric cycles of water and energy may be considerable. Similarly, the exact contribution of deforestation and forest burning to the increase of carbon dioxide in the atmosphere is not yet known. At the local level it is clear that the presence of trees affects microclimate, lowering extremes of air temperatures, raising humidity, and reducing wind speeds at surface level. These bring a substantial reduction in the rate of water loss from field crops, and hence an increase in agricultural productivity. The inclusion of shelter belts and windbreaks must therefore be regarded as an integral part of farming. In addition to increasing the yield of crops and livestock they have the further advantage of producing fuelwood as well. The more adverse the climatic conditions, the more substantial the effects of shelterbelts.

ENERGY FROM THE FOREST

About 80% of all the wood cut in developing countries is used as fuel. A special estimate made for 1974 showed that fuelwood constituted about a quarter of the total energy consumed in these countries though the proportion varied widely from under 10% in the Asian centrally planned economies to nearly 60% in the Africa region (Table 1).

In the developing countries, the greater part of the 2,000 million or so people who live in the rural areas depend mainly, and often wholly, on fuelwood for cooking and heating. Apart from domestic use, it is also the principal source of energy for many rural industries, such as potteries, brickworks, smithies and the curing of meat, fish and tobacco.

Table 1. Fuelwood and roundwood consumption and energy from fuelwood, developing countries, 1974

	Total roundwood	Fuelwood Total	Fuelwood Share of roundwood	Commercial energy	Energy from fuelwood 1/ Total	Energy from fuelwood 1/ Share of total 2/
	.... x 10^6 m^3....		... % ...	x 10^{15} joules		%
Developing market economies	1,336	1,145	86	22,038	11,074	33
Africa	299	268	90	1,848	2,594	58
Far East	668	577	86	7,577	5,579	42
Latin America	298	244	82	9,383	2,358	20
Near East	71	56	79	3,230	543	14
Asian centrally planned economies	206	154	75	16,790	1,485	8
TOTAL DEVELOPING COUNTRIES	1,542	1,299	84	38,828	12,559	24

1/ Assuming 1 m^3 of fuelwood contains 9.67 x 10^9 joules. - 2/ Commercial energy plus energy from fuelwood.

Source: FAO. The State of Food and Agriculture 1976. Rome, 1977, p. 90.

In the form of charcoal wood is a fuel for many of the 500 million urban dwellers in developing countries. It is also used in small enterprises in towns such as bakeries and laundries. The production of charcoal by traditional methods is, however, very wasteful, since 50% to 80% of the energy content of wood is lost in the process of carbonization. To supply a given amount of energy in charcoal therefore requires from two to five times as much wood and correspondingly more forest. In some cases, villagers have been forced by the need to earn income to produce charcoal for sale to urban markets instead of conserving their wood resources to meet their own future needs.

Population growth and rising levels of living have caused many forests to be used faster than they can regenerate themselves. Ideally, only fallen branches are taken for fuel. They are already air dry and yield more energy per unit of weight. Above all, their removal does not affect forest growth. As demand rises, however, pressure grows to lop or fell living trees, legally or illegally, and over-exploitation can rapidly destroy not only the forest but any residual woody vegetation. The process is exacerbated by some of the new methods of agriculture. Mechanization and monoculture both encourage the disappearance of intercropping systems employing trees, which are a feature of much traditional agriculture. More productive strains of coffee and tea have been evolved which grow better in the open than under a canopy of shade trees.

The search for firewood is one of the main causes of deforestation in the vicinity of human settlements and the consequence is that people have to go further to find wood. It is not uncommon now for villagers to have to spend a whole day going to a source of wood, collecting it and bringing it back, only to have a few days' supply. It has been estimated that in some areas of east Africa it now takes 250 to 300 man-days a year of labour to supply household with firewood. 7/ This is a task for women in many societies and the growing labour burden is therefore a major impediment to the improvement of their lot.

7/ E.M. Mnava. Village afforestation in Dodoma District. Background Paper for the Second FAO/SIDA Expert Consultation on Forestry for Community Development, Rome, 1977, p. 13.

In some areas where forest sources of fuel have been exhausted, and in the absence of any other alternative supplies of fuel being within reach, use has been made of other organic fuels, such as crop residues or dung. As organic manure is usually the only available soil conditioner, its use for burning lowers soil fertility. Thus, once again, the pressure on forestland contributes to declining agricultural yields.

The reduction in fuel supplies is also highly detrimental to nutritional levels 8/. None of the principal food crops is palatable or even fully digestible unless cooked. There are reports from a number of areas of peasant communities that now eat only one cooked meal a day where formerly they had two, and of the cultivation of vegetables than can be eaten raw in place of those that must be cooked. Reduced cooking times have been found in west Africa to decrease the biological availability of proteins in staple foods. 9/ In various countries the intestinal parasite loads have been observed to increase because of the ingestion of partially cooked meat as a result of shortages of fuel.

FOREST MATERIALS

Timber is a major element in the industrial economy as well as in the life of the rural population. It can in fact be used at any level of technology for a wide range of purposes from building materials, fencing and furniture, to farm implements, carts and water-wheels, even to carving.

At a higher levels of technology, timber is the raw material for a great variety of industries, including sawmilling and the manufacture of such products as plywood, block-board, particleboard, fibreboard, pulp, paper and paperboard, celluloid and rayon. Many species of tropical hardwood are greatly appreciated as decorative woods, or because of exceptional stability or durability, or their freedom from flaws and the ease with which they can be worked.

Between 1968 and 1978 the value of exports of industrial roundwood and forest products from the developing market economies rose more than fourfold (Table 2). Three quarters of the volume exported is in the form of logs, so that little of the value added accrues to the country of origin. 10/ However, recent developments indicate a faster growth of exports of processed products than of logs, with an increase in their share of the total value from 44% in 1968 to 51% in 1978.

Much of the exploitation of tropical hardwoods has taken the form of timber mining - the removal of all valuable material without concern for regeneration or improvement. Poorly conceived or badly drafted contracts have largely been responsible for tracts of forest being made over as concessions on short-term leases to logging companies without the prescription of conservation measures. Even where contracts were properly drafted many forest services have not been adequately staffed, equipped or organized to supervise their application. 11/.

8/ G. Poulsen. Wood-fuel and nutrition: the complementarity of tree cover and food supply, In Man and Tree in Tropical Africa, International Development Research Centre, Ottawa, 1978, p. 13.

9/ W.M. Floor. The energy sector of the Sahelian countries. Policy Planning Section, Ministry of Foreign Affairs, The Netherlands, p. 9.

10/ S.L. Pringle. Tropical moist forests in world demand, supply and trade, Unasylva, Vol. 28, nos. 112-113, 1976, pp. 106-118.

11/ F. Schmithüsen. Forest utilization contracts on public land in the tropics, Unasylva, Vol. 28, nos. 112-113, 1976, pp. 52-73.

Table 2 . Production, consumption and gross exports of industrial roundwood and forest products, developing market economies, 1968-78

	Industrial roundwood		Sawnwood		Panels		Paper	
	1968	1978	1968	1978	1968	1978	1968	1978
	million m^3				million metric tons			
Production	141	226	33	52	4.0	10.6	6.6	15.1
Consumption	118	189	31	50	2.8	8.0	10.5	19.9
Gross exports	29	48	5.5	9.3	1.7	4.0	0.5	1.3
	million $							
Value of gross exports	672	2,499	278	1,181	181	943	67	429

Source: FAO, Yearbook of Forest Products, 1978, Rome 1980.

The rural poor have gained very little from the rapid increase in the demand for wood for industry. Not being titular owners of commercial forests, even where they have been sole occupiers for generations, their only benefit from sales has been the opportunity for some employment. Being unable to compete with the prices paid by industrial buyers, they have lost their freedom to use the wood for their own needs. In those countries of south-east Asia, for example, where teak was the traditional building material, villagers now have to make do with inferior woods.

The cost of the increasing shortage of wood can be measured only partly in terms of the price of substitutes and the value of goods foregone. Many rural people have turned to alternatives such as metal or plastic which may be aesthetically displeasing but are nevertheless practical, durable and, not least, cheap. In some cases, such as that of metal cans salvaged from the industrial economy and beaten flat for use as roofing, the cost may even be negligible. There are, however, also less tangible losses involved in the decline of people's artifacts so necessary to maintain their identity and self-respect. Indigenous woodcraft and the traditional skills that go with it have often been victims of the shortage or high prices of the wood used as raw material. In the process, rural occupations such as carpentry have in many areas become depressed.

FOREST EMPLOYMENT AND INCOME

Though forest have diminished in area and access become more difficult, rural communities have had some compensating benefit from employment in forestry and forest-based industries. So far, there has been relatively little mechanization in forestry and logging, both because of the natural irregularity of trees and of the terrain on which they stand, and because of their frequent remoteness from sources of fuel and servicing for mechanical equipment. Foresters and loggers have relied greatly on manual labour for planting, tending, thinning, pruning, felling and extracting trees, as well as for the harvesting of products like cork and resin. Much of the processing of wood has also been carried out in the forest or in small local sawmills using labour-intensive methods. Table 3 illustrates the labour requirements for the primary processing of forest products in a number of tropical countries.

Employment on forest work can provide extra income for farmers during the slack season for crop production. Some of the work does not require much skill or training. It can be particularly convenient for remote forest communities, who would otherwise have to go to work far from their homes.

Table 3. Estimated labour requirements for primary processing of forest products

	Man-days per ha per year
Indigenous forest, Ghana	1.97
Indigenous hill forest, Malaysia	2.11
Indigenous swamp forest, Malaysia	1.66
Teak plantation, Nigeria	8.87
Teak plantation, Thailand	9.82
Albizzia plantation, Philippines	36.45
Gmelina plantation, Nigeria	28.77
Pine plantation, Malaysia (manual)	23.35
Pine plantation, Malaysia (mechanized)	17.35
Taungya, Nigeria (teak)	17.18
Taungya, Nigeria (Gmelina)	61.43
Taungya, Thailand (teak)	16.71
Tree farming, Philippines (Albizzia)	124.36
Rubber plantation, Malaysia	112.48

Source: Nils Svanqvist. Employment Opportunities in the Tropical Moist Forest Under Alternative Silvicultural Systems Including Agrisilvicultural Techniques, FAO, Rome, 1976, p. 67.

Unfortunately this is not always the case. Forest work may only be temporary employment, or available when there are also heavy seasonal demands for labour in agriculture. It may be far from the nearest villages, so that workers have either to camp for long periods away from home or to travel substantial distances each day. The wages are often insufficient to compensate for the potential dangers of felling and logging or the risks of heat stroke in plantation work without shade. 12/ Furthermore, they have usually been low in relation to those in other sectors, so that there have been many cases where sufficient labour could not be recruited for establishing or tending plantations.

Parallel with the growth of employment in commercial forestry, there has been a rapid increase in employment in the supply of firewood and charcoal to urban markets. 13/ This activity is often destructive, and in some cases illicit, and it is by no means clear that it can sustain the present levels of employment. Table 4 gives estimates of the magnitude of such employment in different parts of Africa. In Upper Volta the 325,000 man-days required to supply wood fuels to Ouagadougou generated income equivalent to $520,000, and further income of $2.5 million was generated from the transport and distribution of wood fuels.

The production of wood fuels for urban markets is also an important rural activity in many parts of Asia and Latin America. For example, charcoal production, for both industrial and urban markets, is one of the principal economic activities in the Chaco region in northern Argentina. Sales of fuelwood are an important source of income for the poor in forest villages in many parts of India, where it has been found that it is the poorest in the

12/ Olav Axelson. Heat Stress in Forest Work, FAO, Rome, 1974.

13/ J.E.M. Arnold, Wood Energy and Rural Communities, Eighth World Forestry Conference, Jakarta, 1978, p. 16.

Table 4. Estimated rural employment in the supply of wood fuels to selected urban markets in Africa

Urban market	Annual employment
Bamako, Mali, 1974	246,000 man-days full time 325,000 man-days part time
Ouagadougou, Upper Volta, 1975	325,000 man-days
Northern cities, Nigeria, 1974	16,700 man-years
Maputo, Mozambique, 1977	6,000 families
Ghana, 1974	45,000 persons 1/

1/ Total employment in commercial wood fuel production, distribution and marketing.

Source: Canadian International Development Agency. Study Mission on Forest Energy in the Sahel and West Africa, 20 October - 17 December 1974. Ottawa, 1974, p.57, 106, 134. Le déboisement en Haute Volta; les besoins de chauffe de Ouagadougou, Le Développement Voltaique, 40, 1976, unpublished FAO studies.

community, the landless and jobless, who depend on selling fuelwood. 14/ In a number of countries it is the poorest areas, where physical and climatic conditions do not permit the expansion of crop or animal production, and the natural woody vegetation is the only resource, in which sales of firewood are most important.

Employment in the production of both industrial wood and fuelwood is being increasingly threatened by new forms of mechanization as well as by the degradation and loss of forests, which are often worst in precisely those areas where surplus labour has the least opportunities for other work. Increasing mechanization has also reduced the labour requirements for logging. There have even been instances where tree-planting machines have been imported to work in areas of high rural underemployment, on the grounds that workers could not be recruited at the going rates and on the terms offered.

The most ubiquitous introduction has been the chain saw which is nearly always imported from industrialized countries and requires continuing imports of spare parts, lubricants and fuel. A two-man crew working in tropical conditions with axe and cross-cut saw can fell 10 to 20 m^3 day, whereas with a power saw their productivity rises to 30 to 80 m^3 a day. 15/ Working conditions in logging have been greatly improved by the chain saw and in financial terms the forestry sector has profited. The foreign-exchange costs and social costs, however, have been high.

What is true of the chain saw is even more true of the heavier machines, that have come into forestry, many of them capable of very substantially increasing the productivity of labour. The type of sylviculture, based on the uniform treatment of large areas, that such machines make possible or even require, is precisely that which does not need the skills of rural people, such as their knowledge of soils and plants and readiness to tend trees individually.

14/ B. Sivaraman, Forestry for Community Development (Village Forestry). Background Paper for the Second FAO/SIDA Expert Consultation on Forestry for Community Development, Rome, 1977, p. 26.

15/ R. Heinrich and H.A. Hilmi. The Training, Motivation and Social Promotion of Forest Workers. Eighth World Forestry Congress, Jakarta, 1978, p. 14.

The search for economies of scale has also caused much wood processing to leave the forest. Modern factories are mostly designed for large-scale centralized production, and the problems of providing adequate infrastructure and services have caused them usually to be sited in large towns. Sawmilling was perhaps the most despersed form of wood processing, with the widespread use of pit-sawing (the ancient practice of converting a tree to boards where it was felled with a hand-operated saw). However, today even a small-scale modern sawmill requires road access and a power supply, which usually means that it cannot be located in the remoter rural communities.

Though future demand for forest products will undoubtedly increase, greater efficiency may result in very few extra workers being employed; indeed, numbers may actually fall. However, the importance of employment in forestry lies not in its volume but in its location. Choice of appropriate technology and of processing operations is, therefore, crucial in ensuring that forestry contributes significantly to stability, employment and income in rural communities, particularly of developing countries.

ELEMENTS OF A NEW BALANCE

In their efforts to increase rapidly food and agricultural production, the developing countries will have to give due consideration to achievement of optimum and sustained productivity. It is urgently necessary to restore the balance (as has already been done in much of the temperate world) between soil formation and soil loss, between biological production and human consumption, between perennial and annual plants, between food and wood production, between exploited land and wilderness, and above all between the living levels of people in different regions and under different productive systems. Forestry has a vital role to play in restoring this balance.

The problems of shifting cultivation exemplified the sort of mutually supporting improvements that are needed. To help farmers settle permanently, technical and institutional support is necessary, including security of tenure in those parts of the forest more suitable for cultivation. The introduction of a planted fallow of appropriate species could provide additional output for local use, and (where the necessary infrastructure exists) for industrial or urban markets. Improved crop combinations for sustained production most relevant to the capability of the land and the people could improve their income from cultivation and lengthen the period between fallows.

The development of proper farming systems for many of the poorer soils is likely to require multi-storied or mixed associations of trees with crops on the same piece of land. Preference should be given to developing land use systems that are closest to traditional systems, and fit into existing socio-economic patterns. Credit would have to be extended to cover purchase of seeds and fertilizers. However, the need for external inputs can be limited by the use of draught animals, rotation with leguminous crops (either arboraceous or herbaceous), and the use of all locally available organic material for green manure and composting.

Another example concerns mountain regions which, with their steeper slopes and higher rainfall, are particularly subject to erosion. The process of erosion can be reversed effectively only through proper land use based on suitable cultivation practices and appropriate cropping patterns. This may require supplementary engineering measures, but since these are costly and do not last very long, the main emphasis should be on proper land use. If this is to succeed, it must have the cooperation of the local people. In the short run, they experience substantial inconvenience, losing access to their grazing lands and for several years getting little or no return from the newly terraced slopes and newly planted trees. A full programme must include help for them to produce food in the period of transition, to intensify their animal husbandry techniques, and to learn to tend and market the new perennial crops. Improved communication with the outside world and the provision of other essential services are also necessary.

There have as yet been too few attempts at integrated solutions to the various problems posed in different regions by the loss of trees and forests. The following pages describe a number of the approaches that have been made, and some of the technical innovations or rediscoveries that can contribute in the future. Figure 2 indicates the main factors that may have to be taken into account in such approaches.

TREES OUTSIDE THE FOREST

There is anormous potential for introducing trees on land that is conventionally seen as strictly agricultural. The objective is not only to increase wood supply, thus reducing the pressure on forests. It is also to contribute to food production, whether directly by the fruit or fodder from the trees, or indirectly by giving shelter from wind and sun, restoring nutrients from deeper layers, and increasing nitrogen fixation. Such planting may take many forms, occupying strips and pockets of land not used for crops, mixing

Figure 2 Factors for analyzing the place of forestry in rural development

Factors	Possible responses
Competition for land (trees are a less intensive use of land than crops)	
- Competition for forest land	- Intercrop trees and crops - Allocate forest land rationally between trees and crops - Improve non-food benefits to forest communities: forest and forest industries employment, secondary forest product income, social infrastructure
- Competition for crop and grazing land to afforest	- Plant trees on roadsides, river banks, field boundaries and other unused areas, areas marginal for crop production, erodable areas unsuitable for crop production and grazing - Improve productivity on the better arable areas in order to release land for tree growing - Plant multiple-use species or mixtures of species to increase productivity - Intercrop trees with other crops or combine with grazing - Introduce additional sources of income (e.g. beekeeping)
Timescale for forestry (delayed returns from tree growing)	
- Output from trees will not meet immediate needs	- Plant multiple-use species, or mixtures of species, which give some early return - Provide financial support during the establishment periods: low-interest loans, grants, subsidies, wage employment - Introduce or expand complementary non-forestry sources of income
- Risk that producer will not benefit	- Ensure security of tenure of land used for tree crops
Dispersed distribution of benefits from forestry	
- Benefits from protection forests or from timber production may accrue in part outside the community	- Provide compensation for those benefits foregone or inputs provided by the community which generate benefits elsewhere
Seasonal shortage of labour	- Adopt forestry systems which do not compete with peak demands for labour
Lack of a tradition of forestry (unfamiliarity with the necessary techniques, lack of understanding of cause and effect, behavioural patterns inimical to forestry, inappropriate institutional framework)	- Provision of guidance and support through extension services: education of the people, technical advice and technical inputs, grass-roots training - Demonstration projects - Encourage producer groupings (cooperatives, etc.) - Legislation and regulation

Source: FAO, Forestry for Local Community Development, FAO Forestry Paper No. 7, FAO, Rome, 1978, p. 9.

trees with agricultural crops in varying proportions, or alternating annual crops with tree fallow. The trees used may have as their primary products timber, poles, fuelwood, fodder or food, and preferably several of these together. 16/

Many people have long cultivated trees alongside their crops. Such practices have their origin either in pragmatic observation that the presence of trees improved yields, or as a response to the progressive disapperance from the forests of trees that provided food, fodder, shade, gums, medicines, and other benefits. 17/ Besides gains in productivity, there are advantages in the form of increased security and better diet from enlarging the range of products, and a better spread of income over time. Where the trees have a value as timber, they can provide a wide range of commodities from fuel and building materials, down to such things as the stakes used as supports for growing yams in west Africa.

The consequences of clearing trees from agricultural land to make way for farming systems involving mechanization or monoculture have included rising water tables, wind damage to crops, disruption of nutrient cycles, vulnerability to pests and diseases, loss of diversity in the local economy, and shortages of fuelwood, timber and poles. Truly modern systems for much of the tropical regions (and elsewhere) would extend and elaborate the well-tried methods of the past, adding new or improved species and varieties of tree, and developing new combinations of crop plants and trees that maximize the use of space and light and limit competition. Where forest is cleared for agriculture, it should be ensured that appropriate trees are retained or replanted.

The retention of wild trees is common in most forest areas. Farmers maintain and protect tree species that are of direct use to them for food, fodder, minor commercial products, windbreaks or soil improvement. In Latin America and elsewhere, forest trees are retained on coffee and cocoa plantations in an agro-forestry system where they provide shade and humus, and mobilize through their root systems the mineral nutrients in the soil. The people in Latin America also have a long list of palm trees which are retained because of their usefulness in providing such things as edible fruit, oil-bearing seeds, palmito shoots for food, woody stems for a wide variety of uses, and fibre for ropes.

In the difficult environment of the arid zones, various legumes are respected by local people for their close association with agriculture, their beneficial effect on soil fertility, and their usefulness as windbreaks. In the Sahel, Acacia albida is left standing when land is cleared for cultivation. Its roots go mostly straight downwards rather than sideways, drawing up nutrients and using water that otherwise would be lost to local production. It provides shade for cattle in the dry season but sheds its leaves in the rainy season, when agricultural crops are growing, thus providing them with humus and not competing with them for nutrients, and it produces poles, fuelwood and fodder for local needs. 18/

Trees are not only retained when their direct usefulness to rural people is recognized but are also planted for green manure, fodder, fuelwood, and nitrogen fixation for soil improvement. Intimate mixtures of trees and agricultural crops occur in intercropping and multiple cropping systems and, recent research has shown that these widely used

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16/ FAO. The Place of Forests and Trees in Integrated Rural Development, COFO - 78/3, Rome, 1978.

17/ B.N. Okigbo. Neglected plants of horticultural and nutritional importance in traditional farming systems of tropical Africa, Acta Horticulturae, 53, 1977.

18/ G. Poulsen. Man and Tree in Tropical Africa. International Development Research Centre, Ottawa, 1978, p. 9.

tropical systems, which were formerly considered primitive, are highly productive. Yields may be 20% to 50% higher than for the same crops growing separately, and the yield advantage is greatest when annual crops are mixed with perennials, including trees. 19/

Instead of trees and annual crops growing side by side, they may be alternated in a controlled and improved version of the natural forest or shrub fallow of shifting cultivation. Many of the fast-growing leguminous trees used in forestry plantations have also been found suitable as a planted fallow to be used in restoring soil fertility in only three or four years, at the same time providing fuelwood, poles and green manure. 20/ The intimate symbiosis of forest tree and food crop cultivation has been observed in several countries, where certain trees are widely used as a cash crop in agricultural diversification, or play a role both in timber production and in support of agriculture, or in an agro-forestry system with fruit trees or rice. 21/

Some of the benefits of the presence of trees on cropland can be obtained in their absence by spreading a mulch of foliage or leaf litter, gathered from a nearby forest or plantation. The mulch protects the soil surface against the direct impact of sun and rain, replenishes the nutrient stock and maintain the population of earthworms. In parts of western Guatemala, for example, farmers spread as much as 40 tons of litter per ha on their fields each year, mostly from oak forests that produce only 4 tons per ha; thus the required ratio of forest to farmland is ten to one. 22/ Research into mulches of various origins and into mixtures of species might reveal ways of obtaining these benefits with a smaller ratio of areas, using foliage from fast-growing plantations.

Where it is not desirable or practicable for trees to be cultivated on cropland, they can instead be planted wherever there are strips and pockets of unused land. This system has been very effectively developed in China in the so-called "four-side" or "all around" planting programme. Communes are encouraged to plant trees wherever there is a place: along the banks of streams and rivers, beside roads, between fields, and next to houses and villages. In Chunhua County of Shaanxi Province, which has a relatively dry climate and poor soils, "four-side" planting has established 15.2 million trees, of which 10.5 million are around houses and villages, 4.5 million along 1,600 km of roads, and 160,000 along 232 km of rivers and canals. 23/ Success of this kind is evidently made much easier by the absence of freely grazing ruminants in most of China.

The amount of technical advice and material help necessary to get such a programme started depends very much on local circumstances. Some of the most successful examples have started by being organized like a reforestation project but have then acquired a momentum of their own, forming a transition either to spontaneous planting on "four sides",

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19/ M. Stelly (ed.), Multiple Cropping: Proceedings of a Symposium held at Knoxville, Tennessee, 1975, American Society of Agronomy. Madison, Wisconsin, 1977.

20/ B.N. Okigbo. Legumes in farming systems of the humid tropics; A. Ayanaba and P.J. Dart. Biological nitrogen fixation, in Farming Systems of the Tropics, Wiley, New York, 1977, p. 69.

21/ Tran Van Nao. Forest resources of humid tropical Asia, Natural Resources of Humid Tropical Asia, UNESCO, Paris, 1974, p. 211.

22/ G.C. Wilken. Integrating forest and small-scale farm systems in Middle America, Forest Ecology and Management, 1, 1977, pp. 223-234.

23/ FAO. China: Forestry Support for Agriculture, FAO, Forestry Paper No.12, Rome, 1978, p. 75.

or village forestry. For example, in the State of Gujarat in India, the State Forest Service started roadside and canal bank plantations, each strip being linked to a nearby community that had grass-cutting rights among the trees, helped protect the saplings, and shared in the profits of the operation. Although the early plantations did not involve much popular participation, they marked a critical psychological turning point. People started to realize that forestry was possible around their communities and in many cases gained for the first time favourable impressions of the forest department when they saw that its activities could benefit them directly. By 1978 about 6,000 km of State's 17,000 km of roads and canals were lined with trees, and each year trees are planted along another 1,500 km. 24/

The constraints to be overcome vary greatly according to the nature of the community and its present land use. They may include problems of reorganizing grazing or of going through a period in which the use of land has to be partially foregone while waiting for trees to grow. Difficulties of the latter kind may be partly solved by using fast-growing species. For example, Calliandra callothyrsus, of central American origin, grows 2.5 to 3.5 m in six to nine months in Indonesia, and can be harvested for firewood after a year, yielding 5 to 20 m^3 per ha. It regrows from the stump, sending up coppice shoots that reach 3 m in six months. Once in full production it yields 20 to 100 m^3 per ha per year. It has many uses, providing edible foliage and fruit for animals, and is valuable for soil restoration and conservation. 25/ Other tropical legumes exist with similar properties.

AGRICULTURAL PRODUCTION INSIDE THE FOREST

Even where forestry rather than agriculture is the primary use of the land, systems exist for combining the two. Indeed, it becomes difficult to draw the line between agriculture with forest fallow on the one hand, and forestry with agricultural interludes on the other. The classic version of the latter is the "taungya" system (from the Burmese taung ya, which means hill cultivation). It was first developed in Burma in 1856, as a method for reducing the cost of replanting teak forests, and has since been widely adopted. The essence of the system is that the forest trees are planted by workers who at the same time cultivate crops alongside the seedlings for two or three years.

In the original version of taungya the planters were paid in kind, merely obtaining temporary use of the land in return for planting and tending the trees. They remained landless labourers, carrying out arduous work without security or rights to permanent settlement. Various improved versions are aimed not only at replanting forests, but also at improving the lot of the local population and helping to solve the problem of shifting cultivation.

In Indonesia, for example, planters who enter into two-year tenancy contracts are helped by the forest authority (Perum Perhutani), which provides a superior variety of dry-paddy rice, as well as loans for the purchase of fertilizers and insecticides. Rice yields have more than doubled, and the fertilizer has also had beneficial effects on tree growth. The intensified programme, started in 1975, has been well received, as the income from crop production per contract period is some $ 50 higher than with the traditional system. By the end of 1978 the programme was expected to cover an area of 20,000 ha. 26/

24/ B.K. Jhala. Social Forestry in Gujarat, Ahmedabad, 1978 (mimeographed), quoted in E. Eckholm, Planting for the Future: Forestry for Human Needs, Worldwatch Paper 26. Worldwatch Institute. Washington, D.C., 1979, p. 52.

25/ National Academy of Sciences. Tropical Legumes: Resources for the Future, Washington, D.C., 1979, p. 197.

26/ Soekiman Atmosoedarjo and S.G. Banyard. The prosperity approach to forest community development in Java, Commonwealth Forestry Review 57(2), 1978, pp. 89-96.

In Thailand taungya is used within the framework of a programme to resettle dispersed forest populations and reconstitute the forest. The Forest Industry Organization concentrates the cultivators and their families in those areas where viable settled agriculture can be practised, and at the same time employs the people in replanting the degraded forest areas they no longer use, and in other forest work. To encourage people to settle in villages they are provided with roads, electricity, schools, tap water, medical and other social and physical services, together with an allocation of land for growing crops, and assistance in obtaining materials for house building and in transporting their crops to the market. Reforestation is carried out by the taungya system, which is improved in two ways besides the provision of permanent cropland. Transport is provided to enable farmers to cultivate and tend taungya areas over a wide area without having to move from the village. Dependence on crop growing is reduced by enabling villagers to earn alternative income. In addition to the proceeds from the crops they grow, they receive a cash payment tor the land they clear and plant, and bonuses for extra productivity. They are also given priority in recruitment for forestry work. 27/

The Thailand "forest village" system points the way to a probably more permanent and sustainable formula. The allocation of forest land between crop production and tree growing is based on an assessment of site capability. Land use is based to the fullest extent possible on intercropping, vertically structured cropping mixes, and other ways of maximizing productivity. Conscious efforts are made to develop the social as well as physical infrastructure necessary to provide the basis for sustainable, socially acceptable conditions for the communities living within the forests. Similar approaches are being worked out in other countries as for example in southern Nigeria. 28/

Forest grazing is a very widely practised production system, especially in more arid regions, but it appears to be particularly difficult to regulate and render stable, perhaps because grazing people do not have a tradition of cultivating trees. Nevertheless, with the wide spacing of trees and high pruning to obtain knot-free stems, it is possible to cultivate improved mixtures of grasses and legumes on the forest floor for grazing, as is done in New Zealand with Pinus radiata. 29/ In Indonesia, elephant grass (Pennisetum purpureum) has been sown experimentally under teak, mahogany and pine plantations since 1973. It is sold to farmers to cut for their cattle, but no animals are allowed inside the forest. 30/

Orchards are normally regarded as part of agriculture, though their wood production is a supplement to that from forests. There is scope for foresters to develop forest orchards of species whose potential has not yet been discovered by farmers, especially in the case of plantations for the production of fodder. This may be only a transitory phase in a plantation whose main purpose is to produce wood, with low branches being pruned and fed to animals in the early years, or it may be the primary purpose. A fodder orchard could be managed very simply on the coppice system, with edible branches being removed regularly and replaced by new shoots from the stump. A combination of fodder plantations and silvicultural measures to improve forest grazing could be the incentive offered in exchange for the acceptance by graziers of the regulation of the size and movements of their herds.

27/ Sa-ard Boonkird. Taungya System: its Application, Ways and Means of Improvement in Thailand, Eighth World Forestry Congress, Jakarta, 16-28 October 1978, pp. 14-15.

28/ J.B. Ball. Taungya in Southern Nigeria, NIR/71/546, December 1977, FAO, Rome, p. 82.

29/ J. Kirby. A technique for the tropics: forest grazing, World Crops, Nov./Dec. 1978, pp. 14-15.

30/ Soekiman Atmosoedarjo and S.C. Banyard, op. cit., p. 82.

There are also many other ways in which forests may be exploited to supply additional products or income to local people. Fungi and a long list of seeds, nuts, fruits, leaves and shoots can be collected for home consumption or for sale. Urban dwellers may not fully realize their importance, but rural people know them as a supplement to their diet and an addition to food reserves. The importance is well known, for example, in south-east Asia of Sagu palm, from which a low-protein starch is extracted which can replace rice or wheat. Encouragement of these lesser known items of diet, if approved should be included in the national nutrition policy.

Honey used to be an important commodity throughout the tropical and sub-tropical forests and wild bees' nests are still collected. Bee-keeping can be encouraged by simple measures such as making available suitable clearings for hives. As production depends largely on the plants which exist in the forest, account has to be taken of nectar or pollen quality when selecting species for plantation. Where legislation expressly forbids the lighting of fires in the forest, amendment is necessary to allow bee-keepers to use devices of approved design to produce smoke for controlling bees. The collection of honey from wild nests is a frequent cause of forest fire, and public expenditure on popularizing domesticated bees might be amply repaid by its impact on this alone.

In planning the management of forests, especially in the context of agro-forestry, the potential contribution that wildlife can make as a source of food, especially protein, is often neglected. In the southern parts of Nigeria, wildlife has been estimated to account for 19% of the consumption of animal foods, compared with 60% for fish and 21% for domestic livestock. The proportion of animal protein from wildlife was particularly high amongst communities in forested areas, where it contributed over 80% of the total in some places. 31/

As many of the impacts of forestry activities can result in greater productivity of certain wild animal species, the possibilities need to be explored for modifying forestry and sylvicultural practices and management in order to optimize the benefits in terms of food production.

VILLAGE FORESTRY

Where land is available for a small forest plantation, or where woodland is destined primarily for local use, the problems are less technical than organizational. There may in the first place be difficulties in persuading villagers to plant trees or to accept the constraints of forest management. Once their participation is obtained, there may be material difficulties to be overcome.

An example of successful persuasion starting from strip plantations comes from Gujarat, India. In 1973, following the initial success of the roadside and canal-bank programme described above, foresters began visiting villages to discuss the possible establishment of plantations on some of their communal lands. They proposed to the panchayats (the elected councils that govern each village) that they should set aside a minimum of 4 ha for this purpose. The government would supply seedlings to the poorer villagers who derive their income from the communal lands, either as village herdsmen or by collecting the meagre grass or fuelwood they might produce, and pay for the preparation and planting of the land. The village would in turn guarantee to protect the areas from grazing and unauthorized gathering, a guarantee that was easier to maintain since the previous users obtained some gainful employment. The villagers would have the right to harvest grass and fruit from the plantations free of charge. When the time came to harvest the trees, the panchayats and the forest department would share the proceeds. Harvested firewood and timber would be sold through government-run depots at prices well below those of the market place. The system was designed for the betterment of all villagers and to be carried out by them, particularly those who were most affected by it.

31/ Federal Office of Statistics. Rural Economic Survey of Nigeria, 1965-66 - Rural Consumption Enquiry, Food Items, West, Mid-West and Eastern Nigeria, Lagos.

At first the panchayats were suspicious, and some villages had to be visited by foresters five or six times every year or two. Indeed, the relationship and trust between the villagers and the extension agents has been crucial. The extension service has been greatly expanded to cover this activity. By 1978 nearly 3,000 of the State's 18,000 villages had established woodlots through this programme. Each year more agree to enter the scheme, and many have decided to devote more than the minimum 4 ha to forestry. Some have even made precious irrigation water available for tree growing. One reason for the village programme's growing popularity is the quick return it generates. Most of the land planted was degraded common pasture that produced hardly any grass. After a year of protection from livestock, grass that could be harvested by hand usually sprang up on these lands. In the second year, some fruit trees began to produce, even in the absence of irrigation. The villagers then began to realize that they had an economic system bringing added benefits from an area formerly treated as almost worthless. Evidence of success was to be seen in the absence of good fencing around both the roadside and village woodlots. The trenches, live cacti or thorny shrubs now used to demarcate the forests would scarcely be sufficient to deter someone intent on stealing fodder or fuel. 32/

Similar results have been achieved in the Republic of Korea, using a very different system of remunerating labour and distributing the produce. In 1973, to counter serious and deteriorating erosion, overcutting, and fuelwood shortages, the Government adopted measures designed to enable every village to set up a fuelwood plantation. To enter the scheme, a village has to set up a Village Forestry Association (VFA) to which all villagers belong. Planting is on communal land or on private land reserved by law for use only for forestry. Private landowners who turn over their land to the VFA receive 10% of the output in return. The rest of the output is distributed among the VFA members in relation to the voluntary labour they contribute. By the end of 1977, there were over 21,000 VFAs, grouped into 141 Forestry Association Unions belonging to nine provincial branches of the National Federation of VFAs. The VFAs are also part of wider inter-village associations, grouping them with village horticultural, farm cooperatives and livestock associations. In 1977, the VFAs established 77,000 ha of fuelwood plantations.

This programme has achieved a remarkable degree of collaboration between local regional and national organizations. In addition to the establishment and maintenance of village fuelwood forests, the VFAs also take care of the protection of other forests in the neighbourhood of the village. They provide forest patrols to control the illegal use of forests, and voluntary forest fire brigades, as well as the carrying out of pest control measures. The Forestry Association Unions provide marketing services for the sale of minor forest products collected by VFA members, such as Kuzu fibres (for wallpaper), mushrooms, moss, and medicinal herbs. In 1977, the revenue from such sales amounted to $ 18.7 million. The National Federation provides technical advice to the VFAs through its extension agents, and helps them organize their activities. The national forest service extension service also provides the VFAs with planting stock and fertilizer. All cash costs for these and other inputs are subsidized by the Government. 33/

FORESTRY FOR JOINT SATISFACTION OF LOCAL AND INDUSTRIAL NEEDS

Forestry for industrial or export markets may also cater for local needs, either indirectly by providing employment and income, or directly by furnishing goods and services. The local population may also be helped to become producers themselves, either of industrial wood from plantations that they can manage themselves, or of forest products that they can collect and market from an existing forest. Their grouping into cooperatives has great potential for expanding this type of activity.

32/ E. Eckholm. Planting for the Future: Forestry for Human Needs, Worldwatch Paper 26, Worldwatch Institute, Washington, D.C., 1979, p. 55.

33/ Bong Won Ahn. Village Forestry in Korea, Eighth World Forestry Congress, p. 11.

In one type of scheme, local people are organized for producing wood as a cash crop from land they themselves manage. An example is given by the smallholder plantations organized by the Paper Industries Corporation of the Philippines (PICOP), which are designed to improve the lot of the small farmers on the edge of the corporation's forest land. 34/ The principal element of this programme is the encouragement of farmers to grow trees as a cash crop on their land for sale to the corporation for use as pulpwood. The species grown is Albizzia falcataria ("falcata"), a fast-growing leguminous tree, the fibre of which is particularly suitable for the manufacture of newsprint. It is ready for harvesting in eight years, and saleable thinnings can be harvested even earlier. It thus provides income within a short enough time to make it attractive and feasible for small farmers.

The Development Bank of the Philippines provides credit for the programme, supported in part by a World Bank loan. Farmers who do not have title to the land are assisted in obtaining it. In addition to providing advice and tree planting stocks, the extension agents help in improving farmers' crop and livestock practices. Farmers are encouraged to devote 20% of their farm area to food production and 80% to tree growing. PICOP undertakes to buy pulpwood from farmers prepared to enter into a marketing agreement at prevailing market prices, but leaves them free to sell elsewhere at higher prices.

Starting in 1968, participation in the programme has grown rapidly since the results achieved by the first demonstration farmers made it clear that the growing and harvesting of falcata pulpwood is well within the capabilities of small farmers, and quite profitable for them. It has been estimated that the financial rate of return to the farmer from tree growing would be about 25%. By March 1978, some 3,400 farmers were growing about 17,000 ha of falcata for pulpwood on their smallholdings. The programme is now being developed further, to introduce a second species, Eucalyptus deglupta (Bagras), which can be grown for lumber as well as pulpwood, and to help farmers to set up cooperatives to improve their purchasing position.

Producer cooperatives may also help to solve the problems of small private owners of natural forest and perhaps even of some shifting cultivators. At present much timber is inefficiently extracted and marketed (or not used at all) because of organizational difficulties. A producer cooperative can pool resources to buy or rent equipment, organize felling and transport to achieve economies of scale, and undertake direct sale, bypassing middlemen. There are successful examples of this in several countries of Latin America. In Guatemala, cooperatives enabled smallholders to carry out the sanitary felling and marketing of beetle-infested pine trees.

India has a long history of forest labourers' cooperatives. They have taken over cutting rights formerly allocated to contractors by the State Forestry Departments. The workers, through their organization, schedule the cutting, transport and distribution of labour, oversee finance and marketing, and reimburse the State for the timber harvested. Maharashtra and Gujarat States have large numbers of forest workers' cooperatives with thousands of members, which have been further extended to include the collection of minor forest products. 35/

34/ Michael Arnold. A habitat for more than trees: new approaches to tropical forestry. Ceres: FAO Review on Agriculture and Development, 12(5), 1979, pp. 32-37.

35/ T.E. Edwardson. Prospects for Forestry Cooperatives in Smallholding and Forest Communities, Eighth World Forestry Congress, Jakarta, 1978. For a more detailed review, see: M. Digby and T.S. Edwardson. The Organization of Forestry Cooperatives. Occasional Paper No. 41, The Plunkett Foundation for Cooperative Studies, London, 1976.

The exploitation of timber by cooperatives is likely to remain a relatively unusual system, as most commercial forest is publicly owned and managed. There is great scope, however, for the cooperative organization of the exploitation of other forest products. In addition to wood, other materials that come from the forest include the corky or fibrous bark of certain trees, the resins, gums and latex of others, the natural ropes made by climbers, the thatch of some grasses, the tubular stems of certain plants (of which the best known are the bamboos), the products of forest insects (for example, beeswax and shantung silk), and the many medicinal products, dyestuffs, tanning substances and other chemicals obtained from forest plants and animals. The past century has seen many of the latter fall into disuse in the industrialized countries as synthetic replacement became available, but pharmacologists and chemists are now realizing that many half-forgotten natural products are potentially valuable either as sources of substances for refinement or as models for future synthetic molecules.

It is also possible to cater for local needs within the conventional systems of large-scale forestry. The concept of multi-use forestry is inherent in the very nature of trees. An example of a joint production system is coppice-with-standards. A lower tier of smaller trees cut on a short rotation, typically for fuelwood, is produced by the coppice method (regeneration by stump shoots), while an upper tier of full-sized trees is grown from seedlings or cuttings. This system appears to be well adapted to the heterogeneous composition of tropical forests, as well as appropriate for meeting the needs of local people. It can also accommodate a short cultivation period for food crops in the annual felling areas, provided sufficient care is taken to avoid any damage to stump shoots and seedlings.

Even where forestry has been organized entirely for industrial ends, small-dimensioned wood is an inevitable by-product, whether in the form of thinnings (small trees removed to make room for the better ones), or of branchwood from final felling. This is often left in the forest to rot, simply because it does not pay to make it by conventional methods. Ways might be found to make use of it, for example by assisting a group of villages to invest in efficient mobile charcoal kilns to be used in collaboration with the forest management. In the forests of the Salva Lacandona in Chiapas, Mexico, a small sawmill enterprise is being set up to make use of the tops and branches of the mahogany trees left by the more demanding industrial operation that only takes out peeler logs and high-quality sawlogs. The capital to set up the small sawmill comes from timber royalties due by law to local populations. The traditional hunter-gatherers are now supplementing their meagre agricultural derived incomes with chichle collection and camedora palm cutting.

Purely commercial forestry may provide other services to local communities. For example, the network of forest roads may be planned in such a way as to reach isolated villages. Indeed, in areas being opened up, the road system could be the key to land use planning by guiding colonization towards the areas of the best soils. In Belize, the forest service has for many years been the chief constructor of rural roads.

CONTRIBUTION OF WOOD-PROCESSING INDUSTRIES

The wood-processing industries potentially have a great contribution to make to rural development. The direct and indirect off-farm employment created by forest-based industries should help in siphoning off some of the population pressure on the land resource. In addition, the availability of a wider range of construction materials and of the infrastructural services associated with the industry should bring some urban amenities to rural life.

In practice, however, forest-based industrialization has so far failed to achieve its expected results. The reason seems to be essentially that the potential of the forests has not yet been effectively mobilized. Until recently, exports of wood from developing countries have been in the form of unprocessed logs. Thus, it has been estimated that if the 49 million m^3 exported as logs in 1973 had been processed in the countries of origin, this would have brought them another $2,000 million, as well as several hundred thousand man-years of employment. 36/ Almost all of the development potential has therefore been

36/ S.L. Pringle. Tropical moist forests in world demand, supply and trade, Unasylva, 28, 1976, p. 118.

exported with the logs. Furthermore, some logging operations have been short-lived investments, with the subsequent collapse of what local employment had been generated.

For the growth of forest exports to contribute fully to development, it is necessary to carry out their processing in the developing countries now exporting them in unprocessed form. This policy is already being implemented in a number of countries, as has been mentioned in Chapter 1 above, though progress is slow. For it to contribute fully to rural development, it is desirable that most of the employment should be in the countryside and that the products should if possible be partly destined for rural uses. This should be possible wherever processing results in a saving in weight and space, as in the case of sawmilling and plywood, and so reduces transport costs.

More common sense and flexibility are needed in technological transfer and development. Too often, investment has been in factories using labour-saving technology, expensively imported from industrialized countries. It has also been in towns, where it was cheaper to provide the necessary infrastructure and establish the professional and technical personnel.

Factory design should be adapted to circumstances of abundant unskilled labour, but should also take account of scarce capital and managerial talent. Fortunately, sawmilling, which is the most widespread form of processing and likely to remain so in developing countries at least, has a very flexible technology. It can therefore be viable over the whole range of scales from a craft to a quite sophisticated industry. This means that investment and mechanization can be high or low, according to the prevailing situation. In addition, economies of scale are not particularly significant.

However, conventional sawmilling is often very wasteful, using only a small part of the timber volume potentially available. The flexibility of the process can be utilized to reduce waste. In Honduras, for example, rather than accept the closure of many old sawmills with the consequent loss of employment, the Government established a number of modern plants to buy a rough-sawn lumber from the old mills and resaw it to export standards. This is one of several possible ways of achieving adequate standards of quality and reliability in small rural mills.

With the more complex wood-using processes, economies of scale and rising labour costs have forced developed countries towards highly capital-intensive technology. The adaptation of these industries to the situation in the developing countries presupposes that viable alternatives, if not already available, can be designed and produced. As a result of collaboration between FAO and industry, there is now a portfolio of appropriate designs for small-scale labour-intensive mills, especially for the manufacture of a variety of wood-based panels. The transition is not quite so easy in these industries as it is in sawmilling. Nevertheless, under certain conditions, fibreboard shows some promise as a contributor to rural development, since it does not require expensive imported adhesives, can use a great variety of raw materials (including agricultural residues), and produces a product that could easily be used in rural housing.

Small-scale paper industries in rural areas, based on the pulping of non-wood materials, have been successfully developed in India and elsewhere. Wood-based pulping has, in contrast, been much more difficult to modify or develop on a scale suitable for rural development. However, recent advances in mechanical and chemi-mechanical processes have gone a long way towards overcoming the technical and economic obstacles. Even the possibility of small-scale chemical pulping is now less remote than it was two or three years ago.

Because of the more complex physical and mechanical processes involved in the panel and pulping industries, they will generally be less suitable than sawmilling for stimulating rural development. This disability might be overcome by grouping a number of individual communities to provide adequate resources to support industries of these types. However, the main obstacle to a successful programme of rural development based on the employment and income potential of forest industries will be the availability

of skilled operators and managers. Major training programmes will be required and these in turn could make a further contribution to rural development by providing additional educational opportunities. New formulae are also needed for ownership, management and profit sharing, if forest-based and other industries are to contribute fully to rural development.

The capacity of commercial forestry to employ local labour may also be greatly improved by the introduction of appropriate technology. A study in the Philippines compared the use of redesigned manual or animal-powered devices with that of imported machinery. The cost of manual methods for many operations was found to be less than that of mechanical methods that used less labour. For example, it cost $ 35.50 per 1,000 stems to thin by bow saw, and $ 35.27 to do so by chain saw. The manual loading of small logs costs $88 per 100 m^3, as against $ 91 using a mechanical loader. Underbush cutting with a brush hook cost $ 23.24 as compared with $ 51.35 per ha with a motorized clearing saw. 37/

APPROPRIATE TECHNOLOGY FOR UTILIZATION

Many ways have been envisaged of increasing the supply of forest products for rural use or at least of satisfying more needs with the present level of supply. Some of the current techniques for using wood are very wasteful, and can be improved by appropriate technology.

The requirements for wood could be decreased by the introduction of simple techniques for the prevention of decay and insect attack. The wood of many species lasts for only a few years in contact with the soil under a tropical climate. Termite damage in particular is widespread and rapid. Most of the preservation treatments available are expensive and have to be carried out on an industrial scale, but in Papua New Guinea, for example, the Forest Products Research Centre has developed simple preservation techniques for rural users. 38/

Much decay and damage can be attributed to wrong conditions of use. Untreated timber is placed in contact with the soil and thus remains damp and accessible to fungi. The top of timber structures is often left inadequately protected from the elements, cracking in the sun and absorbing rain. Improved building design, by ensuring protection from above and below, ensures greater durability, and the painting of exposed surfaces can further improve performance.

Much may also be achieved by the appropriate choice of tree species. Some of the most durable timbers, such as teak, are now exported because of their highly sought-after characteristics, and the high price they fetch. Research into the durability of less well-known species, particularly those with high growth rates, may in the meantime help rural users.

The customary methods of extracting energy from firewood are highly inefficient, allowing most of the heat to escape. Cooking on an open fire is estimated to need five times as much energy as on a kerosene stove, and even with a simple wood-burning stove 90% of the heat may be wasted. A well-designed stove, simply built of mud or mud bricks, can greatly reduce the amount of wood needed, and also increase the range of wood and other organic fuels that can be conveniently burned. The addition of a chimney also removes smoke from the house, where it is a danger to health.

37/ ILO. Appropriate Technology in Philippine Forestry, Report of the Joint Philippines Bureau of Forest Development/ILO/Government of Finland Project, Geneva, 1977. p. xv.

38/ Papua New Guinea, Forest Products Research Centre. Manual of Rural Wood Preservation. Department of Forests, Ministry for Natural Resources, Port Moresby, 1977.

Studies in Indonesia 39/ have shown that good stove design can increase efficiency from 6% to 7% between 23% and 19%. By using cooking pots that sit deeper and more tightly into the cooking hole, a further improvement is obtained. The overall gain from combining the new stoves and pots is a reduction of 65% in the wood requirement. By simple measures, such as always covering the pot with a lid and always replacing a cooking pot by a water pot when cooking has finished, it can be ensured that all the available energy is used. Waste can also be prevented by the use of suitable tools for cutting fire-wood to size for use in a stove. 40/

In countries with a cold season, where wood is important for domestic heating, similar gains may be made by better stove design and by simple techniques of insulation. Local application of heat, for example through warming pans and hot-water bottles, are often more efficient than general space heating. Better methods for making and using charcoal can also bring great gains. A modern retort gives three times more charcoal per unit of wood than a traditional burning-pit, and may also provide valuable distillation products such as wood alcohol and biogas. Energy may also be saved by ensuring that wood is as dry as possible before being converted. Charcoal burning should therefore preferebly take place at the end of a dry season

The charcoal thus produced can be made to go still further by improvements in the design of charcoal stoves, the efficiency of which can be increased more easily than that of wood-burning stoves. Nevertheless, the direct use of fuelwood should be preferred wherever possible because of the substantial loss of energy in the conversion to charcoal.

The more efficient use of fuel is vital in the face of increasing difficulties in supplies and not least in its relation to nutrition. Despite much research, no one has yet invented a cheaper or more adaptable system for capturing and storing solar energy than leaves and wood. Petroleum fuels and natural gas may be easier to distribute and more convenient to use, and coal contains more energy per unit of volume than wood. However, these fuels come from non-renewable resources, entail heavy capital investment for their production and distribution, and require the user to install and maintain costly equipment. Liquid and gaseous fuels can be extracted from wood, and charcoal pressed into briquettes has as high an energy content per unit of weight as coal. The alternatives, however, are as yet rarely used in the rural areas of developing countries, not least because the techniques of manufacture are very little known.

39/ H. Singer. Improvement of Fuelwood Cooking Stoves and Economy in Fuelwood Consumption, Report No. TA: 1315, FAO, Rome, 1961, p. 12.

40/ J. Ki-Zerbo, and G. Lepeleire. L'Amélioration des Foyers pour l'Utilisation Domestique du Bois de Feu: ses Possibilités et son Impact au Sahel, CILSS, Mai 1979, p. 8.

FRAMEWORK FOR ACTION

POLITICAL COMMITMENT

The previous section has shown how many ways there are in which forestry is not only beneficial but essential to rural development. For them to be translated into action involves political decisions at the highest level. The viability of a rural development programme depends on the effective integration of all the activities involved: agriculture, transport, education and so on as well as forestry. There must therefore be a clearly stated recognition at the highest political level of the importance of the role played by each sectoral activity. This must permeate to all levels of officials and professional officers so that their expertise may be mutually respected and their work properly coordinated. In the case of forestry, the relations with agriculture are of particular importance. The production of food crops and of trees and forests, together with the management of natural ecosystems, are interrelated parts of plant husbandry, which, combined with animal husbandry, is itself part of a larger land and water husbandry. Without this understanding by all concerned there is very little chance of any rural development programme being successfully implemented.

In some quarters in the past there has been a tendency to regard forestry as a peripheral activity to which no priority need be attached. Because forest projects are essentially long-term, the short-term benefits are difficult to identify and so have been discounted to the point of being treated as negligible. Though comprehension is still far from being universal, it is now becoming much better understood that forestry is an integral part of the rural development and that foresters have a much broader field of activity than merely caring for large areas of wild or semi-wild forest.

Liaison at the central government level is inadequate without comparable coordination at the local level. The widest possible involvement, including that of foresters should be ensured wherever there is a discussion of any aspect of rural development, including food production, soil and water conservation, energy policy, rural industry, housing development, resettlement or rural road construction. The involvement of officials must be accompanied by involvement of the people. The precise form it may take will vary from country to country but it is essential in assisting to locate projects, organizing self-help, recruiting local technical skills or forming cooperative societies. Popular participation can be almost total in tree-planting outside forests but is bound to remain more limited in the management of complex or fragile forest ecosystems. Its most important function is to inculcate a sense of self-reliance among local communities and encourage them to promote enterprises themselves, within the framework of the national plans and subject always to the activities being approved as technically and economically sound.

The degree of political and administrative action required will vary greatly according to the circumstances. The most straightforward sort of forestry project is the creation of a large-scale plantation or the management of natural forest. Provided there is no problem of population pressure or extensive grazing, the necessary actions are mainly technical, financial and organizational on all of which there is a large literature. More commonly the existing use is the main limiting factor and the development outside the forest or plantation area is likely to be a prior condition for forestry.

The scale and type of problem involved in small-scale tree planting may cover a wide range. Some people are already cultivating trees as part of their land husbandry and only need help in the form of the provision of planting stock of new species and the introduction of new uses and systems. Others who are cultivating trees but are limited by shortage of land need help in raising agricultural productivity. There are, however, many people who

have relied on existing natural woodland or trees and have little or no experience in planting them. This is the situation which exists in many arid areas and calls for a very great effort of education and mobilization. If such an effort is to succeed it requires high-level political commitment and the fullest possible popular participation.

MOTIVATION, MOBILIZATION AND EDUCATION

Motivation must begin with the rural people themselves. Peoples' participation in development activities is not only a means but also an end in itself. The organizing of small farmers and landless labourers into strong homogeneous groups is an important aspect of rural development work. The links between programme and people are the extension workers, change agents or development workers at the community level, who play a crucial role in setting in motion a process of participatory development. They must be properly trained, prepared and briefed, and must possess not only technical extension capabilities but also social skills and a sense of dedication and accountability to the people.

The motivational process required will vary greatly according to the existing place of trees and forests in local practice. It is necessary not only to generate motivation for planting but above all to sustain it through the months (or more often years) during which the young trees remain easily vulnerable. The main need is to communicate the necessary ideas to those on whose land trees are to be planted, but it is also desirable to inform urban populations and increase their solidarity with the rural development process.

The task is challenging but perhaps less so than that of introducing industrial methods to people who have no previous experience of them. Although it has taken mankind a very long time to develop the science and art of forestry and tree planting the principles and techniques can easily be assimilated by rural people familiar with agriculture and horticulture. Some countries have successfully introduced the basic notions of forestry into primary or secondary schooling. Species recognition, the importance of trees and for forests in rural life, the destructive effects of over-exploitation, and simple methods of tree-planting can all be taught to quite young children. An example is provided by the State of Gujarat in India, where some schools run tree nurseries. The children share in the proceeds from the sale of the planting stock they help to produce and become directly interested in the progress of plantations.

The most effective method of extension is probably participation in the actual work and benefits of tree-planting. Many countries organize national tree days on which large numbers of people, mostly volunteers, plant trees. The effectiveness of this approach is probably inversely proportional to the distance between the planting site and the volunteers' home or work place. A tree planted and then never seen again is likely to make only a fleeting impression and to teach nothing about the maintenance or use of trees. More effective by far is the involvement of local people, who are thereby drawn in into the protection of <u>their</u> trees. To the extent that voluntary work replaces paid labour however, it takes away the opportunity to put money into the pockets of the rural poor and give them an early benefit from the plantation. The possibility of such earnings was one of the factors that helped to persuade villagers to accept the woodlot planting scheme in Gujarat discussed earlier.

Particular importance needs to be attached to the role of women. They are generally the main users of fuelwood, which they often gather themselves, so that they are likely to be very conscious of the potential benefits of tree-planting and the conservation of forests. It is not by chance that it has been the women who have triggered the Chipko movement in areas of northern India, in which local people have intervened to prevent the felling of trees. Their closeness to young children gives them special power to shape the ideas of the next generation, and the theme "plant a tree for your child" has great potential appeal to them. This has been one of the initiatives adopted at the international level by non-governmental organizations concerned with children, as a contribution to the International Year of the Child.

The organization of visits by villagers to similar communities that are already enjoying benefits from forestry or tree-planting is another potential means of spreading information and enthusiasm. One of the greatest problems is the time lapse between planting and its results. Even in the tropics, the interval for some sites and objectives is well over ten years. To see the possible future with one's own eyes is far more impressive than merely to hear about it from experts from outside the community in whom one has little confidence. Friendly rivalry between villages or regions may also play a useful part as a catalyst for action.

INFORMATION BASE

Correct action can only be based on a sound knowledge of the situation and one of the main hindrances to rural development, and to forestry activities within it, is the scarcity of the necessary information. There is no simple remedy and more resources will certainly have to be devoted to obtaining and analysing data. The collection of information is expensive and it is therefore essential that what is sought is that which is needed for the decisions that have to be taken.

At the national or regional level, information is required to determine government strategy and the need for legislation and special programmes of action. This entails the collection of general information that allows the identification of the problems that need to be tackled. At the local level, the community needs to know about the availability of land and its potential, the trees to use and the techniques for growing them, and what products they will produce. At all levels, the people involved will want to know what will be the cost of the goods and labour and effort that have to be put in, the amount and value of the goods and other benefits which will be produced, and the cost of the other possible products they have to give up in order to grow trees. Only when they see the result as worthwhile will they be prepared to support the effort and sacrifice involved.

For the development of a rational land use policy, the first requirement is a land capability survey to indicate the areas most suitable for forestry, cultivation or grazing. With the aid of data on requirements, on present and potential yields and on the erosion hazards of different land categories, such a survey can provide the basis for a target distribution of land between uses.

In conducting such surveys, there is much scope for the improvement of information on tree resources. The classic form of enquiry is the forest inventory, which typically is an assessment of the wood volume and the growth rate within the boundaries of a forest. Vast areas of the forests of developing countries have not yet been surveyed. Only 30% to 40% of the area of closed forest of Asia and Africa have been inventoried in any manner. Though the intensive survey of areas which will remain remote from forestry and other community activity is not a priority, the aim in any country where forests constitute an important potential source of economic activity should be the development of a regularly maintained national forest survey to provide the basic data for planning forestry and related community activity.

Major shortcomings of the conventional forest inventory for decision-making on rural development are the absence of data on trees outside the forest, and the failure to include enough data on products and benefits other than wood. Even the information on forest wood may be inadequate for local needs, for it is usually limited to commercial species, and volume is a less useful measure than mass for the assessment of the energy content of wood as a fuel. A fully adequate survey would cover all trees inside and outside forests, and might even include those standing in private gardens insofar as they can contribute to the stock of consumable products. It would distinguish the main species or species groups, and would use density to convert volume into mass. It would also cover all the products that come from trees and forest, except that food production from orchards would normally be assessed by agriculturalists. In areas, where the forest cover is of critical importance in regulating water flow from watersheds, a typological survey is also needed, in order to identify the areas at risk and the potential of the forest to support such uses as grazing and fuel wood cutting.

Within any specific area the aim should be to find out as much as possible about the physical and biological environment (climate, soil, vegetation, land use, etc.); the existing forest and forest related resources, wood use, wood needs and market prospects; and the population, including social systems, land tenure, numbers, income and expenditure, labour budget, and food habits 41/. The people themselves should be involved as much as possible in the survey, in order to create the feeling of trust and confidence that will be needed when the time comes to begin the action programmes.

Adequate physical data on the relations between vegetation, land use and erosion are notoriously difficult to assemble, even though the relations between the destruction of cover and the disasters of siltation and flooding are all too evident. Given the urgency of such problems, policy makers will usually have to accept broadly based assessments as a basis for decisions about measures to protect and to secure the livelihood and well-being of the large number of people at risk.

For information about demand, forest managers are often content to study the market, perhaps adding a nominal figure for material gathered by right-holders. As so much rural consumption takes place outside the market, this can only lead to gross underestimates of actual needs. A full survey should include the assessment of all the existing and potential requirements for forest products, leaving until later the question of whether they are to be satisfied through the market or through some other mechanism.

An adequate understanding of the use of fuelwood is particularly important. Although this is by far the largest use of wood in most developing countries, it is generally the one about which the least is known. Governments are increasingly recognizing the need to carry out special consumption surveys to remedy the information gap. To be of use in clarifying what has to be done, such surveys must do more than just identify how much fuelwood and charcoal is being used. They must also cover alternative fuels, such as crop residues and animal dung, and try to shed light on alternative supply options.

RESEARCH AND THE COMMUNICATION OF NEW KNOWLEDGE

Forestry research is already being conducted by a host of organizations at every level from the local to the international and from the applied to the purely scientific. However, there has been far too little work in the area that falls between forestry and agriculture. This gap can probably best be filled by collaboration between existing institutions, rather than the founding of new ones.

Much knowledge already exists in the form of local practices. This is a field in which the specialists have much to learn from people who have discovered techniques for improving and maintaining the productivity of their land. The reconditioning of soil, the prevention of erosion, and the moderation of climate are not the only benefits threatened by deforestation. Over the centuries farms have taken many foodbearing species from forests and improved them for use as agricultural crops. This is true, for example, of the "home gardens" found in the countryside of such countries as Indonesia, Sri Lanka and Thailand, where fruit trees occupy different levels of the canopy and provide food almost all the year round. These cases of the mixing of planted or self-sown trees with agricultural crops have mostly been found by observing land use systems in various localities.

41/ See FAO. Draft Guidelines on Collection of Socio-Economic Data for Designing Rural Development Projects, Rome, 1979; Idem. Guidelines for the Development of Less Favourable Environment Areas: A Comprehensive Integrated Management Approach, Roma, 1977; L.E. Virone. A Practical Approach to Rural Development. Borgo a Mozzano, Agricultural Studies Centre, 1969.

There is enormous scope for communicating local knowledge to other areas of similar climate and conditions within a country and still more between countries. International organizations such as FAO and the International Union of Forestry Research Organizations (IUFRO) have an important part to play in collecting and disseminating data. Certain national organizations have also been active in recent years. There are many useful recent handbooks on tree-planting outside the forest 42/. Exchanges of personnel could also be greatly expanded, especially between countries of similar climate but different language.

LEGAL FRAMEWORK

Laws are directives for implementing policy and guidelines for resolving conflicts. Rural development and forest policies therefore need to be codified by law. However, to be effective the law must accurately reflect these policies and also be enforceable. Existing legislation affecting the use of forests and land often falls down on both these counts.

Most forest law still reflects earlier policies directed primarily towards conservation. It has not generally been conceived as a positive agent of development, but merely as a means of preventing the misuse of the forest, and has been developed chiefly in terms of litigation 43/. The consequence of this emphasis on the deterrent and punitive aspects of forest law is that law becomes an obstacle to development, embodying the constraints on their use of the forest and its benefits that so frustrate forest neighbours.

Most countries therefore face the need to overhaul their forest laws, so that they properly reflect their new concerns and policies aiming at a more equitable distribution of benefits in favour of the rural people in and around the forests. There is also a wide range of other laws and regulations, such as legislation on land tenure, land reform, colonization and credit, the provisions of which directly or indirectly influence the implementation of rural forestry programmes. This legislation too may need to be reexamined, to see whether it is consistent with the desired new directions.

Particularly difficult problems arise in the law of land ownership. Where landless peasants have occupied forest land illegally for a number of years, strict enforcement of the law cannot be contemplated unless associated with a generous resettlement programme. Recognition of a fait accompli, however, must not be done in such a way as to condone future repetitions. Worst of all perhaps is the absence of any explicit solution, for this leaves the squatters in perpetual fear of expulsion and the authorities with no credible protection against further encroachment. Where a government wishes to convert certain publicly-owned forest land to a system of agriculture with forest fallow, it is desirable that the cultivators be given some security of tenure, if necessary through new legislation.

However successful the policy and law may be, there will always be those who follow their own interests at the expense of those of the public. Because the private gain from over-exploiting a common resource exceeds the user's share in the collective loss, there will always be a need for protective legislation. This is not just a modern or western notion: in Afghanistan, for example, in the mountains of Nuristan, the village elders fine those who take more than their share of wood or wantonly damage trees.

42/ See: FAO. Forestry for Local Community Development, Rome, 1978; FAO. China Forestry Support for Agriculture, Rome, 1978; National Academy of Sciences. Underexploited Tropical Plants with Promising Economic Value, Eashington, D.C. 1975; Idem. Leucaena: Promising Forage and Tree Crop for the Tropics, 1977. Idem. Underexploited Tropical Legumes with Promising Economic Value (in preparation); Idem. Firewood Crops. Bush and Tree Species for Energy Production (in preparation).

43/ FAO. Modernizing institutions to promote forestry development. The State of Food and Agriculture 1969, Rome, 1969, p. 127 - 133.

However, law enforcement should, as far as possible, be visibly in the interest of those who are asked to restrain their activities. In too many cases it has seemed that rural people are kept out of forests in order that outsiders may consume their produce. This is not only due to the restrictive and punitive nature of much forest law, but also to its often excessively complicated nature. If the legislation could be simplified and reduced to its essentials, it is much more likely that people would be able to understand and accept the need for certain restrictions on the use of forests and forest land 44/.

There is also considerable scope for improvement in the system for the enforcement of forest law 45/. In many countries the same person is both the forester charged with technical supervision and the guardian of the law responsible for detecting and prosecuting miscreants. The same officer may also have power to grant permits for activities that are otherwise illegal, and to collect fines from admitted culprits without recourse to the courts. At best these duties and powers are a distraction from the forester's technical job, and at worst they are an invitation to corruption. Law enforcement should be the role of a branch of the police, or of an independent corps of forest guards, or (as in the Korean Village Forest Associations) of patrols of villagers, and sentencing should be by properly constituted courts. The granting of permits should not be the prerogative of individuals, but of boards under some public powers of inspection and control.

ADMINISTRATION AND MANAGEMENT

Traditionally the public forestry administration or forest service has been the motive force in the sector. There is still an important place for the forester as the skilled manager and protector of forests and plantations, and the forest service can serve as a vehicle for bringing those skills to bear. It is necessary, however, to examine the roles involved in forestry support for rural development, and the alternative ways of organizing it.

In many developing countries it is now recognized that forestry's administrative structures must be changed if foresters are to become agents of development instead of only conservationists. A model is emerging which takes into account the complex inter-relationships between the social, protective and productive functions of the forest 46/.

The role of the forester is not only purely technical but also social in the sense of making decisions in the long-term interests of all concerned. On occasion it may involve the embarassing problem of placing the interests of some distant public authority or private owner above the short-term interests of the local population.

The question arises of what role the forester should now perform, and what qualifications he requires for it. The forestry profession has already undergone an evolution from one predominantly based in the biological sciences to one oriented to the management of production. The forester must now become in addition a manager of socio-economic systems, and also be sufficiently conversant with agriculture and animal husbandry to be able to relate them to the broader needs of rural development.

Education, training and preparation for this broadened profession has to be rather different from the conventional patterns. Besides the biology of trees, the ecology of forests, and the uses of forest products, the student needs to learn enough about agriculture and the social sciences to have some insight into the life of forest dwellers and farming

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44/ M. Allaoui. L'Administration forestière. les populations et les exigences du développement, Eighth World Forestry Congress, Jakarta, p. 7.

45/ D. Kamweti. Law and Forest Management in Kenya (M.Sc. thesis, University of Oxford, 1979).

46/ David Palin. A Comparative Study of Public Forestry Administration in the Asia-Pacific Region, FAO, Rome (in preparation).

communities, and enough about the theory and techniques of communication to make imaginative use of all the means of informing and persuading people. On the technical side, more attention should be given to fuelwood production, to forest foods and forage, and to fast-growing trees suitable for planting outside forests and capable of supplying fuel, food, fodder and other rural needs. This may require some substantial changes in the syllabuses of university faculties and institutes where forestry is taught.

Possession of the appropriate expertize will not in itself ensure that a forest service has the essential capacity to organize forestry development. Its organizational structure must also be appropriate to the task. With so much of forest land in the ownership of the state, in most countries the task of the forest administration will remain primarily that of a manager of public land and of the resources of that land. The management objectives of producing a sustained output of wood raw material for industry, and of maintaining environmental stability, remain as important as ever. Many of the main organizational issues facing forest administrations stem from these continuing management tasks. They include how best to control the use of large remote areas with limited resources of trained manpower, and how to ensure the continuity of financing necessary for the orderly development of such a long-term activitiy as industrial forestry 47/.

There are a number of alternative approaches for effectively accommodating within an organizational structure the social objective that has been added to the production and protection objectives of forest management. An example is the multiple uses of its forest land that the Indonesian State Forest Corporation has developed in order to broaden the range of benefits accruing to local people. Alternatively, new institutional arrangements can be envisaged. For example, state-owned land may (without any change of ownership) be placed at the disposition of local authorities to be managed in the local interest. This is the solution adopted in Senegal, with the transfer of responsibility to the Local Community Councils. In such cases the forester is answerable to the local authority. A more definitive step with similar implications is the transfer of titular ownership to the local authority. With either arrangement, the forester may either be directly employed by the local authority or seconded to it.

Another alternative would be to entrust the management of forests to organizations of local people, such as farmers' associations and cooperatives. These might be simply marketing organizations, as have quite commonly been formed to handle non-wood forest products, such as mushrooms and resin. They could also be more ambitious, engaging in the harvesting and even processing of the timber, as has occurred under the Social Forestry System in Honduras.

Alongside the task of managing the forests is that of helping to get trees planted outside the forests and collaborating with the agricultural services to promote the combination of trees with crop and livestock production. This should not be seen as the task of a new profession, but as a new job for foresters. Many of the skills required are those that they already possess, while others can be acquired through in-service training and be included in the education of future foresters. The supplies of tree products from outside and inside forests are two parts of a single set of problems. To divide them between two separate corps of specialists would weaken both, and would destroy their unity of action. Moreover, the future of relations with forest neighbours will be greatly improved if the forester is the provider of new benefits as well as the continuing guardian against over-exploitation.

The various ways in which forestry can be adapted to make it more responsive and effective in the context of rural development have in common the growing role of the forester as an extension agent. In many situations, the task of foresters will be to advise and assist others in the planting, tending and utilization of trees, rather than to manage

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47/ FAO. Modernizing institutions to promote forestry development, op. cit.; Louis Velay. Administrative Organization of Forestry in the Developing Countries, FO: FDT/75/5(a), FAO, Rome, July 1978.

them themselves. This does not necessarily mean that a separate forestry extension service should be created, especially as it could heighten the risk of farmers receiving contradictory advice from different sources. Advice on forestry might more effectively be channelled through existing agricultural extension machinery. It does mean, however, that a major challenge facing forest administrations in many countries is that of adding to their existing capability to manage forest land a capability to deliver the necessary support to enable others to grow and manage trees, both within the forest and outside it.

FINANCIAL IMPLICATIONS

If forestry and tree-planting are to play their full part in rural development, they will need a larger share of the government budget than has been customary. The pattern of spending that is required is, however, such as to contribute to both the growth and the distribution of national income. The capital investment required is mainly in works that can be achieved by the rural labour force combined with a small element of imported machinery and equipment. With the use of fast-growing species, returns can be expected in a few years. They should include import savings on food and fuels, as well as providing the basis for export earnings or import savings on wood products.

The extension forester needs to be able to negotiate particular forms of financial and material aid to villagers. One of the main impediments to tree-planting in many areas is the inability to give up the use of any food-producing land, however poor, while waiting for tree products to become available. This may be overcome by offering loans on easy terms or by giving grants or food aid. Where the trees are destined for sale, advance purchase of the crop may be possible. Interim intercropping with food products would also help.

Land rehabilitation and soil conservation programmes in mountainous and semi-arid lands are particularly onerous and require generous help. In most cases the financial burden of restoration work is beyond the economic possibilities of the local people. As such work will result in the protection of human settlements and agricultural lands downstream, it is only right that society as a whole, through the government should share in the cost.

Incentive schemes and conservation programmes to restore degraded land need to be carefully chosen, so as to lead to increased production and to enable farmers to become self-reliant again. Incentives that have been successfully applied in watershed management and soil conservation programmes include tax exemptions, cost-sharing contracts, village revolving funds, village labour banks, the provision of government-paid labour, food for work, subsidies in kind or cash, and preferential rates in irrigation systems and other government services.

FUTURE PERSPECTIVES

The previous pages have given many examples of the ways in which forestry can contribute to rural development and some of the principal factors which have to be taken into account in formulating a programme of action. These contributions are of particular concern to those developing countries where, until recently, it has generally been believed that vast areas of arable soils lay beneath tropical forests, waiting to be exploited by modern methods of agriculture, such as mechanization. The need for the most careful husbandry of these soils, which are often shallow and very fragile, is now being increasingly recognized.

The implementation of forestry policies as an essential and integral part of rural development involves no great technical problems. There is, however, an urgent need to inculcate a far deeper understanding on the part of all concerned, from policy makers to land users, of the importance of trees both within and outside the forests. The opportunity costs of the various uses to which land may be put must be carefully examined; the short term benefits must be weighed against the long-term need to conserve the environment and ensure the optimum and sustained productivity of plants and animals. This is a matter which transcends any local interests and is vital to all sectors of the community, to both rural and urban dwellers alike. The amount of work that will have to be done is immense and adequate popular support will be necessary if the programmes envisaged are to be feasible.

An indication of the scale of activity likely to be required is given by FAO's latest perspective study, Agriculture: Toward 2000. A cautious estimate suggests that fuelwood consumption in the developing market economies may rise by the year 2000 from the present level of about 1,000 million m^3 to some 1,200 m^3, and that, if availability were not a limiting factor, the figure would be closer to 1,900 m^3 48/. If it is assumed that 300 million m^3 would come from using up the living capital of trees and forests, then to replace this capital and make good the shortfall of 700 million m^3, it would be necessary to install capacity to produce the equivalent of an extra 1,000 million m^3 of wood in 20 years. The "average tree" is too fictitious an entity for such figures to be translated into a certain number of trees. However, even making optimistic assumptions about the provision of energy from crop residues, biogas reactors, solar cookers, and other sources, and about improvements in the efficiency of stoves and cooking apparatus, the required extra number of trees would be several thousand million.

The volume of wood required for all other needs in the developing market economy countries is much smaller and is estimated at 550 million m^3. The need for resources in the immediate locality is also less, so that it should be relatively easy to meet the requirements from existing forests, although great efforts will be needed if this is to be achieved on a sustainable basis. However, if most of this wood is to be processed in rural industry, there is a vast task ahead in designing and installing plant, and in training workers, technicians and managers.

The degree of effort required to ensure that trees make their full contribution to integrated land husbandry will vary very greatly from area to area. There is an immense task ahead if 240 million people who are estimated to live by non-continuous cultivation in tropical forests are all to be reached by extension services. They will need to be helped not only with such things as credit and planting stock but also with the means to become settled communities with access to schooling, health facilities and other necessities. In comparison expanding the number of trees over the vast areas of settled agriculture is relatively easier.

48/ FAO. Agriculture: Toward 2000, Rome, 1979, p. 129.

Hardest of all in terms of material organization is no doubt the renovation of mountainous regions ravaged by erosion. To restore depleted and eroded soils and establish a vegetation cover which can fulfil production and protection objectives, it is necessary not just to plant trees or appropriate crops wherever needed, but to treat the land by constructing check dams, bench terraces and other structures to stabilize the soil. To make this possible, radical alterations in the present production systems will often be necessary. At the very minimum, local people will be faced with a transitional period during which their customary practices are severely disrupted. The rehabilitation of mountain watersheds requires enormous labour and material inputs, and the costs are far beyond the resources of the populations of the upland areas. In order to provide the necessary support and incentives, massive outside aid will be needed, much of it from the industrialized countries.

The hardest task in psychological terms is probably that of reintroducing trees in the arid and semi-arid grazing lands of the world, which occupy some 14 million km^2. Although isolated shade trees and relic forests exist and are valued, there is a general belief that the lack of trees is dictated by the climate. There are far too few successful fuelwood plantations to have an impact as demonstrations to the contrary, and fodder orchards are so few that even many foresters and agricultural specialists have never seen one. The widespread combination of collective land ownership with private herd ownership, with the attendant incentive for each grazier to maximize the size of his herd, is an obstacle even to rational pasture management, let alone the planting of trees. The magnitude of the psychological barrier should not, however, discourage determined efforts to introduce change, for these vast areas threaten to turn to desert if not better managed.