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FOREWORD

For centuries, individuals and communities have been able to live in harmony with their environment, but during the past decades the rapid growth of populations and the higher expectations which have been generated throughout the world have led to an increase in the use of forests to such an extent that forests in many places have become degraded if they have not been razed to the ground. Moreover, the forest dweller's life has, in many places, become one of misery. Industrial exploitation, while sometimes contributing to national and regional economies, has not benefited the rural poor and has often even led to the impoverishment of agricultural soils that are dependent on the protective value of the forests.

Forestry for Local Community Development is a new people-oriented policy adopted by FAO, the objective of which is to raise the standard of living of the rural dweller, to involve him in the decision making processes which affect his very existence and to transform him into a dynamic citizen capable of contributing to a larger range of activities than he was used to and of which he will be the direct beneficiary. Forestry for Local Community Development is therefore about the rural people and for the rural people. Its ultimate objective is not physical but human. The physical goals which will be set are really means towards achieving the objective of enhancing the lives of human beings. And one of the vehicles which we advocate in order to assist in the achievement of these objectives is forestry.

The first phase of formulating this policy has been completed with the publication of this document, which describes the rural dependence on wood, the major constraints which can be encountered when initiating programmes, and suggests possible solutions and specific forestry practices which can benefit the rural poor.

Forestry for Local Community Development is in many respects a new departure in forest management and forest utilization. It is my sincere hope that this document will assist those who wish to tread this new path, which we believe will lead to the improvement of the quality of life of the rural poor.

K.F.S. King
Assistant Director-General
and
Head of the Forestry Department

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INTRODUCTION

This study forms one part of a programme directed towards increasing the contribution forestry makes towards alleviating the conditions of the rural poor in developing countries. The purpose of the study is to examine the nature and dimensions of dependence on forests and forest outputs at the local rural community level, to assess the associated problems and possibilities, and to identify the policies, requisites and measures that are likely to be necessary in order to initiate and implement successful forestry programmes for the benefit of rural communities.

Community forestry has been defined for the purpose of this study as any situation which intimately involves local people in a forestry activity. It embraces a spectrum of situations ranging from woodlots in areas which are short of wood and other forest products for local needs, through the growing of trees at the farm level to provide cash crops and the processing of forest products at the household, artisan or small industry level to generate income, to the activities of forest dwelling communities. It excludes large-scale industrial forestry and any other form of forestry which contributes to community development solely through employment and wages, but it does include activities of forest industry enterprises and public forest services which encourage and assist forestry activities at the community level. The activities so encompassed are potentially compatible with all types of land ownership. While it thus provides only a partial view of the impact of forestry on rural development, it does embrace most of the ways in which forestry and the goods and services of forestry directly affect the lives of rural people.

This study is a first attempt to bring together existing knowledge and ideas. It is addressed in the first instance to foresters, many of whom have long been aware of the need to satisfy local demand and of the possibilities that forestry has for furthering the development of rural economics. It is hoped that they will be encouraged, by this evidence of worldwide interest and support, to communicate their enthusiasm to agriculturalists, to administrators and politicians and to the public at large. They are invited to make use of the material as presented in preparing literature suitable for reading by non-specialists in their various countries. The Food and Agriculture Organization of the United Nations (FAO) hopes to follow up this study with a number of documents and other supporting materials which will provide more detailed information designed to assist the task of implementing the concepts outlined here.

The study was developed through a sequential process of assembling, collating, analysing and interpreting the available information on past and present experience in forestry activities at the community level in different parts of the developing world. This has been carried out by the Forestry Department of FAO, with the support of the Swedish International Development Authority (SIDA) and the collaboration of experts from 18 developing countries with actual experience in such forestry activities.

This process was initiated by setting up a small Advisory Panel on Forestry for Local Community Development. At its first meeting in October, 1976, the Panel decided to proceed by commissioning a series of relevant case studies. These were reviewed and analyzed at an enlarged second meeting of the Panel in June, 1977. This body of material formed the basis for a first draft of the present study. The draft was then used as the starting point for a more extensive appraisal in the course of an Expert Consultation on Forestry for Local Community Development, which was held in Indonesia in December, 1977.

At the Consultation the experiences reported in the draft were reviewed, the lessons of the additional experience of the countries represented at the meeting were added, and the analysis was revised in the light of this wider knowledge. The study was then rewritten to

incorporate these revisions and additions and the comments received in response to the circulating draft for comment both inside and outside FAO.

In the study the information has been synthesized in three parts:

- The nature and extent of forestry at the community level, and of the problems and possibilities that arise.

- Policies, programmes and other requisites necessary for successfully developing forestry activities for the benefit of rural communities.

- Technical considerations to be taken into account in implementing community forestry activities.

As forestry at the community level is an integral part of rural development, much of what has to be done to advance such forestry activities is common to what has to be done in the pursuit of rural development as a whole. In order to maintain a forestry focus, only those technical aspects specific to forestry activities are dealt with in any detail in the document — others are referred to only in passing. However, Appendix 1 contains a list of the more important steps that need to be undertaken in order to analyze the situation of the community in which a forestry component is to be inserted or strengthened.

To provide a complete account of how to identify, design and implement community forestry projects it would also be necessary to extend the coverage and provide more detail on some of the forestry-related components. In particular, a total listing of all possible forest-based activities that might contribute to development at the household or community level would be much more extensive than that contained in Appendix 1. In addition, much more information on techniques, costs, marketing, etc., would be needed for each. Similar considerations apply to the range of possible species that might be grown. In recognition of this, the Expert Consultation recommended that separate compendia of information be compiled for each of these two areas. Coverage in the present study is therefore selective, confined to a representative list of some of the more important species, products and processes.

The study has had the benefit of input from a large number of people. In particular the contribution is gratefully acknowledged of the experts who were members of the Advisory Panel on Forestry for Local Community Development. They provided much of the case material which constituted the core of the experience on which the study was based. In addition, through the discussions at the meetings of the Panel, they provided a vital input to the analysis and interpretation of the experience. The expert members of the Panel were the following:

Mr. Zerai ADAYA
Former General Manager
Forestry & Wildlife Development Authority
Addis Ababa, Ethiopia

Mr. Marc DUROJEANNI Ricordi
Director-General
Servicio Forestal y de Fauna
Ministerio de Agricultura
Lima, Peru

Dr. D. E. IYAMABO
Director
Agricultural Sciences Research Department
National Sciences and Technology Development Agency
Ibadan, Nigeria

Mr. E. M. MNZAVA
Acting Director of Forestry
Ministry of Natural Resources and Tourism
Dar-es-Salaam, Tanzania

Mr. A. SAMPER Gnecco
Presidente
Corporacion Nacional de Investigación y Fomento Forestal
Bogotá, Colombia

Mr. B. SIVARAMAN
Member Planning Committee
Government of India
New Delhi, India

Mr. J. H. LOPEZ Parodi
Director Zona Agraria
Iquitos, Peru

Mr. SOEKIMAN Atmosoedarjo
President
Perum Perhutani
Jakarta, Indonesia.

Acknowledgement is equally extended to the experts from 15 countries and several institutions who constituted the final review body at the Expert Consultation. Appreciation is also expressed to the large number of people who contributed to the drafting and re-drafting of the material for the study. The study was prepared by T.G. Allen, J.E.M. Arnold, L.S. Botero, K.F.S. King, E. Pelinck, F. Schmithüsen, Tran Van Nao and R.L. Willan of the Forestry Department of FAO, and P. Stewart of the Commonwealth Forestry Institute in Oxford.

PART I

THE NATURE AND EXTENT OF THE PROBLEM

INTRODUCTION

During the past thirty years there has been considerable activity in the field of economic development. A great amount of money has been spent by governments and by international and bilateral agencies in the pursuit of economic growth. The international agencies have been expanded, the number of staff made available to them has grown almost exponentially, and the developing countries have been subjected to a plethora of missions of experts, of one kind or another, all devoted to assisting them to develop their economies.

And yet the degree of development in many countries of the Third World remains alarmingly low. There is still much poverty; there is still much underemployment and unemployment; there is still much malnutrition. In general the conditions of the poor, both in the urban and rural areas, have worsened. Where there has been some economic growth, it has occurred in an inequitable manner. The gap between rich and poor in many developing countries has increased, as it has between the developed and developing economies.

The lot of the rural poor is perhaps more severe, more pernicious, more hopeless, given current policies and programmes, than that of the urban dweller. The problems of towns are concentrated and acute, and are constantly visible to town-based politicians and administrators. Apparent solutions are available 'off the peg' in the form of factories, hospitals, schools, and so on. Large sums of money can be invested in a small area, easily accessible for inspection and control. By contrast, the problems of the countryside are diffuse and chronic, and are often visible only to the eye of an expert. To remedy the situation in the rural areas often necessitates the spreading of investment over large areas. This creates difficulties in the conception, execution and evaluation of programmes. There is moreover an 'overflow mechanism' which ensures that excessive misery is transferred from country to town by migration. Governments therefore tend to invest mainly in urban development.

The roots of the problem of rural poverty are, in general, population growth and rising expectations. As long as populations remained stable over long periods of time, the way of life that had evolved to sustain them ensured adequate levels of production to satisfy perceived demands. However, in comparatively recent years, most countries have undergone a period of rapid population growth, making it impossible to maintain sufficient production by traditional methods from the available land area. At the same time the spread of information has led country dwellers to increase their demands and to want the benefits that they now know are enjoyed by many in the towns.

In thickly populated regions, many rural peoples have sacrificed their forests, since wood is less indispensable than food (though in the long run the absence of woodlands may depress farm output). This has often led to erosion, where agricultural crops have been pushed on to unsuitable land. Temporary relief from food shortages has thus been bought by consuming the biological capital of trees and soil, leaving a smaller capital for future production of all kinds.

At the opposite extreme, stand the sparse human communities of dense tropical forests. Their populations have in many cases declined because of imported diseases; and their traditional methods of production by hunting and gathering or by shifting cultivation are constrained by the activities of neighbouring societies and by the shrinkage of the forest area. They inhabit regions of massive biological capital without benefiting fully from its product. New systems of forest management are needed if these communities are to develop.

Between these extremes there are many intermediate cases. Particularly important is that of the more arid lands which are given over mainly to grazing. Here the rural population has often remained relatively constant at a low level, but animal numbers have increased to satisfy the growing demand of neighbouring towns. Natural forests have been reduced to pitiful relics by a combination of grazing, fire and overexploitation. The biological capital of soil and vegetation is maintained near its minimum level. The obvious solution, i.e., the reintroduction of woodland into such areas, is particularly difficult and depends mainly, if not entirely, on the community's willingness to restrict grazing.

Population growth is not the only root cause of rural poverty. In many parts of the developing world, population pressure on the land resource is relatively weak, but still large segments of the rural population remain poor as development takes place around them. This is so because of political constraints and obsolete power and institutional structures, which also contribute centrally to the failure of development to 'trickle down' to most of the rural poor.

The following chapters seek to establish principles which are relevant to a wide range of physical and social situations and to give examples of appropriate techniques. It is clearly beyond the scope of such a study to try and take into account all aspects of the complex problems outlined above which lie at the heart of rural poverty. The analysis in this study will concentrate on finding technical solutions, such as selecting appropriate species, finding ways to better organize communities to carry out forestry operations, how to improve the dissemination of knowledge, etc. However, in doing so it is necessary to recognize a basic precept of rural development, which applies much more widely than just to its forestry component.

The central purpose of rural development is to help the rural poor become self-reliant in their efforts to alleviate their situation. It will not succeed unless it reflects the people's own interpretation of their needs, problems and aspirations. Forestry for community development must therefore be forestry for the people and involving the people. It must be forestry which starts at the 'grass roots'.

RURAL DEPENDENCE ON FOREST OUTPUTS

The importance of forests and the goods and services from the forests to the rural peoples in developing countries is mainly threefold. Forest trees provide fuel and other goods essential to meeting basic needs at the rural household and community level. Forests and forest lands provide food and the environmental stability necessary for continued food production. Forests and forest products can generate income and employment in the rural community. Some of the benefits which forestry can bring to rural communities are summarized in Table 1 and are discussed more fully in the following sections.

FUELWOOD AND TIMBER

Wood is the dominant domestic fuel for rural people in developing countries, and for many of the urban poor as well. In many parts of the developing world, wood is also the principal structural material for constructing shelter and housing.

More than 1.5 thousand million people use wood daily for cooking their food and for maintaining essential levels of warmth in the home. Wood is the preferred fuel because it can be used without complex equipment, both for use and distribution, and can be acquired at little cost, often no more than the cost involved in gathering it. For the poor there is often no alternative to wood fuel or other locally available organic materials. Commercial fuels, even where they are available, require cash outlays on stoves and related equipment which are generally beyond the reach of the rural poor. One consequence of growing rural populations is, thus, an inexorable growth in the pressures on locally available forest resources and other sources of woody material. The source of wood fuel extends progressively from collecting deadwood to the lopping of live trees, the felling of trees, the total destruction of tree cover, the loss of organic matter to the soil, and eventually to the uprooting of stumps and removal of shrubs. Subsequent to this there is the diversion of agricultural residues and animal dung to fuel use, to the detriment of soil structure and soil fertility.

TABLE 1

BENEFITS OF FORESTRY TO RURAL COMMUNITIES

Output	Beneficial Characteristics
Fuel	Low cost in use Producible locally at low cash cost Substitutes for costly commercial fuels Substitutes for agricultural residues Prevents destruction of protective ground cover Prevents diversion of household labour Maintains availability of cooked food
Building materials	Low cost in use Producible locally at low cash cost Substitutes costly commercial materials Maintains/improves housing standards
Food, fodder, grazing	Protection of cropland against wind and water erosion Complementary sources of food, fodder and forage (e.g., in dry periods) Environment for supplementary food production (e.g., honey) Increased productivity of marginal crop land
Saleable products	Raising farmer/community incomes Diversifying the community economy Additional employment
Raw materials	Inputs to local handicraft, cottage and small-scale industries (Plus benefits as from saleable products)

At the same time the steady disappearance of wood in the vicinty of the community means increased social hardship. Progressively, more of the time of household members must be devoted to gathering fuel. It has been estimated that fuelwood gathering now requires 360 man days annually per household in the Gambia and 250 - 500 man days in central Tanzania. As the situation deteriorates further, and the household is forced to purchase its wood fuel, a heavy burden is placed on the household budget. It is reported that up to 15 percent of household income is spent on fuel in the highlands of the Republic of Korea, and up to 25 percent in the poorer parts of the Andean Sierra and the Sahelian zone.

Eventually, this shortage of wood fuel can affect the nutritional well-being of the people. In parts of West Africa, people have been reduced to one cooked meal a day. In the uplands of Nepal only vegetables which can be eaten raw are grown. In Haiti, a principal impediment to the introduction of new food crops with better nutritive value into the wood-poor hills is that they would require more cooking.

FOOD AND THE ENVIRONMENT

There are now perhaps 200 million people living in the tropical forest areas and practising 'slash and burn' farming (shifting agriculture) on perhaps 300 million hectares (ha) of forest lands in order to provide their daily food. In parts of south and southeast Asia this form of land use occupies some 30 percent of the officially designated forest area. Traditional systems of shifting agriculture, which employed a lengthy fallow period under forests to restore the fertility of soils which were capable of supporting

agricultural crops for only a limited number of years, have largely broken down. Growing population pressures, and migration into the forest areas by landless people from elsewhere, have forced a progressive shortening of the fallow period to the point where it suffices neither to restore soil fertility nor to recreate a useable forest crop. Similar trends are discernible in the more open savannah woodlands of more arid areas. The problems of the gum arabic system of Sudan described in Appendix 2 are largely a result of pressures to cultivate more land, at the expense of the fallow period under Acacia. The future of such areas on which productivity cannot be maintained indefinitely under crop production calls for systems of joint production of trees and other crops.

In addition to crop production there are many other ways in which rural communities can draw upon the forests for food in one part of the world or another. Bush meat and honey provide supplementary food sources, as do a wide variety of tubers, fruits and leaves. Fish production in swamps or mangrove forests can also be an important protein source, for mangroves and swamp forests offer a most valuable protective and productive habitat for fish.

In many areas trees are a source of fodder. In Nepal, leaves make up about 40 percent of the annual feed of a buffalo and about 25 percent for a cow. In dry forest areas, livestock often cannot survive without forest grazing. In the Sahel, leaf fodder is the principal source of feed in the dry season, and the excessive grazing of trees during the recent lengthy drought contributed significantly to the large-scale destruction of the vital tree cover.

Concurrent with the pressures on the forest from within from shifting cultivation are the pressures for alienation of forest land which arise from the need of expanding rural populations for more land on which to grow food. In most areas, forests are the largest remaining land-bank — the one land cover which can absorb large-scale further extension of the area under crop production. It has been estimated that the existing area of forest in developing countries is being reduced annually by 5 - 10 million ha in Latin America, 2 million ha in Africa and 4 million ha in Asia. To the extent that this process releases to food production land which can sustain the growth of crops, this is logical and to be planned for. But over large areas, the pressures of growing populations force landless farmers onto soils which cannot sustain crop production and onto slopes which cannot be safely cultivated — at least with the techniques and resources available to these farmers. The consequences of these practices in terms of wind and soil erosion, silting, flooding and drought, are well known. Some 10 percent of the world's population live in mountainous areas, but another 40 percent live in adjacent lowlands, so that fully half of mankind is directly affected by ravages of the watershed environments.

It is reported that in India, 50 percent of the total land area is seriously affected by water and wind erosion. Indeed, displacement of fertile top soil is estimated to be around 6 000 million tons a year. In Pakistan, erosion affects 76 percent of the total land area. Nepal is perhaps one of the most dramatic cases of its kind in Asia. In many parts of Nepal the forests have been cleared up to 2 000 metres (m). Slopes of 100 percent are under cultivation. Huge landslides occur during periods of continuous rain. These landslides, which destroy lives and crops and remove the necessary humus, occur more and more frequently throughout the Nepalese hills, in part because ground-holding trees are disappearing fast. At present, the washing away of top soil is a threat to agricultural productivity in the remaining fields. Similar landscapes, perhaps to some extent less pronounced, can be found everywhere in the hilly areas in other parts of the world.

The erosion of agricultural soils often results in the siltation of rivers and water reservoirs. Thus, the river bed of the Nepalese Terai is rising between 15 - 30 cm a year. This rising of river beds, which occurs because of accelerated soil erosion and siltation, is a major cause of the more frequent and dangerous floods in all regions. But sedimentation also causes loss of reservoir water storage capacity. In the Indian subcontinent the Mangla reservoir is estimated to receive every year 100 million tons of sediment, of which the Jhelum river, due to indiscriminate felling and burning of the forest in the catchment area, contributes about 30 percent. The Mangla reservoir was built to last 100 years or more. Sediment measurement after a few years of operation indicates that most of the reservoir's capacity will have gone in 50 to 75 years. These are illustrative of many similar examples.

The process of environmental degradation following destruction of the tree oover is often accelerated by the pressures of fuelwood harvesting. These tend to be most pronounced in the neighbourhood of large towns and cities. Wood is the preferred fuel not only of the rural poor but also of many of the urban poor as well, who use it principally in the form of charcoal. The large concentrated demands that ensue have led to treeless wastes in peri-urban areas in many parts of Africa, Asia and Latin America, with the areas affected often growing at frightening speed.

INCOME AND EMPLOYMENT

Forests and trees can give rise to cash crops such as mushrooms, chestnuts, walnuts and pine kernels. Bamboo can be cultivated for shoot production, as is done in Japan. In many oountries trees are grown at the smallholder level, to provide fuelwood for sale to the urban and semi-urban areas. In India the income from gathering and selling fuelwood is an important part of the economy of forest villagers, especially for the poor in these villages. Tree farming can also provide profitable industrial wood crops, such as the pulpwood grown by farmers in the Philippines. Among non-wood products, the gum arabic produced as a farmer crop in Sudan is one of the more important export commodities of that country.

In addition to the income and employment generated by their industrial exploitation, forests also provide timber and other raw material for local craftsmen and small-scale artisan and processing activities. Throughout the developing world, doors and other builders' woodwork, furniture, tools and other agricultural inputs such as fence posts are made locally within the community. These products, together with wooden handicrafts, and other products of non-wood raw materials such as 'tasar' silk, can also be marketed outside the community.

Forestry can also contribute to rural incomes in less direct ways. If other alternatives for raising the incomes of the rural poor are not promising, the establishment of fuelwood lots may provide a means to raise their incomes by releasing dung and agricultural residues for reworking into the soil, so increasing crop yields. In this way forests may also oontribute to a more equitable distribution of income. It might be easier to help the poor by providing them with fuel in the form of wood than with similar benefits provided through taxation and redistribution.

CONSTRAINTS AND CONDITIONS

Where exploitable forest exists but does not fully benefit local communities, the necessary adjustments in management praotices are likely to be relatively easy to oonoeive and execute. Where forests have been destroyed, either to make way for farming or grazing or out of disregard for the principles of resouroe renewal, the reintroduction of forestry is likely to pose many problems. The discussion in the sections that follow consequently focuses on the latter. This should not, however, be interpreted as implying that most community forestry will be concerned with afforestation and reforestation. Much of it should be ooncerned with better management of the natural forests for the benefit of local people.

Some of the factors to be taken into account in analysing the place of forestry in a rural economy are summarized in Table 2; these factors and some possible responses are discussed more fully in later sections.

COMPETITION FOR LAND

Traditional community forestry systems tend to be appropriate to areas of low population intensity, in which an abundance of land permits the integration of forestry on some parts of the area with crop growing on others, or an extensive use of the area for both trees and grazing. Typical of the first of these are shifting cultivation systems with their fallow periods under tree cover, and modifications of this system such as is exemplified by the gum arabic system of Sudan. Typical of the latter are the pastoral/forestry systems of the Sahel. However, as has been described earlier, such systems have in many cases been unable to withstand increasing population pressure. The first signs of breakdown tend to be the expansion of the intensive crop component at the expense of the extensive forestry component.

TABLE 2

FACTORS TO BE TAKEN INTO ACCOUNT IN ANALYSING THE PLACE OF FORESTRY IN A RURAL ECONOMY

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/forest industries employment; secondary forest product income; social infrastructure, etc.
- Competition for crop/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 or grazing - Improve productivity on the more 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)
The 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, etc. - Introduce or expand complementary non-forestry sources of income
- The risk that the 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

Such competition naturally is much more intense where population pressure is heavy and the land amenable to cultivation even on a temporary basis. Even where the need to maintain land under tree cover is evident, such as on poor steep slopes in the hills of Java, Nepal and Colombia, forestry gives way to the more urgent imperative of land for food production. A clear condition for inserting forestry into such situations is that it be accompanied by measures to provide the farmer or the community with alternative ways of generating the crop or livestock production, or the income, foregone by placing part of the land under trees.

Wherever the local economy is based on subsistence farming, diet is the primary factor determing land use, in combination with population size and techniques of production, and its demands take precedence over those for wood. Diets based on a single cereal produced by alternating crop and fallow need a large area per household and are particularly likely to exclude forestry. Diets which require a higher content of animal products from free-range grazing make forest regeneration almost impossible even at low levels of human population, especially if surplus stock is readily sold.

Dietary habits are among the deepest rooted and stablest elements in a way of life. They are learned very young and are often reinforced by beliefs about health, fertility or even moral qualities, and in some cases they are consecrated by religion. The introduction of new foods is therefore often fraught with difficulties and must be pursued slowly. However, such introduction is often important, for if greater variety is achieved, it will be possible to rotate crops, and to integrate agriculture and animal husbandry, enabling more food to be produced on a smaller area. Moreover, the introduction of cash crops may allow some of the customary foods to be bought in exchange for the produce of a still smaller area. In such ways land may be released for forestry.

The known techniques of food production, though less fundamental than diet as a part of culture, are by no means incidental. Farming and grazing methods fix the hours and seasons of work and are bound up with the division of labour between the sexes and between age groups, which in turn is an integral part of social structure. A people that enjoys the leisure afforded by free-range grazing or by reliance on a single main crop plant will have difficulty in adapting to more intensive methods. Where crop growing is allocated to women or herd-minding to children, there is likely to be strong male resistance to more efficient systems that require some of the work to be transferred to men. Such features also hinder the release of land for forestry.

Techniques of food preparation seem to be less central to a way of life than techniques of production. The changeover from fuelwood to dung or fossil fuels has been accomplished by countless societies. Scarcity of fuelwood is thus less acutely felt than many of the changes needed to release land for its production. In order to encourage more appropriate use of wood, and the tree growing or tree tending necessary to produce that wood, it may therefore be necessary to bring about changes in attitudes and habits. This is likely to be achieved only if it takes local mores and traditions into account.

Direct competition with food production for land may be avoided by taking up unused areas. However, even in these areas care must be taken to select tree species which are as productive as possible, and competitive with alternative non-food crops (including other tree crops, such as rubber and oil palm). In parts of India, notably in West Bengal, widespread use has been made of roadsides and the ridge boundaries of fields, using trees such as Shisham (Dalbergia latifolia) and sissoo (D. sissoo) which minimize the shade and root competition to adjacent crops. In China, too, trees are planted in such a way as to minimize competition between them and food crops. Intercropping between tree rows in plantations is done during the first two years. Trees are planted on barren lands, around dwellings, along road and riversides, and around villages. Quick growing species are preferred as well as those providing leaves, nuts, fruits or bark for domestic use and for crafts. In this 'four-side planting' (road, river, dwelling and village) the people are actively participating to help solve fuelwood problems.

Inserting trees into intensive land-use patterns may also be achieved through various forms of intercropping, to bring about multiple use of the land. In Java, where pressure on the land is particularly intensive, the area put under trees is intercropped with grass, to provide fodder for stall-feeding animals. Fodder, this time in the form of leaves from suitable trees, is an important component of the solution being tried in the hill areas of Nepal. Equally important in the latter are the measures to improve crop productivity in the flatter and more arable areas and to improve other parts of the communities' economy and their physical and social infrastructure, to enable them to divert land to tree cover.

The whole question of land use is usually confused by the lack of information about land capabilities and about the factors needed for land-use planning. The boundaries between land which can support sustained cropping and land which needs to be devoted periodically or permanently to forest cover are seldom known. Much of forest land unsuitable for permanent agriculture is cleared, in preference to adjacent land which is suitable, through ignorance.

THE TIMESCALE OF FORESTRY

In many cases, attachment to a particular diet and technique of production is reinforced by considerations derived from the timescale of forestry. Historically, rural populations have developed a dependence upon outputs of the forest because the latter existed as an abundant available local natural resource to be drawn upon at will. As long as it remained abundant, this process of exploiting existing forest capital could take place without any regard to the relatively long time involved in producing wood of usable sizes. However, once the point is reached where wood can continue to be supplied only by growing it, the time frame involved can become an important limiting factor.

The timescale of forestry is bound to conflict with the priorities of the rural poor, which are logically focussed on meeting basic present needs. Present needs are likely to be imperative, particularly in subsistence situations. Land, labour and other resources which could be devoted to providing the food, fuel and income needed today cannot easily be diverted to the production of wood which will be available only several or many years into the future. A major effort to induce forest-dependent communities in India to forego rights of usage in the forest and to adopt managed forestry practices foundered on just this issue. The pilfering of wood from the forest and its sale as fuel to nearby urban and semi-urban markets formed a major source of income for the village poor. There was no countervailing incentive at the community level of sufficient force to offset these vested interests effectively in favour of the status quo.

Forestry can continue to exist or be introduced at the community level only if it allows for these real present needs. If local tree cover still exists, it may be possible to provide the same production in a less destructive way. In an area in central India, for example, destructive local cutting of the forest was halted and reversed by concentrating the cut on annual coupes, and protecting the rest of the area so that it could regenerate naturally. Recent experience in areas as diverse as the hills of Nepal and the southern edge of the Sahel has also demonstrated the capability of forests to regenerate with no more input than protection.

With the introduction of plantation forestry, the gap between establishment and production can become a more severe restraint. In the Philippines credit was provided to farmers growing trees. In Thailand and the Solo River Basin in Indonesia it was necessary to provide cash payments for this initial period. In the Republic of Korea a mixture of species was employed in village fuelwood lots with species such as Lespedeza which yield income as early as the first year, interspersed with species to produce both fuelwood and industrial wood in volume over a longer period. In many systems forestry was introduced together with other activities which secured sufficient income to tide the farmer over the period until his trees were yielding.

THE SPATIAL DISTRIBUTION OF BENEFITS

In the case of forest communities considerations of time are less important than those derived from the spatial distribution of forest benefits. To the shifting cultivator, the forest is land upon which to cultivate his food and cash crops, a source of fuel and building materials, and possibly of fodder, shade, etc. The fact that the trees he destroys or uses in this way could provide the raw material for an industry, and in this way income and employment and processed products to be enjoyed elsewhere, is clearly of no relevance to him. To expect him to adapt his way of life in order to accommodate these interests of others is unrealistic. The buildup of more stable forest crop/tree systems is therefore likely to occur only if the community in some way benefits in appropriate measure from the change. Thus, the forest village system in Thailand, which is described in Appendix 2, began to prove attractive to forest dwellers only when it was accompanied by the provision of land upon which to practise settled agriculture, financial and other support to do so, and social and physical infrastructural amenities.

The core of the problem for forest communities is thus usually that they derive insufficient benefit from the forest. That this is so is often attributable to conventional forest management objectives and administrative practices, an orientation towards conservation, wood production, revenue collection, and regulation through punitive legislation and regulation. The task of forestry for the development of such communities is consequently to engage them more fully, positively and beneficially in its utilization, management and protection. This may take the form of greater participation in forest work, for example through logging or sawmilling cooperatives, development of the income potential of secondary products that can be produced in the forest, such as assistance in establishing production, distribution and marketing systems for such products as honey, or through the allocation of forest land for the concurrent production of forestry and agricultural crops, or for grazing of animals. As is discussed later, this can require quite radical reorientation of traditional forestry concepts and practices.

The issue of distribution of benefits can also arise with systems to establish industrial tree crops through farming systems which intercrop trees with food and cash crops1/. The trees in themselves will bring no direct benefit to the farmer. They are rather an impediment, considerably complicating his task. These systems are, therefore, likely to succeed only if the farmer perceives an adequate recompense to himself. In the many parts of the tropics in which such systems have been introduced, the principal such incentive is seen to be sheer land hunger, the unavailability of land elsewhere which the population could cultivate. But it has been observed that, over time, such systems tend to evolve either into settled agriculture, with the rejection of the associated growing of trees, or into full-time forestry employment, as has happened recently in Kenya and Bangladesh. This suggests that land in itself is not a sufficient inducement, other than in the short term.

Similar considerations apply to other types of forestry. Tree cover on the upper slopes of hills in Java, Nepal, Colombia and elsewhere may well provide tangible direct benefits to the immediate community in the form of protection against landslides and excessive water runoff. But a large part of the benefit will be felt in the regions downstream, in the form of reduced flooding, silting, erosion, etc. Again, it is unrealistic, and unreasonable, to expect people to commit land, labour and other resources to such endeavours on behalf of others, unless they are suitably recompensed.

INSTITUTIONAL AND TECHNICAL CONSTRAINTS

There remain situations in which there is no lack of interest in forestry nor any conflict with other aspects of the way of life, but only a lack of organization or of means.

1/ See page 43 for a more detailed description of such systems.

The very successful programme of village woodlots being established in the Republic of Korea utilizes land, too steep to be cropped, which is set aside by law to be used solely for forestry. The programme thus mobilises for this purpose idle land which individual poor farmers are unable to afforest with their own resources. In parts of Ethiopia, Tanzania and Nigeria, communities suffering from shortages of fuelwood have earmarked areas marginal to crop production, such as hill tops and hill slopes for afforestation.

However areas which are marginal for agriculture may well also be marginal for forestry. This is particularly so in arid and semiarid areas, which tend to impose severe climatic constraints on the growing of trees, in particular fast-growing species which are needed if results are to be achieved within an acceptable period. Arid conditions also impose other constraints, including that of availability of labour. Labour is not a problem in most community forestry systems. In some, such as the gum arabic system in Sudan, the bulk of the forestry work falls in the slack season. Where there is a tradition of women working the fields, this releases men in the family for concurrent work on forestry. In the humid tropics, planting can be spread over a sufficiently long period to avoid a concurrence of tree and crop planting. In arid areas, however, the planting season for both is very short and coincides. As a result, the availability of labour for tree planting could be very restricted, and planning must allow sufficient flexibility to overcome such a constraint.

Forestry in arid conditions faces yet another constraint. Successful afforestation of dry lands often involve elaborate techniques, such as deep ploughing, requiring sophisticated and costly equipment. It may, therefore, often be an activity which is beyond the capability and resources of the local community. While local involvement will be as necessary here as elsewhere, in order to ensure recognition of the beneficial role of forestry, and of the desirability of setting aside land and protecting the subsequent tree crop, forestry as an activity which the community can implement may often be confined to managed manipulation of the existing vegetation, for example, the control of use and regeneration by control of grazing in the Sahel. Plantation forestry may often have to fall to the responsible technical arms of government.

The technical problems of steep upland areas are also likely to be beyond the capacity of local communities. In such areas, where the problem is largely one of soil stabilization and control of water runoff, establishment of forest cover on parts of the watershed must usually be accompanied by measures such as the construction of terraces to permit stable crop production on other parts. In many instances farmers will not have the resources to do this. To establish terraces, for example, they would have to forego one crop. They will therefore need the sort of external support such as was provided in Central Java through food aid and in Tunisia through credit and food aid.

Technical problems in implementing forestry at the community level are not peculiar to the arid or upland regions. Though there are examples where a tradition of growing trees exists, such as in Sudan, or where it has emerged or spread spontaneously, as in parts of southern India, eastern Afrioa and the Andean Sierra, a lack of a tradition of managed forestry is the much more common situation throughout the developing world. Thus, farmers are unfamiliar with the growing of tree species, with the properties of different species and their suitability for different sites and purposes, with the teohniques for planting and tending trees, and for harvesting them, eto.

Not surprisingly, therefore, a feature of most successful recent community forestry endeavours has been a strong, sustained technical support system, capable of providing advice and essential inputs such as planting stock, and of maintaining such support through the period necessary to generate forestry as a self-sustaining activity in a particular area.

Access to technology and inputs alone may not always suffice. To adopt and implement a forestry activity, the community may need a new or strengthened internal organization. In order to implement the village fuelwood system in the Republic of Korea, for example, forestry associations were set up in each village to execute the work, the extent of the assistance given to each varying with the level of self-reliance achieved by the village. In Thailand, the village forestry scheme required the establishment of entirely new communal institutions. In India, experience so far has been that forestry has required changes which are usually beyond the competence and authority of the elected village panchayat.

Another institutional issue is security of tenure of the land. The farmer, or community, must have adequate assuranoe that he will still control the land on which he plants the trees at the time when they are ready for harvesting. Thus, an important element in the Philippine smallholder pulpwood project was that eaoh farmer was first given title to his land. However, in this case this provided few problems; the land was vacant forest land classified as alienable and disposable for agricultural purposes. In many parts of the developing world the situation is much more intractable. In large areas, notably in Latin America and south Asia, where the bulk of the farmers are tenant farmers, the consequent insecurity of tenure militates strongly against relatively long-term activities such as forestry. Elsewhere, notably in parts of Afrioa, patterns and traditions of use of tribal or communal land make no provision for usages, such as forestry, which require the setting aside of land for a particular purpose for relatively lengthy periods of time. In many situations, therefore, it may be difficult to insert forestry prior to a more far-reaching reform of land tenure or change in land use.

The consequences of lack of a tradition of forestry tend to extend to more than just a lack of knowledge about tree growing, or of an appropriate institutional framework within which to carry it out. It contrasts with a usually deeply founded tradition of agriculture. This contrast is inevitably reflected in attitudes towards forestry which are sharply different to attitudes to arable crops and animals. With the exception of the benign relationship with the forest of aboriginal forest dwellers, the forest tends to be seen as a negative element of the environment by many poor rural farmers. To the settler it is an impediment to the clearing of his lands which must be removed as rapidly as possible, and a haven for his enemies. These views can persist in modified forms long after the forest has receded from the immediate vicinity of the community. For example, hostility to forests and trees can persist in areas which already experience shortages of fuelwood and building poles beoause of the damage done to crops by birds which are seen to roost in trees.

Other attitudes and behavioural patterns based on the past also tend to be inimical to forestry. There is the widely prevalent attitude mentioned earlier, of wood as a abundant free material to be collected at will. There is a lack of understanding of the role of forest trees in maintaining the fertility of the soil, and an inability or reluctance to recognize the consequences of soil loss, fuel shortages, etc., that will inevitably follow from continued destruction of the adjacent forest cover. Though this is clearly, in part at least, a measure of the priority of present over future needs, it must often be a measure of ignorance of the unknown. For the populations of most areas now encountering the consequences of the depletion or disappearance of the forests and the outputs of the forest, this is without historical precedent. There is nothing in their past that can give them guidance, or which can forewarn of what is likely to happen until it does happen. The same tends to be true of the impact of forestry; it may be difficult for people to perceive or accept the beneficial effects of forestry until they occur.

The introduction of forestry, or the conversion of destructive use of the forest to managed use of the forest, will therefore often require a profound change in attitudes and behaviour.

It is not intended here to revive the old doctrine of peasant resistance to change, for a thousand examples from all over the world have proved that many rural peoples are capable of great change. However, being strongly attached to a system of values, they have generally succeeded in changing those aspects of life that are least important to them in order to protect whatever is most important. Rather than alter their system of food production, many villages have adopted drastic strategies, such as the temporary emigration of the young men: they move to the towns for several years, often leaving their wives and children, in order to send back the money necessary to maintain their families. They are rewarded by the possibility of returning to the country to enjoy its familiar way of life, though many are too much changed by their experience to wish to go back permanently.

The problem is thus not one of bringing change to people who resist all change, but one of reconciling technically desirable change with the value systems that it seems to

threaten. Any voluntary solution presupposes confidence on the part of the population and imaginative sympathy for the local way of life on the part of the instigators of development. The alternative is to force change on an unwilling people and this is generally not to be countenanced.

There remains a category of constraints which bear on this task of bringing change to the people: namely, constraints that arise from inadequacies in the bureaucratic structure charged with this task. Some are faults that afflict most bureaucracies: rigid procedures, emphasis on interpretation of the rules rather than on the rationale of rules, inadequate training at lower levels, arrogance of petty officials, especially to the poor, etc. There is also the tendency for the responsibility for the rural development effort to become fragmented, dispersed among a number of bodies which fail to harmonize adequately and coordinate their efforts. It is important that programmes to encourage forestry in rural development do not contribute to this fragmentation. Forestry is but one part of a complex of different activities that are required for rural development. Its contribution must be integrated with the rest to be effective.

Finally, there are certain particular features of forestry that are not always conducive to effective impact at the community level. As has been noted already, the traditional preoccupation of forestry with conserving the forest, combined with management objectives which focus on the production of wood for industry, are likely to be at variance with the needs of the rural people who live in and depend on the forest. This bias is usually reflected in the structure and staffing of forestry administrations, and in the budgetary priorities of forestry. It is also reflected in the traditional training of foresters, who therefore often find that they are not well equipped to deal with people rather than trees. The challenge to forestry of contributing to bettering the condition of the rural poor is consequently likely to entail a radical reorientation extending from policy all the way through to its technical foundations.

PART II

SOLUTIONS: POLICIES, PROGRAMMES AND INSTITUTIONS

INTRODUCTION

DEVELOPMENT

This study is designed to contribute to one of the world's most pressing problems — the development of rural areas. The term 'development' as it relates to the change of a given society and its environment both in qualitative and quantitative terms is a phenomenon which has been debated extensively during the last 30 years without arriving at any commonly accepted concept or methodology. Furthermore, there is often widespread disagreement regarding the ultimate goals of development for a particular country. The sense in which the word 'development' is used in this study is briefly described below.

The objective of development is to enable the populations of any rural community to live a 'better life' in equilibrium with the environment and natural resources of the target area. The natural resources available to any community are finite, yet population growth in most communities has been expanding at an alarming rate with the result that many of the scarce natural resources are being destroyed, thereby further compounding the problems of attaining a stable equilibrium condition. There are two options to be considered: i) to find new systems of managing a given area or region which will maintain an acceptable equilibrium between society and the natural resources; or ii) to move people out of saturated areas to relieve the pressure on the natural resources of a given area. This study deals only with finding new or improved management systems which will both maintain and improve the productivity of the natural resources and simultaneously increase the population carrying capacity of the target area. Surplus populations in excess of the acceptable equilibrium status will need to migrate.

The concept of a 'better life' is also a relative term both within a given society and between various countries of the world. The minimum level of a 'better life' as used in this study would be at least to supply the basic needs of the population in terms of sufficient produce and/or income to provide adequate food, clothing and shelter to maintain the health of the rural population and a general state of well-being.

Societies maintain themselves through constant adaptive change in order to become compatible with the surrounding physical environment. This adaptation is being accomplished more and more consciously by information exchanged between people with a greater variety of experiences. Encouragement of variety and experiment is therefore one way in which a society may ensure its survival.

Development processes therefore, applied to the rural community, require an adaptation of the population to more complex behaviour patterns which will bring about an improved environment capable of achieving an acceptable ecological and economic equilibrium. Information is thus one of the key elements of satisfactory development. If development is to be achieved at the required rate, it is necessary to avoid the acute human misery, economic and resource losses occurring because of disadaptation of the people, through either their own unfortunate behaviour patterns or misguided government programmes. An enormously greater effort is therefore required to increase effectively the exchange of technical and economically sound information in all directions both between developing countries themselves and, where applicable, between developed and developing nations. It is not the intention to impose a 'standard' or 'model' view upon each community, but rather to provide each community with a set of information which will enable each group to find the development pattern which is most appropriate to their particular conditions.

This study does not, therefore, propose 'the' solution but it does suggest ways in which the search for workable and readily adaptable solutions may be stimulated in the rural areas of the world.

THE POLICY FRAMEWORK

As was seen in Part I, the role that forestry may play in rural development varies enormously from one type of society to another and from one locality to another. The strategies available to governments are bound to be even more varied in view of the range of ideologies and resources. Certain considerations may nevertheless apply to all or most countries, but for the purposes of this study it is assumed that a forestry role is both possible and desirable.

First, forestry is part of the larger problem of rural development, and this is only likely to be solved if sufficiently high priority is given to the rural sector. There must be a commitment by government to rural development. To a certain extent this need not diminish the resources available for urban investment, since part of the rural spending will prevent migration which otherwise would add to the burden on city budgets. Improved rural productivity will also increase the total amount of resources available for both sectors. To some extent however there is likely to be a need for some redistribution of resources from town to country, which may be justified on grounds of equity.

Second, forest development is intimately bound up with varied aspects of the rural way of life, and solutions require an integrated approach. Improvements in agricultural productivity or in the organization of grazing may be preconditions for the release of land to forestry, in which case coordination of the various technical services will be required. In some cases a restructuring of land ownership may be necessary before improved use of resources can be achieved. A policy of integrating forestry into rural development is therefore likely to require appropriate legislation relating to land tenure, land reform and land colonization.

Third, if development is to be through the adaptation by communities of those technologies, processes, institutions and 'systems' which are related to their own societies, and if it is not to lead to disruption of their values, there must be a vastly improved flow of information and opinion between the members of the community and external bodies. This flow should not be in one direction only: policy should be formulated paying due attention to the views of rural dwellers. It is essential that the involvement and participation of the rural people in the development process be secured from the very outset. National and regional rural development plans must embrace the needs and aspirations felt at the community level. Forestry for community development needs to be a process which emanates from the 'bottom-up' and not something imposed from the 'top-down'.

Finally, because forestry is usually a long-term process, it requires a continuing commitment from government. It is better to have no project rather than a failed project or — still worse — a succession of failed projects. This does not necessarily mean that government should be called upon to guarantee all the resources needed for the full cycle of a community forestry project. In pursuance of the overall objective of self-reliance, communities should be encouraged to mobilize their own resources for their forestry projects. The role of government should usually be that of getting the process started and of ensuring continuity.

REQUISITES OF A PROGRAMME

Having made a long-term policy commitment to forestry in a context of rural community development, it becomes necessary to lay down a programme within which projects may be included. Many considerations are common to programme and project design and any division of them is somewhat arbitrary. This section confines itself, as far as possible, to higher level decisions. Those respects in which a programme is simply the aggregate of its projects will be considered in the next section.

First, there is the question of size and this is closely bound up with that of duration. There may be a temptation to opt for a large annual programme over a short period rather than a smaller one for longer, whether out of a concern to impress or because of anxiety about a possible change of policy. The most rational choice is to start slowly on a small scale and allow the programme to grow in size and speed as experience and confidence are gained. The limiting factor at the outset is likely to be trained personnel at all levels and the initial size should be fixed as a function of their availability.

Second, there is the question of location. Many considerations are relevant but perhaps the most important is visibility. Successful projects are needed for demonstration to members of communities that are to be affected by later projects, and also to convince the urban dweller that the expenditure of the government is producing results. The first projects should therefore be strategically sited, for example, near to major roads or railways and in places, wherever possible, that are typical of whole regions of a country. Advantage should be taken of any existing realizations which may indicate that a community is ripe for an early project and likely to succeed with it. The natural progression would be to move outwards from these first project areas on to neighbouring land until the whole programme is completed.

Third, the general objective is to enable communities to produce what they need at an economic cost. Local demand, e.g., for fuelwood, must often take precedence over national demand, e.g., for pulpwood. This does not imply that villagers should be maintained in a subsistence economy, producing no saleable surplus and buying little or nothing from outside. Insofar as they have a comparative advantage, they should be helped to develop marketable forest products.

The fourth area to be considered is the question of staffing. Clearly there may be a need for outside support and supervision: if it were possible for development to occur spontaneously, it would already be happening. Insofar as community action is hindered by lack of means rather than lack of information, the role of outside personnel may be minimal, but there will be many countries in which a large input of information and skills is required. Because of the importance of tact, humility and imagination in dealing with villagers, especially where linguistic or ethnic differences are added to those of income and education, field staff should be selected for outstanding personal qualities as well as technical ability. It may even be that the programme should be designed around the people that are available to run it, at least in its first stages.

Fifth there is a need to specify, for the programme as a whole, that local labour is to be used as much as possible rather than mechanical means. This does not imply that machines should be renounced where their contribution is important and difficult to replace. Where labour is scarce mechanization might be needed. Simple levels of mechanization could also improve productivity, reduce drudgery and fatigue and permit tasks to be undertaken that would be beyond the possibilities of manual labour. Where local labour is available, however, it may be that extra monetary costs are justified where machines would be cheaper. The social cost of failing to relieve unemployment and of failing to involve the population in the work must be taken into account.

Finally, in estimating the budget of a programme, particular importance must be attached to financing the period that precedes harvest or the realisation of production. Many communities are discouraged from planting trees essentially by the prospect of having to bear costs or having to forego the use of land for several years. Even where there are other obstacles to planting, this factor is bound to be important. Appropriate ways of disbursing sufficient sums, whether as grants, loans or tax relief, must be built into the programme. In this, government might be able to draw or more than its own resources by fostering support for community forestry from industry and other non-government sources, through tax incentives, etc.

PROJECT DESIGN AND EVALUATION

In the context of the present discussion, a community forestry project can be defined as a set of interconnected actions and works executed primarily by local community residents to improve their own welfare. There may be outside inputs — extension, training, guidance, technical help, financing, etc. — but the basic focus of a community forestry project is on community involvement in doing something for itself.

At the same time, the definition also calls attention to several potential problems that arise in specifying and appraising this type of project. Any project incurs 'costs' in that it ties up resources. To be worthwhile, it should result in benefits which match or exceed these costs. The traditional financial and economic criteria for judging the 'worth' of a project may be difficult to apply to community forestry projects. How can one judge the financial worth of a project that involves communities where half or more of their daily productive activities are outside the monetary economy, or where a major input into the project is 'free' labour supplied by local residents ? How does one place a financial value on the increase in self-reliance and self-respect that may evolve as part of the benefit of the project ? Project planners and decision-makers have to develop a different set of evaluation criteria which reflect the broader socio-economic objectives of society. Thus, the role of socio-economic analysis, in contrast with financial analysis, becomes much more important in the evaluation of such projects. The case for community development projects and programmes essentially rests not on their profitability, nor even usually on direct quantifiable estimates of their economic returns compared with competing users of public funds. This is an area comparable to health or education, which require government commitment to providing the funding necessary for meeting basic needs.

Elements within a given community forestry programme or project may be amenable to financial analysis — e.g., smallholder tree plantations for production of wood for sale — and such should rightly be evaluated in financial terms. Financial analysis can also be useful in determining which way of achieving a particular goal would be most efficient. But in general, the overall scope of a community forestry project is quite different from a traditional commercial forestry project. The objectives are different and so should be the basic criteria for their evaluation.

Project design must start with the formulation of goals to be achieved. A community forestry project is one that is a response to a basic need felt by the community, defined in terms of a goal to meet that need, and the link between such goals and the basic objectives and needs of the community must be kept clearly in mind. A project should not be designed to 'protect a watershed' as an end in itself. Rather, protection of the watershed is a means to achieve a community goal of maintaining soil fertility so that people can eat (or can eat more cheaply); or it may be a means of protecting life and health through maintenance of water quality; or it may be a means for achieving any number of other goals associated with fundamental objectives and needs of local communities.

The project design must be consistent with the physical, cultural, political-legal, and socio-economic environments within which the project will function. If the purpose of the project is to change some aspect of the basic cultural or existing physical environment, as will often be the case with community forestry projects, the project design must include the means to effect this change. In this case, a basic objective of the project is to change the conditions of 'consistency', not ignore them.

The project must also be workable within the context of those existing constraints which cannot be controlled or changed, e.g., limits on the availability of resources such as land, skilled manpower, technical knowledge, funds, etc. Again, a basic purpose of the community forestry project may be to change the conditions which constrain development, for example, through training programmes, land redistribution, research, etc. However, changes can often only be made slowly over time and a community forestry project, which involves an interrelated set of actions, works and outputs can never move faster than the

slowest link. If all components but one are workable, that one will make the project unworkable, unless it is removed from the project. The project as a whole must be workable and the role of design and evaluation is to ensure that such is the case.

The project design which is chosen should be the one that provides an efficient means for achieving the selected goal. It is the rule rather than the exception that there will be more than one consistent and workable way to achieve a certain goal. It is at this stage that consideration of costs and benefits through socio-economic analysis enters the picture to provide guidance to the decision-maker as to which of the alternatives is likely to be most efficient and evidence on the project's value for use in making decisions on financial commitments.

It needs to be recognized that the identification and design of community forestry projects, as is the case with most rural development projects, is beset by very real information problems. The guidelines outlined above can do little more than provide a loose framework within which to exercise judgement. In addition to the measurement problems mentioned, little is likely to be known initially about the complex framework of factors which make up the social, economic and physical environment of the community in question. This being so, it will generally be desirable to initiate projects at a modest level, recognizing that there is much that is unique in each situation, which can be assessed in terms of project design only through learning-by-doing. In particular, local involvement is likely to be a gradual process, which could be aborted rather than accelerated through too precipitate an attempt to get the project under way. Projects should be gradually expanded only as more knowledge is gained through monitoring and evaluating progress as it takes place, and as local confidence and participation builds up.

INSTITUTIONAL AND EDUCATIONAL ASPECTS

INTRODUCTION

If forestry is to take its rightful place in local community development, the active interest and involvement of the rural population in forestry programmes right through from the design stage will be a first essential, followed by a continuous process of communication between the people and the various government agencies which will be involved in any integrated rural development programme. Changing the minds and attitudes of the people and of government officials through extension, training and education, and providing an appropriate institutional and organizational structure to foster communication and participation must be of prime importance for the promotion of rural forestry.

Of particular relevance will be the organizational structure of the government agencies to ensure an integrated approach and sufficient staff at the 'grass-roots' level to encourage motivation and provide technical advice; the organization at the community level to ensure full participation; an examination of the legal provisions relating to forest land tenure and customary usage rights to ensure that these will not conflict with the development process; and a reappraisal of the educational programmes to ensure that the staff has a wide understanding of rural and social problems, not only from the forestry aspect.

INSTITUTIONAL ASPECTS

Organization of local communities

The importance of fostering self-reliance and the encouragement of communities to mobilize their own resources to run community forestry projects is mentioned again since a modification of the organizational structure and the responsibilities of local communities may be required to achieve these aims.

The most common local entity in which rural people may be organized is the formally constituted village community. Village communities are different from small settlements in the sense that they represent the lowest level of the country's administrative and political organization, that they have a formally established pattern of decision-making

and that they are headed by a representative of the village council who acts as a spokesman for the communities and represents at the same time, the government's authority at the local level. There may also be customary communities, the role and importance of which may vary to a great extent. In some countries customary communities are well-structured units formally recognized by the existing legislation and exercise important political and social functions within the country; in others they may be a reality for the rural people themselves but not be formally constituted and with limited influence in the administrative organization.

The existence of constituted local entities and their political and administrative role, as determined by the countries' constitutional provisions, are of great relevance to the promotion of rural forestry, either directly if the communities are the owners of forest land or indirectly as a platform for fostering collaboration between the local people and the technical government agencies. In certain remote areas, to which new settlers are migrating, the organizing and strengthening of local communities may be an immediate prerequisite for the promotion of community forestry. The formation of local organizations specifically concerned with forestry for community development, such as cooperatives and voluntary associations, should be encouraged.

Though the approach to local development must involve the existing organizational structure of the community, it needs to be recognized that such structures can constitute an important impediment to change. Such organizations are more likely to reflect the interests of the richer and more powerful elements of the community than its poorer members. Where the organization is an elected one the short-term imperative of attracting votes can conflict with the longer term actions needed to pursue forestry solutions. Community development of the sort that encourages self-reliance among the poor may therefore be difficult without changes in the organizational structure of the community, or in the attitudes of those wielding power within it.

Land tenure, customary rights and status of forest land

Communal forest land or community forests owned by villages or customary entities are to be found in several countries of the tropical and subtropical zone, but the extent to which the community exerts its proprietary rights may vary greatly. In some countries most of the decisions relating to the use of the forest resource are made by the owners, subject to approval by the supervising technical forestry administration; the owners may also be directly involved in timber harvesting operations. In other countries important rights of timber disposal are held in trust or are directly administered by the local and/or the national government; the involvement of the community in managing the land is consequently more limited. Private forest land, owned by small farmers also exists in such countries as Chile, Honduras, the Republic of Korea and Paraguay but this form of forest tenure is limited, especially if compared with the forest ownership pattern in the European and North American regions.

In many tropical and subtropical countries the dominant or exclusive forest tenure is state forest ownership, but the local population is usually entitled to a wide range of customary usage rights on such land. In a few examples some form of undefined forest ownership exists in the sense that such land may eventually be transformed into state or community forests and is held in trust for the time being by the national government.

The relation of local people to the surrounding forests and to community forestry will certainly be influenced considerably by the prevailing form of land tenure. Their involvement and long-term interest may be greater if they have some direct influence on the management and utilization of the resource. A national policy aiming at fostering community forestry could thus lead to a reexamination of the existing forest tenure with the aim of introducing such tenurial arrangements that allow for a greater involvement of local people. Various possibilities could be considered:

- The creation or expansion of community forests. These forests would not necessarily have to cover large areas; they could consist of blocks of some tens to some hundreds of hectares but the area should be sufficient for the immediate needs of

a village or settlement and allow for its rational management. The creation of communal forests could also play an important role as compensation for the limitation or abolition of customary rights in other parts of the forest. However, it has to be recognized that solutions which require decisions and actions by the community as a whole are more difficult to achieve than those that are based on the individual, or on individual households or farms, e.g., private woodlots.

- The promotion of private woodlots up to a certain maximum area provided that this would not lead to an irrational fragmentation of forest land.

- A more precise definition of existing customary rights and their further acceptance in forest resource planning and timber management. This could lead to the more effective protection of certain tree species, other plants or animals which are of importance to local villages, and also to regulations restricting the collection of customarily used forest produce in order to ensure its long-term availability.

- The introduction of medium- and long-term leasing systems in order to set aside a certain portion of state owned forest land for the exclusive or restricted use of local communities.

In many countries only a small proportion of land under forest cover or of potential forestry use is legally constituted as permanent forest land (forest reserves) and is demarcated as such on the ground. The remainder of the forest areas is either land for which no definite land-use decision has yet been made or land on which the forest cover will have to be removed since it is required for other land-use purposes. Whatever the legal status of the forests, it must be recognised that a large proportion of land in the vicinity of rural settlements is used simultaneously for agriculture, grazing, fuelwood production, etc., in a manner that does not always ensure the conservation of its fertility.

The legal status of forest land will be of concern to any programme for community forestry. If its objective is the establishment of plantations for the production of fuelwood or local construction timber, it must be ensured that the land is available for forest use on a reasonably long-term basis. Or if community forests are to be created and managed for the benefit of their owners it might be appropriate that they should have the status of permanent forest reserves. On the other hand, the combined use of agricultural and forestry production systems could be made more difficult if all forestry land was subject to the conventional reservation procedures. In such cases it may be necessary to elaborate more flexible arrangements that facilitate combined production methods on a long-term basis or allow for the temporary use of forest land for agricultural production.

In many countries, community forest development will be concerned with land used for agriculture and grazing on which forestry may have a complementary function. This refers, in particular, to tree planting along roads, canals, rivers and boundaries, the planting of fodder trees, the establishment of shelterbelts and windbreaks and alternate agricultural and forestry crop systems with short rotation tree species. Such land is usually owned by small farmers or local communities and subject to the agricultural land tenure legislation. Here again specific amendments and flexible arrangements may be required in order to facilitate the complementary role of rural forestry.

Cooperatives, local credit schemes and other incentives

Most countries have actively encouraged local cooperatives as an instrument to promote rural development. Whereas there are many examples of cooperatives concerned with production, distribution and marketing of agricultural crops, much less use has been made of them in the forestry sector. One reason is probably that large-scale rural forestry programmes are, in many countries, still at an initial stage; another could be the difficulties experienced in organising the utilization of tropical forests for the direct benefit of local communities. The few examples of strong forest cooperative development are to be found in countries implementing sizeable reforestation programmes or in those where community forests are already of some importance.

Greater concern of many governments for community forestry could lead to an increased interest in the promotion of forestry cooperatives. Forestry cooperatives may be organised at village level or comprise groups of settlers and forest owners, or larger regional units which include several villages. Forest cooperatives will often be concerned primarily with planting trees and harvesting the available forest produce but they could expand to processing and marketing to ensure greater benefit to the community.

Community forestry would also greatly benefit if existing agricultural cooperatives became more involved by incorporating certain forestry components into their field of activities.

There are various forms of incentives and local credit schemes which are directly related to community forestry or are at least potentially of considerable interest. The most common are of a monetary nature; they include outright financial grants related to standard plantation costs, tax rebate schemes providing for the rebates of tax payments from land and personal taxes against expenditure for forestry operations and loans that are usually made available at lower interest rates than those charged by the commercial banks.

Incentive schemes have so far been designed mainly for the promotion of large-scale forestry activities and tend to facilitate the operations of large landowners, timber companies and business investors whereas the small farmer in a remote village may find it difficult to benefit from them. Small farmers usually lack the assets necessary to secure loans, the terms of loans are often unfavourable to them, and bureaucratic procedures make it difficult for them to apply for loans. The considerable experience of the agricultural sector in channelling incentive and credit facilities to small farmers should be drawn on when new programmes for community forestry are designed. Moreover, those procedures that are applicable for the implementation of forest incentive systems should be carefully scrutinized with regard to their effectiveness for communal forests and small landowners.

Effective incentives for peasants and rural poor must be simple and may often better take the form of grants or the provision of goods, or of production means (fertilizer), or food aid to communities at or close to the subsistence level in order to enable them to divert part of their efforts to tree production. The World Food Programme is operating many food aid schemes. Other incentives which may be more appropriate for rural communities in remote areas, at least at the initial stage, include the use of physical production inputs as well as the execution of infrastructural improvements from which the local people will benefit directly. As far as forestry is concerned the most common example is the distribution, either free or at a nominal charge, of seedlings and the necessary hand tools for tree planting; the construction of access roads to communal forests by the forest administration is another example. In the general context of rural development these incentives may comprise a much wider range of inputs such as medical services, construction of community roads and water supply systems, the distribution of food and fertilizer and the provision of local construction material.

A further practice, which is not strictly an incentive scheme, is crop sharing between communal landowners and the government or a private company. Its basic idea is that the community provides the land and the necessary labour for establishing forest plantations while the forest service or a private company provides the seedlings, fertilizer and technical assistance. When the crop is harvested the net profit is divided among both parties on a proportional basis depending upon the inputs that have been made available. In some cases the planting and tending of the plantations is done by the forest service or a forest industry and not by the landowner.

The problem of the time gap between establishment and harvesting of forest plantations has been discussed before and the restraints resulting have to be recognized. Examples have been given how some countries have dealt with the problem. An interesting approach of advance payments on the future harvesting return has been developed in New Zealand in order to allow the establishment of plantations on communal land. This system is based on a crop-sharing agreement but, in addition, the government makes annual payments per hectare of planted area against the expected net crop value at the harvesting stage. The same principle

could be applied through a forestry credit system, through which the landowner or the community would receive annual payments, calculated in the form of a rent, in relation to the crop value at harvest. The use of the average annual increment rate of the planted trees as the basic reference unit for the economic and financial calculation would facilitate the application of such a system. In line with the basic objective of community forestry of promoting self-reliance, incentive and support programmes should be designed to enable the producer to build up his own resources so that external support can be progressively phased out.

Enabling legislation and regulatory provisions

In many countries the lack of appropriate legislation has been a considerable constraint to the integration of forestry into rural development. Many laws are characterised by a detailed set of provisions which are concerned more with the protection of the forest estate than with general development. In some cases the existing rules and regulations or the lack of appropriate provisions, in particular as far as the status of forest land is concerned, might even be an obstacle to the promotion of community forestry. A close review and, where necessary, a redrafting of the enabling legislation and regulatory provisions may be necessary as a prerequisite for the development of a community forest programme.

This study does not attempt to review in detail the various legal provisions. It is, however, important to summarise what type of legislation may have to be considered and to indicate that some of the existing legal provisions might impede forestry for community development and may have to be modified in order to support effectively the execution of field programmes.

Of major concern to community forestry is the country's forest law together with its subsidiary forest regulations and rules. This law generally establishes the principles guiding the use and management of the forest resources, defines the nature and status of forest land, regulates its reservation and prescribes its timber allocation procedures. In many countries specialised forest legislation encompasses forest cooperatives, reforestation incentives and tax exemption. In others these matters are dealt with in the general agricultural or rural development legislation or in special laws on cooperatives and producers' associations. There is also a wide range of other laws and regulations such as the land tenure legislation, legislation on land reform, colonization and rural development, as well as the organization, credit and business laws, the provisions of which might influence, directly or indirectly, the implementation of rural forestry programmes.

Involvement of government agencies and non-government organizations

As already mentioned it is the local community itself which must play the principal role in community forestry programmes but at the same time government agencies and existing non-government organizations will have to make important contributions.

A firm commitment by the government to community forestry development and a continuing involvement of the various services concerned is thus essential if any major break-through is to be obtained. This will entail the support of community forestry objectives in national, sectorial and regional development plans.

Several government agencies will usually be concerned directly or indirectly with community forestry. It is important to emphasize that the multi-disciplinary character of this subject will require the careful coordination of the various ministries and technical agencies that are concerned both with policy formulation and project implementation. Coordinating committees at ministerial level or formal consultation arrangements at departmental and divisional level may help to ensure the necessary collaboration.

Whatever distribution of responsibilities among the various government agencies may be decided on in any particular country, it is necessary that these responsibilities should be clearly defined and that the agency entrusted with the implementation of any programme has the full authority, adequate budgetary provisions and the organizational structure to carry it through.

The national forest administration, as the government's agency primarily concerned with forest development, will certainly have to assume an important role in any expanding rural forestry programme. Most forest administrations have been concerned with commercial timber production and with the management of state owned land; their traditional concern with protection, policing, revenue collection and the production of wood as an industrial raw material, has had little relevance to community forestry. Fundamental changes will often be needed in structures, attitudes and training of national forest services in order to orient their activity more to the needs and aspirations of local communities. However, the many problems involved cannot be solved only by a reorientation within forestry agencies but will also require a complementary reorientation towards forestry within other agencies working in the field of community development. This understanding should then lead to increasing cooperation between forest departments and other government and non-government institutions.

Forest services will have to adapt their objectives and operational programmes more specifically towards community development which will entail changes in their organizational framework. A special division or department concerned with community forestry, extension and training may need to be created at central and regional levels. In addition the field staff will need to be reinforced so that continuous contact can be maintained with the rural people. Some sort of incentives may be necessary to encourage staff to stay in the field for long periods and their career prospects should be ensured so that there do not have to be frequent changes of staff.

The staffing pattern of a strengthened field organization, as well as the number of specialists required at central and regional levels, will have to be evaluated carefully. It is probable that a detailed assessment of the manpower demands for an increased programme of community forestry will lead to a substantial revision of the forestry sector's manpower estimates. A first step towards a more realistic evaluation of future manpower requirements would be the revision of the currently used assessment methodology which plays little attention to the aspects of rural forestry.

Farmer associations could play an important role and their involvement should be sought at an early stage. Their interest, collaboration and support could contribute substantially to the promotion of community forestry programmes.

Non-government organizations operating at the community or regional level might also be associated with the promotion of community forestry. The many contacts of village leaders, religious leaders, representatives of youth groups or other local associations with neighbours and fellow community members, and their familiarity with the most pressing needs and problems, will put them in a position where they can respond more rapidly to the aspirations of rural people and help to increase their confidence and self-reliance than would be the case with government officials.

The possible contribution of forest industry also needs to be considered. Where forestry can be inserted as an income-generating activity, industry can certainly contribute directly to local forestry programmes through assuring markets and providing technical support. The experiences of some companies in the Philippines serve as a good example. There has been little experience of industry investing in social forestry but the management skills of the forest companies could be a valuable complementary element in promoting community forestry. Joint structures with government or non-government organizations could eventually emerge. Specific tax exemptions or loans to those industries that are prepared to support community forestry, or the introduction of a cess to be levied on certain production units to provide funds for rural forestry development could be considered.

Research

The final institutional aspect is that of research which is recognized to be of considerable importance. While some research on items connected with community forestry has been and is being done in a number of national institutions, there has been little coordination of effort and communication of results.

All research should be applied research, should be field orientated and should have clear objectives and there should be cooperation between countries themselves and with international research organizations such as the International Union of Forest Research Organizations, the International Development Research Centre and the International Council for Research in Agroforestry in the design of research experiments and in sharing experiences and comparing results.

The following areas of research are likely to be relevant to community forestry: sociology, species introduction, soil improvement, farming and silvicultural systems and techniques, systems for combined agriculture and forestry on a long-term or permanent basis, joint forestry and grazing, product utilization, identification of new sources of income, development of technology, economics of production, and soil and water conservation. Within such a research framework, countries would want to pay more attention to those areas which have a high priority according to their particular needs; these might be items such as incentives for people to implement soil and water conservation measures, or identification of new sources of incomes, improving the production of land or making fuller use of resources to increase employment and income.

There is a need to consider environmental objectives in community forestry research projects, particularly with regard to the improvement of degraded land. Other items could include studies on traditional systems of land use and on the nutritional needs and habits of the communities.

Social scientists should work with foresters in research projects to identify the particular needs of the community, identify constraints and to formulate priorities for the process of developing self-reliance with regard to the basic community needs.

EXTENSION AND TRAINING

Dissemination of information

This subject has two equally important aspects: firstly, that the concept of community forestry should be spread widely to policy makers such as government ministers, planning commissions, senior officials involved in all aspects of rural development and to persons who have authority in public affairs; and secondly, that the benefits which community forestry could bring to rural areas should be brought to the attention of the public in general and particularly the people living in rural areas.

The policy making group can best be reached by the preparation and distribution of documentation explaining the role that forestry can play in rural development and stressing its labour intensive nature and any other factors which might justify strong government support. The role of national forest services and other government agencies concerned with conservation and the development of the resource should be clearly set out in such documentation. This could be complemented by lectures, the organizing of conferences and visits to demonstration areas — all stressing the multi-disciplinary nature of the exercise.

The public in general can best be reached through public information campaigns taking full advantage of the mass media. An excellent example of such use of the mass media was the nation-wide campaign launched in the Republic of Korea in which 21 000 village forestry associations were involved in large-scale planting programmes. Any campaign launched through the mass media would require careful preparation and would involve close personal contacts with media representatives and with the Ministry of Education.

If community forestry programmes are envisaged on any appreciable scale it may be necessary to create specialist posts in forest services specifically for public relations activity.

A further very important aspect of the dissemination of knowledge is the introduction of an understanding of the role of forestry in rural life into schools, starting at the primary level and continuing right through to adult education. In this connection regular visits by school children to see general forestry activities and to visit demonstration areas should be encouraged.

Extension and training for rural communities

A wide range of promotional and educational actions, usually referred to as extension and training, will be necessary to obtain the active interest and involvement of the rural population in the participation of programmes necessary for community forestry. An important first phase should be to assist rural communities to articulate and communicate their needs, their problems and their solutions as they themselves visualize them; this will help to reassure the people that the programmes drawn up are relevant to their needs and that they will derive benefit from them; it will also give the people a sense of responsibility towards ensuring the success of what would be 'their' programmes which would be carried out with whatever technical government support was necessary.

The more traditional role of extension may include:

- Pilot projects that are implemented by a government agency or by active and interested farmers, or by a combination of government and farmer which may bring about a direct response from other inhabitants. Such pilot projects should be carefully prepared and should be seen to reflect local conditions; they should be complemented by explanations regarding the inputs that are necessary to achieve the required results.

- Technical advice on many technical, economic and organizational aspects either on an ad hoc basis or through a programme of regular field visits. The supply of printed information and instruction material could also assist provided that illiteracy is not a major problem.

- Technical assistance through a technical government service which provides physical inputs and performs specific operations. In the early stages such inputs as seeds, seedlings, fertilizer and organizational support may be provided. At a more advanced stage, technical assistance may involve help in the management of communal forest land as well as support to or execution of specialised forestry activities such as the organization of local timber sales, wood extraction and maintenance of machinery.

Training is, of course, an integral part of all extension work but it may also be an important component in itself. Active training programmes, usually in the form of short-term courses, field visits and practical demonstrations, are an important prerequisite for community forestry. The content of such training programmes may cover specific forestry aspects such as the use and maintenance of hand tools, planting techniques, the tending of tree crops, the use of appropriate felling techniques and the observation of safety regulations. It may also be concerned with more general subjects such as health, agricultural inputs, community action, etc.

In practice several of these elements may have to be used simultaneously; it is the right combination which will determine the effectiveness of the extension and training measures.

The creation of an appropriate organization at the village level is of particular importance if duplication of extension efforts which may lead to confusion among the rural people is to be avoided. Possible organizational structures for extension work could be:

- the forest administration being responsible and providing specialised personnel, organizing forest cooperatives and collaborating directly with the villages and other government agencies giving technical advice and support in matters for which they have technical competence;

- the agricultural service being responsible and the forest service providing technical support and advice on request;

- a rural development service being responsible, relying on its own specialists in various technical disciplines with community forestry as part of a general rural extension programme;

- voluntary and other non-government training and extension groups engaged in rural development activities being responsible or participating.

Any such structure would have to be related closely to the organization of the local community; this will vary widely between countries so that any decisions on how extension programmes are to be carried out will rest with individual governments.

Extension methods, personnel and teaching material

It is beyond the scope of this study to discuss, in detail, extension methods which have been used successfully. Appendix 6 provides references on this subject. It is true to say that little work has been done in rural forestry extension and it will therefore be necessary to adapt general experiences and techniques to the specific aspects of community forestry.

Extension work and training of rural dwellers should take into account the experience and immediate interest of the trainees. The starting point should be the assembling and analysis of traditional knowledge and attitudes, and these should be related to the concepts and techniques to be introduced. The demonstration of immediate and direct benefits resulting from the proposed measures should be a major teaching objective. The use of local languages may be necessary.

Training programmes will have to be organized for local community leaders and interested farmers through the existing channels of the country's vocational training system, supplemented if necessary through additional courses; they can be taught the principles of community forestry and, along with this, some land management rules for improved crop production. Arrangements should be made for the training of suitable youths from the villages where community forestry is introduced. As an incentive, stipends could be given to interested applicants.

Success or failure of a community forestry programme may often depend upon the presence of competent instructors. The creation of the necessary number of posts for such personnel, their selection and training, and continuous support to their activities are key elements for the implementation of such programmes.

Particular attention should be paid to ensure that extension is entrusted to people who have a genuine motivation and inclination for community activities and who are able to gain the confidence of the local people. In order to do this they must avoid giving the impression that their role is to impose forestry solutions on the community, but instead that it is to give advice in response to the community's efforts to better its situation. In most cases women are mainly concerned with the collection of fuelwood and would thus benefit greatly from community forestry. In order to communicate effectively with the community on improvement of wood use and supply, it may well be necessary to have women foresters and field workers.

There is considerable need to prepare and disseminate teaching material such as manuals, booklets and audio-visual aids that can be easily used at all levels of the community. Textbooks to be used for functional literacy programmes should illustrate community forestry aspects. Such material should be as simple as possible and its preparation should be guided by what is known on the perceptual capacities of rural people. The use of manuals and textbooks, especially in rural areas which often have a high rate of illiteracy, may be limited. Such material should therefore be designed mainly for the extension worker or forestry instructor who can make use of it in working directly with the villagers.

The preparation of extension material for rural forestry needs to be coordinated within the various services involved in forestry, agriculture and rural development. Forestry extension units could have specialists for its preparation, production and dissemination.

Education and training for technicians and professionals

Changing the attitudes of people requires a broad understanding of rural development problems, as well as knowledge of specific technical and economic aspects, by those government officials concerned with the elaboration and execution of community forestry programmes. Education, especially at the technical and professional level, can help in the creation or improvement of such understanding.

A review of the existing teaching programmes of technical forestry schools and at university level indicates that comparatively little attention has been given to rural forestry problems. Forestry education programmes, both for serving personnel and for new entrants, should therefore place greater emphasis on:

- an insight into the socio-economic problems of poor rural areas;
- more effective ways of communication with rural populations and how to gain their confidence;
- land-use under arid and semi-arid conditions;
- soil and water conservation;
- fuelwood production;
- combined forestry and range management systems.

In addition, they should include basic notions of related subjects such as agronomy, fruit tree arboriculture and animal husbandry. New professional and technical-level forestry programmes need to be conceived to match emerging needs in the longer term.

Sufficient experience has been accumulated over the past ten years on aspects of community forestry to enable this subject to be introduced into teaching programmes. The curricula of forestry schools, both at the technical and professional levels, should be revised to include community forestry and more general courses in rural development as new subjects. At the same time more suitable teaching material should be prepared focussing attention on community forestry. This would help forestry students to look at social, economic and political problems more objectively. The basis of recruitment of forestry school instructors and forest service personnel should be expanded to include people with some experience in disciplines other than forestry, such as agronomy, sociology and anthropology.

Similarly forestry and agricultural students should become mutually acquainted with each other's subjects. Interdisciplinary contacts with students of other faculties, in particular with sociologists and anthropologists, may be equally useful. It will also be of importance that training facilities for agricultural engineers and technicians as well as training programmes for rural extensionists incorporate certain forestry elements in their curricula in order to convey to the students of these disciplines some basic knowledge about the scope of forestry and its role in fostering the well-being of rural people.

As far as professional education programmes are concerned staff and students from the universities could become more involved in community forestry by having the opportunity to participate in surveys and studies on ongoing projects, and to work in actual field operations, so that they become more acquainted with the reality of rural life. This would be applicable both to forestry and agricultural schools, the establishment of interdisciplinary teams being particularly desirable.

The effective promotion of community forestry thus requires trained manpower with quite different skills than those of traditional forestry, and the establishment of new areas of specialization within the forestry structure. To achieve results quickly more must be done than simply restructuring the curricula for future generations of foresters. Some of the additional expertise needed now can be acquired by recruiting into forestry people from other disciplines, such as the social sciences, and by improving the knowledge of existing staff through continuing programmes or postgraduate education. Where necessary, opportunities for training staff overseas through fellowships should be used more readily.

Inservice training

The revising of teaching programmes of educational institutions to incorporate the concepts of community forestry is likely to be a slow process and it will be some time before new staff trained in these concepts become available. In the meantime it will be necessary to arrange inservice training programmes for serving forestry personnel to enable them to carry out their future role in the promotion of forestry with an integrated rural development approach.

Programmes for inservice training should be arranged with great care and in close cooperation with the various ministries, development agencies and personnel from other disciplines so that full use is made of all the training and other facilities which may be available in the country. Short courses, visits and seminars should be organized and any forestry extension instructors should be given wide scope to spread their knowledge.

Advice from farmer associations, labour unions, etc., should be sought and practical training carried out in typical areas which will illustrate the technical, economic and social aspects, both positive and negative, of rural forestry development programmes.

PART III

PROJECT SPECIFICATIONS

INTRODUCTION

This part of the study attempts to bring together factors which are likely to be relevant to project specification. Many of the procedures involved in working out technical solutions are not peculiar to community forestry (site classification, socio-economic survey, etc.), and where these are adequately covered by standard manuals they are omitted or merely alluded to. Similarly there is little or no treatment of types of forest production that are already undertaken on a large scale by forest services (production of sawlogs, pulpwood, etc.). Nor has any attempt been made to prescribe special methods for the management of communally owned woodland, though this form of ownership may account for many millions of hectares which are in need of such attention.

IDENTIFICATION OF NEEDS AND POSSIBILITIES

PROJECT AREA SURVEY

The forestry problems of a community can seldom be solved in isolation. The purpose of a project area survey is to ascertain the needs, problems and possibilities of the community and to determine what priorities the community attaches to them. In many instances it will only be when priority problems have been solved that it will be possible to mobilize community support for forestry.

The formulation of a project should therefore be based on the available knowledge of all the interrelated parameters — physical, biological and human — and should take into account the needs, etc., and the priorities of the community. The investigation should cover the current situation and the various future options and possible trends arising from changes in land use, changes in the intensity of the use of the resources, the application of inputs for increased productivity, and the changing conditions and attitudes such as the purchasing capacity of the community, market conditions, etc.

Because there are many project survey manuals, no attempt is made here to provide an exhaustive check-list that may be applicable for all types of project situations. However, Appendix 1 includes guidelines on the most relevant topics to be considered in a project area survey. In practice, the availability of reliable and adequate information is usually a limiting factor, and time, funds, qualified personnel, rapidly changing conditions, etc., may impose constraints on data collection. However, this should not prevent project formulation; the latter should proceed making use of such information as can be obtained with the resources available.

It is desirable to consider small communities involving several hundred families, living in a physically very clearly defined area such as a watershed, a forest reserve, an irrigation district or a small administrative unit comprising a village or a group of villages. This territorial unit (taking into account spatial interrelationships, e.g., migration, marketing) should constitute the study area in which an inventory of all resources, physical and socio-economic, should be conducted as a basis for sound economic planning.

The depth of the investigation will vary in accordance with the records already available on the environment, its resources and their potential for production, and on the community. The information can be divided into three main groups:

a) the physical and biological environment (climate, soils, vegetation, land use, etc.) and the environmental impacts of current and future human activities, leading to a land capability classification;

b) any existing forest and forest-related resources, use of and needs for forest products and the market prospects for forest products;

c) the community, both qualitative (special systems, land tenure, etc.) and quantitative (demography, areas, production, etc.), including survey data from a large sample at farm and family level.

The procedure to be adopted in conducting the survey in most cases will differ little from standard patterns. It is necessary, however, to lay great stress on the need for information to be collected, as much as possible, through members of the community. The aim is to complement the technical, 'objective' view of the situation with a picture of it as it is perceived by the inhabitants. The process of collecting information and opinion will also be the beginning of the building of relationships of mutual trust and respect between project sponsors and local people. As far as possible the survey should be carried out by those who are to assist or supervise work, so that enduring personal links may be formed.

For most items in the survey reference should be made to standard handbooks. Three topics which relate specifically to forestry at the community level are treated in detail below: land-use planning, assessment of local needs for wood and fuel, and assessment of existing or potential local or market demand for other forest products and services.

LAND-USE PLANNING

If land is to be used efficiently on a permanent basis, the distribution of uses must correspond with:

- its inherent capabilities, as determined through the appraisal of soil, topography and climate;
- its possibilities of improvement, through restoration, conservation, irrigation, etc.;
- other factors influencing the land-use pattern such as population pressure on land resources, population relocation, land tenure, watershed protection, road infrastructure, distance to market, etc.

The first step in land-use planning is the zoning of the project area into homogeneous physical units. There are several types of land capability classification methods, ranging from quite subjective empirical classifications based essentially on the current land use, to socio-economic classifications which consider dynamic factors in addition to the physical parameters. Simple classifications based on those factors which have a major influence on plant productivity are the most appropriate. The main factors to consider in this approach would be the physical and chemical nature of soil and the limitations, hazards and attributes of the various topographical features. Climate is likely to be important only if the range of altitudes is great, and may be treated as a function of topography.

One difficulty in this approach is the arbitrary rating of parameters. Classifications[1] based on the land systems approach, which identify land forms and land patterns, considering the recurring characteristics of climate, geology, vegetation, soils, land use and topography as a whole, are a way to avoid this arbitrary rating. Another way is the examination of the land, through a screening process, considering the presence of limiting physical factors.

1/ References on the most common classification systems are provided in Appendix 6.

Potential land-use classes should be restricted in number, and should be recorded on a map indicating the series of uses, ranging from highly suitable to highly unsuitable. In practice the local inhabitants are unlikely to conform exactly to such a scheme, the classification map serving rather as a permanent basis for a negotiating process in which the limits of compromise are represented by the unsuitable uses indicated for each site class. The technical ideal would be to organize production in such a way as to obtain from each site class the most valuable product, without destroying or depleting the soil resources and without creating other environmental hazards in the area of influence (silting, floods, droughts, destruction of wildlife, etc.). Once the land-use pattern with its basic technical and sociological considerations has been agreed upon, it should be adhered to and not be altered at the whims of politicians or other people with local influence.

In land-use planning, particular attention should be given to areas which are currently considered as land still available for cultivation, since on further examination, their quality may indicate that they are not arable lands. On the other hand, lands which may be considered as non-arable, might be made productive for agriculture with a higher level of technology. Conversely, low labour costs and shortage of land make it possible, on certain sites, to terrace steep slopes which would be marginal in mechanized farming. The definition of arable land must take into account inherent fertility, responsiveness to management, the availability of the required technical and financial inputs, the possibility and the responsiveness of the community to adopt improved techniques, and the hazards which may result (e.g., structural deterioration of the soil or pollution of inland waters because of unbalanced application of fertilizers).

Distance to the nearest village and accessibility will be essential factors in deciding between various suitable uses and different intensities of cultivation and management. The areas in which forestry is the preferred use among suitable alternatives will often be those which are unworkable for agriculture, such as steep slopes, or areas remote from settlements. Nevertheless, trees may be planted on arable land if the value of the tree crop exceeds that of alternative crops and if the waiting period can be financed. Tree planting may also be envisaged for agricultural lands along roads, railroads, canals, boundaries, rivers and on the ridges of irrigated plots. The establishment of shelterbelts, the fixation of sand dunes and the protection of the quality of water resources should also be ensured whenever required.

ESTIMATING LOCAL NEEDS FOR WOOD AND FUEL

An important component of the process of identification and design of projects intended to provide forest products required by the community must be assessment of the likely order of magnitude of the local need for these products. The starting point for such an assessment will be measurement or estimation of the quantities used at present. But it should also take into consideration how usage might change, or could be changed, in the future.

Fuelwood

The identification of fuelwood needs is likely to require information about four factors:

- the quantities of fuelwood, and other fuels, being used at present;
- the scope for using wood fuel more efficiently, and so reducing fuel requirements;
- the possible need to increase fuelwood usage, e.g., to improve availability of cooked food;
- the availability of fuelwood and of alternative fuels which could be substituted for fuelwood.

Current fuel usage may be known from recent surveys in the area. If not, then it must be measured. If the fuelwood used is purchased then it may be possible to assess the quantities involved somewhere along the distribution chain, i.e., by recording how much is sold by the fuelwood merchants, or how many lorry loads, donkey loads, etc., are brought in for sale over a particular period, and how much wood there is in such loads. In the more usual situation, where fuelwood is gathered rather than bought, it is unlikely that useful estimates of use can be obtained except by direct measurement at the household level, by means of a sample survey. If the population to be surveyed encompasses areas or groups which are likely to exhibit markedly different usage patterns (hill and valley locations, groups with different income levels, etc.), then a stratified sample survey should be designed which will allow these differences to be identified, and taken into account.

Weighing is likely to be the most accurate form of measurement of fuelwood, but care must be taken to record the type of wood, and whether it is green or dry, in order to be able to translate this weight information into equivalent volumes of standing wood. In most areas fuelwood use varies markedly with the season: in mountains more is needed in the cold season than the hot season, in the tropics less tends to be used in the wet season than the dry, etc. The measurements of usage must therefore be repeated at sufficient intervals to establish the nature and magnitude of this seasonal fluctuation, in order to arrive at a realistic estimate for the year as a whole.

The survey should also incorporate measurements or estimates of such other information as will be needed in assessing future change and alternative solutions to the fuel requirement. Such information might include some or all of the following:

- what other fuels are used, and in what quantities;
- to what extent is the fuelwood used for cooking, heating, and other uses;
- is the fuelwood used in an open fire or a stove;
- is the fuelwood burnt green or dry;
- is there evidence of increasing fuelwood scarcity: rising prices, more hours per day spent on gathering it, etc.;
- is fuelwood gathered for sale as well as for own use; if so, how much and what income does it generate?

A fuelwood survey of this kind could well be carried out in conjunction with a household budget survey. As should be the case with all such surveys, its actual form and dimensions need to be consistent with the importance of fuelwood to the community. If it is going to be possible to provide ample fuelwood supplies with little difficulty, then rough estimates of the quantities needed will probably suffice. On the other hand, if there are severe constraints on the development of fuelwood supplies, such as acute shortage of land for tree growing, then the situation is likely to have to be studied in some depth. The survey should therefore be preceded by a preliminary assessment to establish the dimension of the problem, the type of information needed, and the factors that should be taken into account in designing and carrying out the survey.

In assessing how much fuelwood the community is likely to need in the future, it is important to consider whether requirements per household could be reduced. Fuelwood is traditionally used very inefficiently and most of the heat is wasted. If it could be used more efficiently, a given level of requirement for heat, for cooking and warmth, could be achieved from substantially less quantities of fuelwood, or of other fuels. To reduce fuel requirements, the important points are:

- the wood or charcoal must be dry and the stove for burning the fuel must be correctly designed; this is especially important for wood;
- open wood fires should be avoided; they are very inefficient;
- cooking utensils should be closed, especially when food is prepared by boiling and the use of pressure cookers makes for great savings in fuel;
- fuel used in colder climates may be indirectly reduced by improved housing to reduce draughts and heat loss through walls, floor and roof, etc., and by better clothing.

At the same time, it is necessary to recognize that in situations where fuelwood is already scarce, current usage may be below what is needed or desirable to maintain adequate levels of warmth or to provide sufficient cooked food. In these circumstances, if the necessary improvements cannot be effected by improving the efficiency of fuel use, an increase in supplies per household might have to be planned for.

In assessing what share of the community's fuel requirements might be met from fuelwood in the future, the following points should be kept in mind:

1) Use of commercial fuels will depend in the first place upon their availability: the existence of a distribution network which makes them available within the community. However, even where they are available, they will be used only where the population is able to afford the costs. Because of the cash outlays required for stoves, installation, etc., these fuels may not be a viable option for the rural poor.

2) Charcoal can be made from any woody material but dense charcoal which can be transported and handled easily requires wood of medium to high density. Because of the need to dry wood before carbonizing, charcoal production is more successful in low humidity climates. Charcoal is favoured as a fuel over wood because it cannot deteriorate in storage, is convenient to use, produces no smoke or tar and requires a simple stove. Its combustion efficiency considered at this point is usually higher than wood. However, there is a great loss in the carbonization of the wood to produce charcoal. Thus, use of wood for fuel as an alternative to charcoal should always be seriously considered. An important factor in the choice between fuelwood and charcoal is that the latter can be transported economically over longer distances. It could be possible, therefore, to draw supplies of wood fuel in the form of charcoal from wood sources too far away to supply fuelwood economically.

3) Agricultural residues and animal dung are direct substitutes for fuelwood, commonly used either when fuelwood is in short supply or seasonally when the residues are widely available. A factor to be taken into account in assessing the balance between these fuels and fuelwood is the possible alternative value of the residues and dung in maintaining the fertility and structure of the soil. Increasing fuelwood supplies could be desirable to avoid the loss of agricultural productivity that diversion of these organic residues to fuel would bring about.

4) Biogasification converts agricultural residues and dung to a gas fuel, methane, through anaerobic fermentation, while the plant nutrient value of the organic material is retained in the residues, which can thus be used as a fertilizer. It is, therefore, an alternative to be considered where fuelwood is in short supply, leading to an undesirable diversion of residues and dung to fuel use. Factors that could influence the choice between biogas and fuelwood are: cost of the plant and associated equipment to store and use the gas, a minimum size more suitable for community than household use, the need for assured supplies of water, and the technical knowledge required to maintain a uniform temperature.

The appropriate solution in a given situation could well involve several elements. It is important to bear in mind that a situation of fuelwood scarcity might be as significantly, and as quickly, alleviated by reducing demand, in one or more of the ways outlined, as by embarking on an afforestation programme to increase supply.

Poles and timber

In assessing local needs for poles or for sawn or hewn timber, where these are used as building materials in the community, a similar investigation to that outlined for fuelwood will usually be necessary.

As in the case of fuelwood, it will be important to take into account likely future changes in usage. For example, in East Africa a common early stage in the process of upgrading rural housing as incomes rise is the substitution of corrugated iron roofing for thatched roofing. To provide a proper base for corrugated iron it is desirable to use sawn timber members for the roof structure instead of poles. Therefore this trend in housing development is accompanied by a faster growth in needs for sawn timber than for poles.

Where a need for sawn timber is foreseen, the investigation should be broadened to cover an assessment of how sawn timber could best be produced locally from roundwood. This could be by handsawing, which is simple and inexpensive. Alternatively it might be possible to establish a small sawmill, or at least a powered saw, within the community. Details of types of equipment which might be suitable are given in Appendix 5.

IDENTIFYING OTHER FOREST PRODUCTS

There remain to be considered the many forest products, other than wood, which are in the forests and which may or may not be utilized by the local community. If forestry is to provide the maximum benefit to the community, it is important that the people should be encouraged and assisted to make the widest possible use of the available products, and made aware of others which might be introduced if the environment is suitable and markets are available.

Table 3 summarizes some forest products, the species which produce them and the benefits they provide, while Appendix 3 gives examples of a wider range of species and products with some notes on their distribution, production and uses. The products are grouped in three categories indicating in what ways they are likely to be relevant to rural community needs: provision of food, income generation and increased land productivity.

Provision of food

The role of forests in providing food for the rural community either directly in the form of seeds and nuts, fruits, shoots and leaves which can be eaten raw or cooked, or indirectly as fodder for livestock, or by providing environmental conditions suitable for wildlife and fish, is well known. In planning a project, the extent to which the community has drawn on these food sources in the past would need to be evaluated and the following factors would require consideration:

- the abundance and frequency of the tree species yielding edible products;
- the origin of the tree, whether natural or planted;
- the period of the year when the product is available and most abundant (This may be of particular importance if it coincides with the beginning of the normal cultivation cycle or with adverse climatic conditions when food reserves may be low. If the product is sold as a cash crop, the seasonal price fluctuations and the reason for these should be established);
- the traditional rights of usage observed within the community.

The impact of these 'secondary food sources' on the stability of the community should also be assessed. The presence of stable communities practising shifting cultivation may be partly explained by the fact that they preserve trees which provide food in the course of their usual slash and burn practice.

TABLE 3

SOME OTHER FOREST PRODUCTS AND THE BENEFITS THEY PROVIDE

Nature of product	Type of product or species	Time lapse between planting and harvesting	Life span benefit	Kind of benefits: Main	Kind of benefits: Secondary
Food	Nuts - cashew, chestnut, *Macadamia*, *Pistachia*	Short to medium	Very long if protected	Nut	Fuelwood, poles, shade, fodder
	Nuts - brazil, pine, hazel, *Canarium*	Medium	"	Wood, fuelwood, shade	Nut
	Fruits - jakfruit, mango, *Durio*, *Garcinia*, *Ficus*, *Tamarindus*	Medium	"	Fruit	Wood, shade, fodder
	Palm	Medium if cultivated	Very long for fruit and oil	Fruit, oil, edible heart	Leaves for fuel and roofing
	Fungi	Short	Renewable source if cultivated	Mushroom	
	Animal protein	-	Renewable if protected and managed	Meat and fish	
Fodder	*Acacia*, *Prosopis*, *Albizia*	Short	Medium	Fodder	Poles, fuelwood, bee forage
Forest products providing employment or cash	Bamboo (also crop diversification)	Very short	Renewable by planting and good management	Raw material for industries, handicrafts, handmade paper	Shoots for food, forage
	Resin tapping	Medium to long	Sufficiently long if resources renewed after timber exploitation	Employment	Further employment if rosin and turpentine industry follows
	Tasar silk	Short	Forever if vegetation protected	Income by harvesting silk	Fuelwood, employment if silk industry follows
	Acacia senegal (also crop diversification)	Short	Renewable by planting and good management	Gum arabic	Fodder, fuelwood, poles, soil improvement
	Medicinal and other economic plants	Short if planted	Very long if protected	Income and employment	Impact on health (medicinal)
Forest products which increase land productivity by diversification	All species which provide bee forage as well as wood, nuts or fruits			Income and employment, honey	Impact on nutrition
	Thea oleosa	Medium	Very long	Oil, oilcake for animal feed	Bee forage, wood for handicrafts

Note: The species and products mentioned above are examples only.

Any programme for community forestry should therefore take into account:

- the food habits of the local people and their preferences;
- the conservation and development of all trees which yield edible products;
- the planting and management of fodder species;
- ensuring suitable environmental conditions for fish and wildlife.

Income generation

The natural resources available to the community might be able to support production of saleable outputs thereby providing cash income which will contribute to greater food security and a better standard of living. Some examples of such activities are:

- resin tapping of some pine and dipterocarp species which can lead to a local industry for the production of turpentine and rosin;
- gum cultivation in combination with foodcrops and fuelwood products;
- use of natural shrub species for tasar silk culture which can lead to a local industry in silk handicrafts;
- beekeeping to take advantage of the nectar and pollen yield of plants to provide honey and beeswax.

Several non-wood products have great economic importance and can provide a fair share of the farmer's income. Gum arabic in the Kordofan Province of Sudan is a good example, not only providing considerable income to the farmers but also having a significant impact on the national economy through its export earnings. Anacardium occidentale is another cash crop very suitable at the farmer or community level. The export prospects for the cashew nut are good with increasing markets in developed countries and also increasing world prices for both the nut and the oil. Other examples are palm hearts and bamboo shoot which already have an international market and for which, at present, the demand in developed western countries is greater than the supply.

In estimating the potential which could be created by this type of activity, consideration would need to be given to the manpower available and whether it would be full-time or seasonal, the resources available for each type of activity envisaged, the potential for the development of the resource and the availability of markets for the sale of the product.

If the activity selected depends on existing resources it will be essential to ensure proper management for maximum and long-lasting benefit. If new resources have to be developed, quick establishment providing a minimum time lag from planting to resource use would be desirable.

Increased land productivity

The needs for food, employment and income can best be met from resources which can provide a range of uses thereby increasing land productivity. Some examples of such multipurpose species are the many plants which produce nectar and pollen for honey production; bamboo, which is used as a simple building material, for handicrafts, for fodder, for the production of handmade paper and to provide shoots for human consumption; and such species as Acacia senegal and Thea oleosa which have a wide range of uses (Appendix 3). Other examples of multipurpose species, of which there are many, are given in Appendix 3. Rural communities could benefit considerably by the introduction of such species if they do not occur naturally and if conditions permit.

DISTRIBUTION AND MARKETING

Many of the products that have been discussed are items that could or would be produced partly or wholly for sale rather than for local consumption within the community. There will be many situations where even fuelwood or other wood products might also be

produced for sale. It is very important that if the small producer is to be encouraged to engage in such production he be assured that he will be able to market the product, and market it at a profit.

A number of issues arise in this respect. The first is the need to be able to identify markets, to be able to match markets to the range of products that the farmer might produce and be able to assess the likely financial profitability to the producer through analysis of the value in the marketplace and the costs of producing the goods and placing them in the market. In short, the forest service, or whichever agency is encouraging new or expanded production, must base this on sound market intelligence. As some of the crops likely to be grown in community forestry projects have a lengthy production period, it may be necessary to assess what is likely to happen in the market some years ahead.

A second factor is the need to ensure that the producer benefits to the fullest extent possible. All too often, a disproportionately large part of the market value accrues to intermediaries. The latter also tend to encourage the producer in negative practices: for example, encouraging production of commercial products at the expense of essential protective practices.

One solution to this problem can be to encourage and assist cooperatives and other forms of producer grouping (see pages 22 - 23). It is to be noted that cooperatives, to be effective, usually need to be vertically integrated through to the marketing stage, and the maximum benefits will often only be achieved if they also engage in processing. Alternatively the forestry authority or a state forest corporation might undertake the marketing of their production on behalf of small producers. However, to be effective and efficient this calls for commercial and management skills which a forest authority may not possess. One way of overcoming this could be for the authority to set up a joint enterprise with industry for this purpose.

A related issue is that of ensuring stability of prices inorder to avoid fluctuations in the income of the producer. Price controls, price commissions and buffer stocks are devices which might be appropriate in particular situations. However, with a few notable examples such as gum arabic in Sudan, the proportion of the production of a commodity which is generated through community forestry projects is seldom likely to be so large as to warrant a separate price control mechanism, and price stabilization measures would normally have to take place as a part of the machinery for stabilization of prices of agricultural products in general.

Other distribution and marketing issues include availability of credit, which has been discussed on page 23, and access to markets. Community forestry projects often involve populations in remote areas which lack even physical access to markets. The forest authority may have to accept the responsibility to provide such access through the building or upgrading of feeder roads to link the community with the existing transport network.

ENVIRONMENTAL ASPECTS OF FORESTRY

The following sections consider the services rendered by forestry which are frequently insufficiently known to the local population, and comprise such benefits as erosion control, soil conservation, watershed protection, stream flow regulation, dune fixation and local modification of wind, temperature and humidity. These are immense topics of enormous complexity, the treatment of which is covered by numerous publications some of which are listed in Appendix 6. Of particular relevance are two papers (FAO 1977 (a)(P) and FAO 1977 (b)(P)).

Erosion control, soil conservation and land reclamation

In areas with a high erosion hazard, because of the type of soil, steep slopes or because of the distribution and intensity of rainfall, both the establishment of annual and permanent crops and the establishment of tree plantations require the adoption of suitable conservation techniques. On very steep slopes, where intensive conservation

farming techniques, including bench terraces, cannot be established, only perennial plant cover can ensure protection. Rural communities are only likely to undertake protective measures if they see disadvantages to themselves in failing to do so (for example where torrents from above deposit debris on arable land), or when they anticipate benefits in the form of production. Incentives, such as subsidies or soft credit, may be necessary for the introduction of conservation practices in most cases.

In the protection of public facilities, the involvement of the community should be encouraged but the total economic burden should be the responsibility of the government. Such would be the case with mountain roads which are affected by landslides and gully erosion, the prevention of silting in canals and reservoirs, and the protection of human settlements against floods through river training.

Land reclamation and erosion control schemes may secure unemployed or underemployed people with a regular income during the periods in which agricultural or forestry activities cannot provide full employment. Some of the possibilities to be considered are sand dune fixation, establishment of shelterbelts, road protection, desiccation of swamps and reclamation in arid zones, saline soils, lateritic plains or badly eroded areas.

Effects on local climate and hydrology

Trees affect the climate in their vicinity by reducing wind speeds at ground level, and by shading the ground, which causes heating to be raised to canopy level. Where forest maintains a deep soil that otherwise would be unexploited by roots or eroded away, the resulting retention of water for local evaporation makes for lower temperature and higher relative humidity than would prevail if the forest was absent. Shade and shelter have been known and appreciated from time immemorial, but some of the effects on the cycles of water and energy are only now beginning to be realized, even by specialists. Villagers are unlikely to wish to plant trees only for their climatic effects, but these may constitute a useful subsidiary argument.

Amenity aspects

Restoration of an area to scenic beauty will contribute, in addition to the psychological, esthetic and physical benefits on the community involved, to making it more attractive to tourists through the improvement of landscapes and the establishment of recreational possibilities. The implementation of recreational facilities will provide additional employment and cash income to the local community. A pleasing landscape, in the place of eroded slopes and a wildlife-depleted habitat, will certainly give the community an outlook that will be very different from the attitude of resignation, poverty and disease that is characteristic of communities where the natural resources have been misused and abused.

Tree plantations may also be established in waste and sewage disposal areas, thus making better use of the land, preventing wind- and water-borne diseases from affecting neighbouring areas and promoting the recycling of water and nutrients.

Wildlife management

Wildlife can also contribute to the development of local communities, either by providing food or other products or by becoming a source of attraction for tourists and for gamehunters. Crocodile-rearing in village pens and the management of deer for the production of antlers are two of the many possibilities which are discussed in more detail in Appendix 3.

PRODUCTION AND MANAGEMENT SYSTEMS

INTRODUCTION

To satisfy existing and potential needs, once these have been identified, production systems must be set up. These will rarely be as simple as the systems of classical silviculture if the associated products mentioned previously are to be integrated into them. Where the need for land for food production is very great, forestry may only be acceptable if it is combined with agriculture or grazing in an integrated system.

It is convenient to treat the many possible combinations of productive systems under a few main headings, comparable with the silvicultural systems of classical large-scale forestry. There is a problem of terminology, several terms being used in some cases for a single system and a single term in others for several. For example, 'agri-silviculture' is sometimes used to mean any combination of annual crops with trees and sometimes to mean the particular method of plantation known as 'taungya' (i.e., planting of forest trees by farmers who are paid partly or wholly by being allowed to grow foodcrops between the trees in the initial years). More recently the term 'agro-forestry' has been introduced to signify any system that includes both tree cultivation and food production. In the present document an attempt is made to use terms that are precise and unambiguous and that lend themselves to translation.

All the systems described below have in common the feature of yielding products that can either be directly consumed or easily harvested and marketed by the local community. At one extreme (small-scale forestry or 'village woodlots') this result is assured simply by scaling-down and adapting classical silviculture. At the other extreme stand complicated systems that combine two or more simultaneous or consecutive productive sub-systems.

The main categories are as follows:

- multiple-product forestry,
- small-scale forestry (village woodlots),
- arboriculture (tree farming),
- agrisilviculture,
- silvipasture.

This study has taken into account the experiences of 18 projects, which are summarized in Appendix 2.1/ Twelve of these were examined in detail in the Desk Study presented at the Second Expert Consultation in June 1977 and six were individually tested as case studies by participants in that meeting.

Fourteen of the projects fell into the category of 'small-scale', two into agrisilvicultural/taungya, one arboricultural and one into silvipastoral. The major objectives of the projects were as follows:

1 pulpwood production

1 gum arabic production

2 fodder production

5 fuelwood production

9 timber, poles and fuelwood production.

Eight of the projects were strongly motivated by environmental protection and improvement, five by social considerations and one envisaged integrated multi-product forestry.

1/ Two of the projects have been summarized jointly.

MULTIPLE-PRODUCT FORESTRY

This term is used to cover all cases in which a forest ecosystem is made to yield other material products in addition to wood (but not including annual crops, forage for forest grazing, nor such products as water that would be produced under any system). At one extreme this may mean no extra management provisions other than perhaps facilitating access, as with honey production amongst eucalypts. At the other extreme complex manipulation of the ecosystem may be necessary. In between lie a range of possibilities in which the forester treats the requirements of subsidiary production as constraints on silviculture.

Multiple-product systems are particularly indicated where the local inhabitants are forest communities with a tradition of obtaining a variety of products from the forest, and where past management has aimed exclusively at timber production to the detriment of the people's livelihood. In the case of plantation forestry it seems likely that only the simplest provision of secondary products can be catered for, at least in the first rotation.

SMALL-SCALE FORESTRY ('VILLAGE WOODLOTS')

This is silviculture on the scale dictated by local demand for forest products and local availability of suitable land. There is a single main product, normally firewood, and the techniques of cultivation are simple. Skilled advice is likely to be necessary only on establishment and harvesting. The loss of the land for other uses will be felt during the more or less lengthy period before production starts, and some form of compensation is called for. Because of its simplicity this sytem is the most suitable for peoples with little tradition of cultivation, notably the grazing communities of relatively arid lands, and for farming communities that rely on a single main-crop plant.

An important sub-class is constituted by line or group plantations, in which the trees are dispersed in small groups or lines wherever suitable patches or bands of land are available. The purpose may be to provide wood or shelter or both. Management of a set of such groups as a single wood-production unit is clearly more difficult than the case of a single block, and protection of the young trees against damage requires greater awareness and discipline. This type of plantation is therefore suitable for communities with a strong tradition of cultivation and crop protection.

It is also convenient to treat under this heading the intensive plantation of fast-growing trees for wood production by private owners, though this category merges into that of arboriculture (see below). Quick-growing species such as Gmelina arborea and Albizia falcataria can be regarded as cash crops. A plantation of Gmelina after 8 years can yield 200 m^3/ha which may give a return which is as much as the return from several agricultural crops. The additional advantages are threefold: (i) earnings become regular, (ii) cropping may continue for a long time under a coppicing system, and (iii) soil fertility is maintained.

Other cases of trees as cash crops using Casuarina spp. on sand dunes, various species of bamboo, or cashew (Anacardium occidentale), can be found in many countries.

ARBORICULTURE

This term is used to signify the intensive cultivation of trees individually or in small groups or orchards for whatever purpose.1/ Arboriculture is a bone of contention between foresters and agriculturists. Where the crop is edible the latter have usually succeeded in taking charge, though there are many cases of forest services planting fruit or nut trees, particularly if there is novelty (for example, carob trees). Where the crop is not food, the allocation to foresters or agriculturists has been arbitrary. For example the former has kept cork oak while the latter has had rubber.

1/ The English-language usage in industrialized countries, restricting the sense to the tending of ornamental trees, often in an urban context, is derived from this original meaning.

Rules for allocation do not seem to be possible or useful. Foresters should adopt a pragmatic approach and be ready to help to introduce or improve arboriculture wherever no one else is acting. All the trees of agriculture initially came out of the forest, and if the forester can get promising new species out into fields and orchards he should do so.

Arboriculture is skilled work and is unlikely to be successfully undertaken except by farming or forest communities with a tradition of planting, grafting, pruning and tending trees.

AGRISILVICULTURE

General

This term is used here to cover all systems in which land is used to produce both forest trees and agricultural crops, either simultaneously or alternately. Where the agricultural component comprises food trees this category merges into multiple-product forestry, the distinction depending on the ownership and the intensity of cultivation. Their complexity makes these systems fragile, and they tend to simplify themselves either into plain agriculture or to plain forestry. And for the same reason they are more likely to succeed with communities that have a tradition of cultivating both trees and annual crops. Several major systems may be distinguished.

Agriculture with tree fallow

This is simply an improved version of that most ancient system, shifting cultivation, the trees of the fallow being valuable species, planted or sown instead of being allowed to spring up spontaneously. As with the shifting cultivation, the problem is that increasing demand for food may lead to the fallow period being shortened or eliminated altogether. The solution, to be adopted wherever the forest fallow is necessary for the maintenance of the soil, is to increase the productivity of one or other or both phases and to inform the farmer of the hazards of soil degradation. This system is most likely to be appropriate for forest communities but where a particularly valuable forest product is available it may also be proposed to farming communities. In southern Iraq a system is practised which can be counted in this category: tamarix trees are planted on land which was once used for growing vegetables and was later abandoned after the well water had become very saline.

Agricultural afforestation

This system consists of intercropping a forest plantation with agricultural crops in the initial years, until the canopy of the forest trees closes. In principle this system may be used on any suitable land, irrespective of ownership, and with labour provided by paid workers. In practice, however, it has been used mainly as a method of afforesting publicly owned land, using the labour of land-hungry farmers who are paid wholly or partly by being given the use of the land: this is the well-known taungya system, first used in Burma in 1856 and since adopted in various forms in many countries. It is important to note that taungya is only one possible method of agricultural afforestation. This system should not be used in hilly areas with steep slopes, unless special management is introduced.

It is logical to assume that if agricultural crops are to be grown in conjunction with forest crops, and if forestry is to be the dominant land use from the inception of the plantation, the tree species that are used should preferably be chosen because they display silvicultural characteristics that would permit them to compete effectively with the agricultural crops, namely:

- they should be fast-growing light demanders so that they may quickly over-top the foodcrops;
- they should either be capable of closing canopy early or should be capable of being planted at close spacements to allow early crown closure;

- their root system should not be superficial thus making them liable to root damage from the cultivators;
- they should have the overall ability to withstand short periods of competition for light, water and nutrients.

By the same token, the agricultural crops should also possess certain features:

- they ought not to cast too much shade;
- they should not be climbers unless the farmers provide supporting sticks for climbing plants;
- their nutrient requirements should not be such that they rapidly exhaust the soil;
- if rhizomes, they should not have the propensity to spread rapidly;
- their period of gestation, and continued production, should not be so long that competition from them is prolonged.

If possible, the agricultural crops should also display certain qualities, advantageous to the tree crop, such as those of soil improvement (through the fixation of nitrogen, for example) and water conservation.

These general propositions are based on the assumption that the main goal is to establish a tree crop as soon as possible. However, because of socio-economic reasons, it may be desirable to assist the farmer as long as possible, making a compromise between the agricultural and the forestry objectives. In such cases the tree species should be amenable to early wide spacement, should possibly possess self-pruning properties, should not cast a dense shade and should themselves be tolerant of side-shade, if not full overhead shade, in the early stages. (King, 1968 (S)).

The system begins with the clear-felling and burning of either the remains of a recently exploited forest or of the secondary growth. However, some valuable tree species may be marked for retention, as is done in some parts of Sierra Leone. In most cases the first agricultural crops are planted before the tree crop, but they may be planted after the tree crop, or simultaneously. The actual time of planting of both types of crops is regulated by the rainfall regime of the area concerned. Where agricultural planting precedes forest planting the objectives are to provide an incentive to the farmer to clear the land, to give the farmer a period of use during which he is not burdened by the necessity of caring for the forest crop, and to ensure that the land is properly cleared before the forest crop is introduced. But it is also true that when the two crops are planted simultaneously or the agricultural crop is planted first, the trees will receive an initial boost in growth from the burnt vegetable matter and the farmer will be more careful in his tending of the trees when his own crops are giving returns, since his interest in the tree crop will be related to the yields of his agricultural crops.

A few examples of particular agricultural afforestation systems are given in Appendix 4, together with a list of agricultural crops most commonly grown in the geographic regions where taungya is most frequently practised.

Perennial crops under forestry

In many countries the cultivation of tree crops or other perennial crops other than timber species are proscribed in forest reserves for various reasons: they suppress the forest crops; they encourage the farmers to stay on after the forest trees have grown up; they compete with the forest species for water, nutrients and crown space; in the event of forest trees being found to be hosts for pests which attack the agricultural crops, there will be irresistible pressure on the Forest Service to destroy the timber crop; and they may lead to claims for ownership or rights and other claims against the Forest Service. The agricultural tree species which are sometimes grown with forest species include cocoa, coffee, oil palm, citrus, papaya, rubber and tea.

SILVIPASTURE

This term covers systems in which controlled grazing of forest vegetation takes place during part of the rotation. It does not extend to destructive overgrazing such as is currently practised in large areas of the world's forests. Nor does it include the growing of fodder crops that are harvested and fed to stalled animals: this is classified as agri-silviculture even though animal husbandry is involved, since only plant production takes place in the forest. The transition from unmanaged grazing to silvipasture is one of the most difficult tasks facing rural authorities in grazing communities, but the only alternative is to watch further losses of biological capital. The principle considerations which must be the basis for all grazing management programmes are the following:

Proper intensity of use - Plants thrive when the degree of use is moderate. Enough of the herbage and browse production must be left to permit the plants to keep their food factory productive and to provide for ground cover, and the return of organic matter to the soil. A general estimate is to utilize 50 percent and leave 50 percent.

Proper season of use - Grazing during rapid periods of growth is especially damaging. The most critical period is soon after growth starts on a given range and the animals must be kept off at this time.

Uniform livestock use over the range - Livestock tends to use some areas more heavily than others especially near water, along level bottomlands, ridges and certain range sites. To attain uniform livestock use would require well-planned water development, establishment of division fences and construction of trails in rough and bush country. Salt may also be used to some extent to attract livestock to areas which would otherwise be little used. Assigning the class of stock to any given locality according to forage preferences of the animals is also very important. Goats for example can do well on leaves and twigs of brush and dwarf timber species. Horses need grass. Sheep sometimes do well on weeds. Cattle will take a certain amount of browse from brush species in addition to grass which they prefer.

Periodic rest from grazing - Year-long use of ranges places the range plants at a tremendous disadvantage since they have little opportunity to make root growth, replenish carbohydrate reserves, initiate new shoot or to meet a combination of these growth requirements which could not be met under a year-long grazing period Rest during any part of the year is therefore important but it is especially essential during early stages of growth. Many systems of deferred and rotation grazing have been developed to permit the plants to rest during part of the year. However, any successful system must fit the local conditions if it is to be of any value.

Good livestock husbandry - A correct grazing management programme should not be an end in itself. Any grazing management programme should aim at increasing meat production. This requires that special consideration be given to the improvement of the methods of herding, removal of marketable stock, to avoid shrinkage in weight, to improvement of the strains of grazing animals and the eradication of insects and plant pests.

Where range lands have been completely depleted as a result of overgrazing, conservation and improvement action should be undertaken. To this end the programme should include the following steps, in this order: 1) reducing the number of animals grazing in the particular range; 2) preventing further erosion and repairing erosion damage; 3) improving fodder production by reseeding or replanting the range where necessary; 4) adopting a set of good management practices, which may include such requirements as provision of water, rotating stock on range sub-divisions by means of fences, eradication of unpalatable species and careful observance of grazing seasons.

Major work has been done on fodder improvement in forest plantations in Papua New Guinea, including studies on grazing rotations, carrying capacity, economics of integration, etc. In the Araucaria forest pastures in Bulolo about 2 000 head of cattle are grazed in some 4 000 ha of forest plantations. While cattle are now introduced in open plantations of above seven to eight years of age, it is expected that this can be done even in plantations over three or four years old. Fencing would be required to prevent cattle straying into younger plantations.

In Indonesia, the State Forest Corporation (Perum Perhutani) has been investigating since 1973 the productivity of elephant grass (Pennisetum purpureum) under teak and mahogany plantations in the National Forests. Also, on private land in the Upper Solo watershed, with technical advice from UNDP/FAO, underplanting of elephant grass is carried out at 0.8 x 0.8 metres (m). Trees are planted at 2 x 2 m spacing, the choice of species varying with climate: Pinus merkusii, Albizia falcatari, Eucalyptus alba, Acacia auriculiformis and Calliandra calothyrus. The elephant grass density is increased by the farmer by planting cuttings during the first two years and full production of 60 tons/ha/year is attained in year three, but yields of 140 tons/ha/year have been reached. The Pinus/Albizia/grass system would employ two men on a full-time basis on a 1 ha holding. The Eucalyptus/grass system would employ one man per hectare continuously, but in the area where this system could be used, holdings are often 2 ha in extent.

In Nepal, fodder plantations are generally multi-purpose, the main species being Ficus cunia, F. lacos, Albizia spp, Litsea polyantha, Morus spp, Castanopsis spp, and Leucaena glauca. Seven hundred to fifteen hundred trees per hectare are planted and harvesting commences some five years after planting, full production being obtained in the tenth year. Tree foliage is harvested all year, but particularly after the monsoon season. A farmer's estimate is that one mature fodder tree will provide supplementary feed for a cow or a buffalo for one month. A buffalo will eat up to seven tons of leaves per year, which comprises 41 percent of its feed, and a cow will eat up to 2.5 metric tons, comprising 27 percent of annual feed. Other estimates of annual yield are 5.7 metric tons of starch equivalent or 26 metric tons of dry matter per hectare and 5 - 12.5 metric tons of leaves per hectare.

In the Sahelian zone, an effort is being made to regenerate and enrich the savanna for grazing purposes. In Senegal, in the Cap Vert area (annual rainfall about 350 millimetres(mm)), Acacia albida is planted at a 10 x 10 m spacing. Felling is prohibited and there is no specific fencing against cattle. Guards or watchmen are used to protect recent plantings.

INTEGRATED WATERSHED MANAGEMENT

Comprehensive watershed management is in fact a complex of systems which is geared toward four main objectives:

- the rationalization of the land-use pattern, according to the land-use capability and other environmental criteria;

- the optimization of the use of natural renewable resources, within the concepts of multiple purpose use and continuous yield of goods and services;

- the protection of water resources quality, quantity and timing and the conservation of the soil's productivity;

- the improvement of quality of life, both for the benefit of local communities as for other human settlements which are dependent on the watershed's resources and on the stability of the tributary area.

Therefore, integrated watershed management requires the combined input of all pertinent rural development actions plus a series of specific actions which may involve the application of one or more of the following measures and techniques:

- preventive regulations,
- manipulation of the vegetation cover,
- mountain road stabilization,
- afforestation and revegetation,
- torrent control,
- conservation farming,
- range management.

Intensive erosion control works for improved upland agriculture can be justified in areas with a high pressure for agricultural lands, as has been demonstrated in a UNDP/FAO pilot watershed project in Smithfield, Jamaica. The steep slopes were systematically terraced and fruit and forest trees were introduced, with excellent returns, particularly from harvests of lucea yam and yellow yam (Dioscorea spp). Net returns of US $ 1 875/ha were obtained, the annual cost of bench-terracing being US $ 200/ha with soil improvement practices. At the same time, the amount of soil loss, as compared with the traditional cropping systems, is greatly reduced with terraces. In the same project a comparison was made of the two methods during four years on a 17° slope (annual rainfall 3 250 mm), which showed that the average of dry soil loss per hectare per year from the check plot was 135 tons, while the loss from the bench terrace plots was 17.5 tons. Plots with hillside ditches with continuous mounds lost 27.5 tons (FAO, 1977 (S)).

In the Mae Sa Integrated Watershed and Forest Land Use Project in Northern Thailand, the objectives of soil and water conservation and also important social objectives are being attained by an integrated effort comprising:

- stabilization of shifting cultivators as settled farmers through incentives, demonstration and extension;
- improvement of the living standards by adjusting the population/natural resources ratio and by introducing new crops, new cultivation practices, education and health measures, market promotion, security of land tenure according to the availability of land, etc.;
- employment for the landless and those leaving the rural areas, training of local staff, introduction of labour intensive activities and improvement of the physical and institutional infrastructure.

Small farmers practising subsistence agriculture in steep upland areas, who progress uphill as the soil is depleted, are generally reluctant to establish conservation farming systems, for in establishing bench terraces, for instance, they would initially lose a crop. In the case of the Upper Solo project in Indonesia, food aid from the World Food Programme enabled the farmers to establish bench terraces. In Tunisia, credit from the Government and food aid enabled the farmers to do likewise.

Subsidies may be a convenient incentive for integrated watershed management projects, as has been shown by 20 years' experience in Venezuela, particularly in the Andes, through a successful conservation subsidy programme. Afforestation, contour ditches, check-dams and other erosion control practices are encouraged through payment in kind of fertilizers, seeds, livestock, sprinkler irrigation equipment, construction material and other inputs which rapidly allow the small landholders to increase productivity and to improve their standard of living.

The integrated approach is particularly pertinent in the case of watersheds. The upper watershed and the downstream area should be complementary and a socio-economic

balance should be maintained. Since the community is unlikely to take the initiative in this type of effort, the government should take steps to establish the necessary authority for interagency cooperation but involving the community as much as possible.

SELECTION OF SITES, SPECIES AND TECHNIQUES

INTRODUCTION

Implementing the chosen production system requires detailed choice of site, species and technique, though to treat one decision as subsequent to the other is merely a didactic convenience: normally the system will have been chosen with the available options in mind and these will have been selected in the course of the survey on needs and possibilities. It is therefore not necessary to reiterate considerations that have already emerged. Thus the issues that arise in ensuring that production is economically sound, that were discussed on pages 38 and 39 are not repeated here. Nor will the following outline include much of the detail that is to be found in standard handbooks (see Appendix 6). Table 4 shows, in simplified form, the various considerations which need to be taken into account in the selection process, and this is followed by sections which describe the principle of selection giving some examples.

SILVICULTURAL CONSIDERATIONS

The choice of species is dependent on local conditions for growth. Local environmental conditions may, for convenience, be divided into:

Site - That part of the local environment which it is difficult, or impossible, for man to alter, e.g., climate, soil depth, topography. In the present context 'site' is considered to include climatic as well as soil factors.

Cultural treatment - Techniques used by man which can alter the local environment significantly, e.g., soil preparation, fertilization, weeding. Such techniques may have only a temporary effect, but they are usually applied at that stage in the life of the trees when it is most effective, i.e., the establishment stage, when the trees are young and most responsive to man's intervention.

Because the choice of species should never be made without considering the characteristics of the site to be planted and the cultural techniques to be used, these are dealt with first.

Site

The effects of extreme differences in site are self-evident but even within a restricted area where a species is capable of surviving and growing, local differences in climate and soil can have considerable effect on its rate of growth and yield of produce. An example is *Pinus radiata* in South Australia, where volume production on the best site planted (S.Q.I.) is nearly four times that on the poorest (S.W. VII).

In slower growing species in north temperate conditions the ratio lies between two and three (e.g., Scots pine and Sitka spruce in U.K.).

The better the site (adequate rainfall, warm temperature, deep and fertile soil), the wider the range of species which will flourish and the greater the difference between the inherently fast-growing and the inherently slow-growing species. As conditions approach the limits of tree growth, for instance because of increasing aridity or increasingly low temperature, the number of successful species becomes fewer and their rates of growth and yield are reduced.

TABLE 4

CONSIDERATIONS IN SELECTION OF SITES, SPECIES AND TECHNIQUES

			Remarks
SILVICULTURE	Site	Climate Soil Topography Biotic factor Plant indicators	
	Cultural treatment	Weeding Simple techniques Protection Seeding	
	Species	Adaptability Resistance to pests, etc. Easy seed supply Easy establishment Easy regeneration Absence of adverse side effects Productivity Early returns	Local experience and research
UTILIZATION	Fuelwood	Heating value Specific gravity Moisture content Extractives Ease of harvesting Durability	See example page 52
	Poles and posts	Straightness Strength Natural durability	
	Sawlogs, plywood, etc.	Long rotation	In general not suitable for community efforts but could be exceptions (See page 36 and Appendix 5)
	Pulpwood	Short rotation	See PICOP, page 54
	Multipurpose species	Producing several products simultaneously	See page 36 and Appendix 3
ENVIRONMENT	Shelterbelts	Adaptability Growth rate Crown formation	
	Sand dune fixation	Adaptability to macro and microclimate	
	Watershed management	Good survival on impoverished sites Produce large amount of litter Strong and wide-spreading root system Ease of establishment Dense crown and all-year foliage Resistance to disease, etc. Soil improvement Economic return	Pioneer species better adapted to harsh sites
	Riverbank/Roadside protection	Strong, dense and widespread root system	

The following site factors should be considered in determining the sites most suitable for planting and in the selection of suitable species.

Climate: temperature, rainfall, relative humidity, wind, elevation aspect, exposure. Seasonal and annual variations in temperature and rainfall are more important than totals or means. Length of dry season and its relation to temperature ('summer' or 'winter' rainfall regimes), mean daily minimum temperature in the coldest month and maximum in the hottest month are factors which may be limiting for certain species.

Soil: depth, texture, parent material, fertility, pH, salinity, degree of compaction or permeability, aeration, water relations and drainage. Of these, soil depth is usually the most important for tree growth, followed by soil texture.

Topography: important because it may have a considerable effect on both local climate and local soil development or soil erosion.

Biotic factors: influence of man, fire, domestic and wild animals, pests and diseases and competing vegetation. The effects of these may be modified by cultural or protective treatments.

Plant indicators: the existing vegetation, being itself the result of the interacting factors of climate, soil, topography, historical and biotic factors, may give valuable indications as to the characteristics of the site.

Accessibility: Planting sites close to the community have big advantages in the saving of transport costs and in facilitating planting and tending. In some cases a relatively poor quality site close to the community may be preferred to a higher quality, but more distant, site.

Within rural communities the scope for site selection for forest plantations is limited because the best sites are often reserved for agriculture. Within the forestry area, however, the assessment of the above factors should assist in selecting species adapted both to the general climate of the area and to the local soil variants, such as ridge tops and valley bottoms.

Cultural treatment

The intensity of cultural and protective treatment of planted trees affects both survival and growth. In some cases treatment may make the difference between success and failure, e.g., the exclusion of stock from newly planted palatable species, the addition of zinc to pine plantations in Australia or of boron to eucalypt and pine plantations in Africa. Species differ in their response to treatment: for example, eucalypts respond to weeding much more strikingly than do pines, to such an extent that weeding may make the difference between success and failure in eucalypt plantations.

For tree-planting in rural communities reliance should be placed, as far as possible, on relatively simple techniques, since it may be impossible to ensure the close technical supervision demanded by more sophisticated techniques. However, certain minimum standards are obligatory if it is to be worth planting at all. Adequate pitting is necessary whenever potted stock is to be used and it is essential to protect young trees from browsing by goats and cattle, and from fire, which can be a serious hazard, particularly if weeding is neglected.

Species vary in their silvicultural demands and detailed information is available in the various references listed in Appendix 6. Certain techniques which succeed with some species can result in failure with others, for example Cassia siamea is often established successfully by direct sowing, a technique which is entirely unsuited to the smaller-seeded eucalypts. The local possibilities for cultivation and protection will exert a considerable influence on the choice of species. Where the necessary technical advice is available, it should be possible to introduce immediately species which need intensive culture but which, given it, will produce large yields of products or services. If conditions are very

difficult or technical advice is not readily available, it may be necessary to select a 'tougher' but somewhat slower-growing species, at least in the early stages.

Selection of species

A species selected for planting should possess the following silvicultural characteristics:

1) Ability to survive and remain healthy under the given conditions of site and cultural treatment. Adaptability to local climate including annual variation in climate, and to a range of local soil variation.

2) Resistance to local hazards, including pests, diseases, fire, browsing and trampling.

3) Ease of seed procurement, handling and storage.

4) Ease of handling in the nursery and establishment stages.

5) Ease of regeneration for later rotations, e.g., the advantages of coppicing or prolific seeding species.

6) Absence of undesirable biological side-effects such as the harbouring of agricultural pests or competition with agricultural crops by surface-rooting species.

7) For production planting, biological productivity under the given conditions of site and cultural treatment. In the case of wood production, yield data are commonly expressed in terms of volume.

8) For rural communities, productivity in the early years is more important than later productivity, since it allows short rotations and early returns on the initial investment in planting. 'Quick starters' are preferable for this and most of these are ecological pioneer species, rather than members of climax communities.

9) For protective planting, special characteristics may be required: e.g., crown shape for shelterbelts; rooting system for soil stabilization.

In deciding on the species best suited for planting in rural communities, as much use as possible should be made of local experience and research within the country. Rural communities seldom have the facilities to conduct their own research, but often it is possible to make use of research carried out by the national forest service, universities, etc. Where additional applied research does prove necessary in order to identify appropriate species and techniques, it should be carried out in conjunction with the local people.

In the case of exotics, which play an increasingly important role in plantations, useful guidance may be obtained by matching local climate and soil with those of other areas where a given species has performed well as an exotic. Comparison with site conditions within the natural range of the species is also useful, but gives less indication of its adaptability to new environments than does its performance as an exotic.

There is much evidence that, for certain species, the provenance or geographic location from which seed was collected may be as important a factor in adaptability and rate of growth as the taxonomic species itself. A good example is Eucalyptus camaldulensis, of which the Lake Albacutva provenance in Victoria has given outstanding results in the Mediterranean region, while the Petford and Katherine provenances have performed excellently in savanna conditions south of the Sahara. Where such knowledge is available, it may be as important to select the right provenance as the right species.

UTILIZATION CONSIDERATIONS

The function of rural plantations is to provide either products such as food, fodder and wood, or services such as soil stabilization, shelter and shade. Any successful species can fulfil at least two purposes because 1) all trees produce wood and all wood can be burnt as fuel, 2) all trees produce roots and all roots are beneficial in reducing soil erosion and improving percolation of water. The versatility of a species in fulfilling more than one function simultaneously should always be assessed and, other things being equal, multipurpose species should be preferred to the single or dual-purpose species. It is, nevertheless, necessary to attempt quantitative comparison of the different functions separately. In some cases it may be more efficient to plant several species, each performing a separate function. A range of species may be less prone to pest and disease hazards than monocultures of a single multipurpose species.

Fuelwood

Fuel is likely to be the most important and the most universal of wood products obtained from rural community plantations. Even where a plantation is intended to provide other products such as poles or pulp, inferior material, suitable only for fuelwood, will make up a significant proportion of the total yield.

In addition to the silvicultural characteristics listed previously, such as high yields and quick growth, the following utilization characteristics are important in choosing species for fuelwood production.

1) Heating value. The heat produced by unit volumes of wood of different species is determined by the factors of specific gravity, moisture content and extractives. Of these, differences in specific gravity are likely to be the most important in modifying any choice of species based on volume yield per hectare. Moisture content and extractives are less important, although the former may have a significant effect on handling and transport. Further details of these factors are:

   a) Specific gravity (S.G.). For wood at a given moisture content, heating value is directly related to specific gravity. Comparisons may be made at different moisture contents, of which 'oven-dry' (0 percent) and 'air-dry' (12 - 20 percent) are those most commonly used. Although air-dry specific gravity varies by a factor of eight between the lightest (*Ochroma*) and the heaviest (*Piratinera*) species in the world, the ratio between alternative species likely to be grown for fuelwood on the same site is unlikely to exceed two. It should be noted that specific gravity in fast-growm short rotation crops may differ considerably from that in mature natural stands. An example is *Eucalyptus grandis*, which has an air-dry S.G. of 0.82 in natural Australian stands but only averages 0.55 in plantations in South Africa.

   b) Moisture content (m.c.). Freshly felled wood usually has a m.c. of between 50 percent and over 100 percent. A given volume of average density species (S.G., 0.5) if dried from the 'green' (100 percent m.c.) to the 'air-dry' (20 percent m.c.), loses 40 percent of its weight and gains 16 percent in heating value (the 16 percent would be needed to evaporate the additional moisture if burnt green). The gain in heating value is less important than the saving in weight, an important factor if much handling or long transport hauls are involved.

   The moisture content of green wood tends to be higher in the lighter woods, in which there are plenty of air spaces, than in the denser woods. As a general rule, therefore, a species which would be preferred for its higher S.G. air-dry, is likely to be even more superior if used green.

c) Extractives. The higher the percentage of extractives (oleo-resins, etc.) by weight, the higher the available heat per unit weight of wood. Differences rarely exceed 10 - 20 percent, even between the most resinous coniferous species and the more resin-free hardwoods.

2) Ease of harvesting: e.g., disadvantages of crooked or thorny species. Harvesting costs per m^3 are inversely related to volume per hectare. Thus a more productive species will not only need less land for a given yield than a less productive species, but will also be cheaper to harvest.

3) Durability. Where it is necessary to dry fuelwood before use, its natural durability may be important in reducing losses from termites, borers or fungi.

4) Special characteristics. Certain characteristics of a potential fuelwood species may become limiting for particular uses. Emission of sparks is a disadvantage in an open domestic fireplace or when burned in proximity to inflammable buildings. Odour from combustion may rule out the use of certain species for cooking, fish drying and tobacco curing. Neither characteristic would matter if the wood was used in a furnace for production of mechanical or electrical power.

The following example illustrates the sort of evaluation which may be made when considering alternative species for fuelwood species. Both Eucalyptus grandis and E. paniculata thrive in similar conditions in Africa on warm, moist, frost-free sites. Published data (Wattle Research Institute, 1972) indicate that the volume yield of E. grandis is about 2.1 times that of E. Paniculata. But the specific gravity of E. grandis at 10 percent m.c. is only 0.6 that of E. paniculata, the m.c. when green is twice as much and the heating value per m^3 green, is only 0.57. The net advantage for fuelwood is with E. grandis, but only by 20 percent. E. paniculata is much more durable than E. grandis (less loss in drying) and is in considerable demand for durable poles. Both species coppice well, are resistant to the snout-beetle Conipterus and produce excellent honey. E. grandis, being a quick starter, closes canopy and shades out weeds more quickly and is thus easier to manage in the establishment stage. In this case, it is probable that E. paniculata would be favoured where there is a demand for durable poles, E. grandis where there is not. As an insurance against unforeseen hazards, it would be wise to plant a proportion of the area with each.

Poles and posts

These products are usually for local use. Straightness, strength and natural durability, or suitability for impregnation by one of the cheaper methods such as the hot and cold tank are the main desirable characteristics. Where there is a local demand for telephone poles, suitable species may provide a valuable cash crop with excessive rotation length. If there is demand for a variety of sizes of pole and post, this may simplify management. For example, thinnings of coppice shoots may be used for small posts or poles, leaving one shoot per stool to be grown on for telegraph poles.

Pine and eucalypt species have proved successful in plantations for producing poles and posts. Teak and Acacia spp, particularly A. mearnsii, are also used. Preservative treatment is necessary in each case, because the wood of plantation grown trees is rarely durable in the ground. In wet tropical areas preservative treated hardwoods, especially eucalypts, have given serious decay problems due to soft rot. Experience is now favouring softwoods, especially pine, in these situations.

Sawlogs, pulpwood, etc.

These products can be produced best from comparatively large, and therefore old, trees. Rotations usually need to be long, of the order of 25 to 50 years or more, and returns on investment are delayed. In addition, the management of the plantations may

call for considerable skill, since provision must be made for operations such as pruning and thinning. Rural community plantations will therefore seldom be planted for these purposes. However, under good climatic and soil conditions, sawlogs suitable for milling with simple equipment to provide sawnwood for local joinery and furniture could be produced in about 10 years. Suitable equipment is comparatively low in cost, cheap to maintain and requires a low level of skills and could function at the community level. Appendix 5 gives details of the type of equipment which could be used under these conditions.

Pulpwood

A pulp project based solely on rural community plantations is unlikely, but a pulpmill obtaining part of its intake from large-scale industrial plantations and part from rural community plantations may be an attractive proposition for both sides. A good example is the PICOP project in Mindanao, Philippines, using Albizia falcataria. On the one hand high quality nursery stock and advice on technical matters such as spacing and pruning can be made available by foresters of the industrial forestry enterprise. On the other the production from the rural community plantations can contribute a significant proportion of the pulpmill intake without an equivalent input in labour, management, etc., from the enterprise. Such a symbiotic arrangement confers mutual advantages and should be encouraged wherever the conditions are suitable.

Multipurpose species

The benefits which multipurpose species can bring to communities have already been discussed on page 38. Further examples are given in Appendix 3, particularly in section III.

ENVIRONMENTAL CONSIDERATIONS

Shelterbelts

To be successful in shelterbelts, trees must have the following specifications:

Adaptability: the environment of arid regions in need of shelterbelts will generally test the hardiest of species. Trees with the ability to withstand persistent winds, drought and extreme temperatures must be used.

Growth rate: this is expressed in terms of the rate and uniformity of height growth. Height is important because it determines the size of the area protected. The taller the tree the greater is the area protected and the minimum the area occupied by the shelterbelt.

Crown formation: characteristics of crown such as height, width, length, shape and density determine the effectiveness of the shelterbelt. Trees with dense foliage from top to bottom, good live branch retention, uniform and dense crown should be used. Sometimes a combination of species that provide a uniform vertical density for the shelterbelt can be used (eucalypts and acacia for instance).

Sand dune fixation

Trees for dune fixation must meet two major requirements. First and most important they must be adapted to the macro and the micro environment of the site. In general this means that in addition to their adaptation to the macro climate, they can be established and grow well on the various catenary variations of the dune sites. Wherever possible species used for dune fixation should be capable of producing firewood, poles and posts and perhaps even timber.

Trees that have been successfully used for dune fixation in arid areas are Acacia spp (A. cyanophylla, A. cyclopis), Pinus spp (especially P. pinea, P. halipluris, P. maritima),

Casuarina spp (C. equisetifolia, C. cunninghamiana), Haloxylon aphyllum and H. ammodendron, Calligonum spp, Eucalyptus gomphocephala in combination with Acacia cyanophylla.

Watershed management, protection and rehabilitation

The following general criteria would be applicable in most cases for the choice of species, when watershed protection is the primary objective, the direct economic return being a subsidiary goal (FAO, in press (I)):

- good survival and fast growth on impoverished sites;
- ability to produce a large amount of litter;
- strong and wide-spreading root system with numerous fibrous roots (In landslide zones deep roots are usually essential);
- ease of establishment and need for little maintenance (The ability to establish readily from vegetative material is an advantage);
- capacity to form a dense crown and to retain foliage all the year round, or at least during the rainy season(s);
- resistance to insects, disease and browsing by game, stock and smaller animals;
- soil improvement, such as nitrification by legumes;
- provision of an economic return.

The logical starting point is to consider the local species. Suitable species should be examined from the natural vegetation, looking into the temporary successional stages, rather than those of climax vegetation, since pioneer species are better adapted to exposure and harsh sites. Some sites may be too severely degraded to support a tree cover, without preparatory treatment. This might consist of the introduction of a pioneer species (which may be a herbaceous species), or by subsoiling, discing, ploughing, terracing, infiltration trenches, 'gradoni', check dams for gully stabilization, contour wattling and staking. In some areas trees should not be planted at all where preparatory site treatment would be too costly to be justified, or on areas where regeneration of the natural vegetation would secure the same protective function. There are areas where trees would be inefficient or even harmful such as very steep slopes subject to slippage or slopes that may be subject to deep landslides. Tree root systems would not be able to provide anchorage, and the increased weight of the tree mass could induce solifluxion.

The establishment of mixed plantations of two or more species allows for a better use of the site if both deep and shallow rooted species are planted and if shade tolerant species are established under light demanding species. Interplanting of cover crops between the trees may also be considered. Where tree species that produce little litter are chosen, the inducement and management of a well-developed understory may be necessary for effective erosion control. The main goal, protection, is not in conflict with the possibility of obtaining a direct economic return from the plantation, except in very steep or very erodable soils. This possibility of a multipurpose use of the watershed is illustrated by the Rio Blanco watershed, which secures the water-supply of the city of Manizales, in Colombia. The watershed has been treated with a combination of Alnus jorullensis and Pennisetum clandestinum (kikuyu grass) at 2 200 m altitude. Nitrogen fixation by the roots of the alder enhances sufficient grass growth for the grazing of three calves per hectare. Telephone poles are obtained from the alders at 12 years of age. Similar successful combinations of Albizia falcataria and Pennisetum purpureum (elephant grass) are reported in nutrient-deficient latosols in Indonesia.

Riverbank and roadside protection

Because of the diversity of situations that may be faced in practice, general criteria cannot be used for the choice of species for the stabilization of river banks, channel banks and road cuts and fills. The only common requirement is a very strong, dense and widespread root system capable of building a natural defense that will resist scouring, undercutting and overland flow, in the case of riparian plantations, and that will hold in steep slopes and unsteady cuts and fills in the case of roadside stabilization.

Except in arid and semiarid zones, where phreatophytes are undesirable because of reduction in water-yield, riparian vegetation should be encouraged as long as it does not impede the normal flow. Plantations may be introduced over the seasonal variation level (extraordinary flood strip of the riverbed).

Species of Eucalyptus, Alnus and Populus are frequently planted in riparian zones, with very high yields, due to the permanent access of the roots to the water table.

For the stabilization of river levees and dikes, and for riverbank protection, cuttings of species of Salix, Alnus and Populus are frequently used, often combined with the physical stabilization of plants by shoring and groins. Bamboo and sago palm are other species which provide a compact rooting system which resists the undercutting action of water and prevents collapse of the bank due to rapid soil moisture variations and changes in the water level.

For the stabilization of road fills, shrubs and herbaceous vegetation are more adequate, although small trees such as Robinia pseudoacacia are also very effective. The planting of slopes in cuts and fills is combined with mechanical treatment, including mulching, in order to secure soil stability for the establishment of vegetation cover.

Wildlife and fisheries habitat

Wildlife, particularly mammalian forms that contribute significantly to the diet of rural communities in forested areas, is generally more varied and prolific where habitats are varied. Thus management of forests that ensures a series of stages of the vegetation is particularly appropriate and produces conditions that provide food and shelter, the basic requirements of all wildlife species.

In many tropical areas, secondary growth of vegetation following timber harvesting or shifting agricultural practices is especially attractive to certain mammal and bird species. Indeed the distribution of some is virtually confined to areas where they have access to such disturbed conditions. Fire also contributes in this respect and can be a powerful tool in the manipulation of habitat for optimal wildlife productivity.

Fish are of course dependent on the presence of aquatic habitats that in forested areas usually take the form of rivers, pools and swamps. The rise and fall of water levels with the seasons are important to the life cycle of fish in tropical waters.

Appendix 1[1/]

PROJECT AREA SURVEY

The purpose of this Appendix is to outline the preliminary surveys that need to be undertaken in order to define the present situation of a community, and to identify what can be done to assist that community in bettering its situation. It describes in summary, in checklist form, the broader range of rural development investigations of which the community forestry development activities will usually form just one part. The surveys described are of two kinds: a survey of the social and economic framework, and a survey of the physical environment. Together, the findings of these surveys should define the framework of needs, aspirations, resources, possibilities and constraints within which community development must take place.

Before a decision is taken to initiate such a survey, care must be taken to assess whether the three main requisites for a successful community project exist:

- political support for rural development at the government level;
- the willingness of the local community to participate, and its capacity to continue the development process with its own means and resources;
- an institutional framework sufficiently flexible to secure interagency coordination at the working level.

If bottlenecks are identified with respect to any of these three areas which would seriously jeopardize the prospects of a successful project, it would be advisable to concentrate on removing these bottlenecks before committing resources to the project area surveys.

Because there are a number of manuals which deal with preparatory surveys (see Appendix 6), the checklist here is given only in outline. It needs to be recognized that the range of data outlined represents what would be desirable in total. In practice there will be factors limiting the effort that can be devoted to data collection, such as time, funds, qualified personnel, rapidly shifting conditions, etc. The surveys will therefore have to be tailored to these constraints.

Although the survey may take several months, a long period may entail the risk that the information may become obsolescent and that the hopes and expectations of the people involved, both the sponsor and the community, may turn to frustration.

The survey team leader should prepare a timetable for the survey, ensuring that the information required can be obtained in the time made available. Information feedback and interdisciplinary exchange between the various team members should be taken into account, as well as the logical sequence of surveys and particular studies. The Critical Path Method (C.P.M.) may be a very useful tool in survey programming.

The field worker entrusted with the collection of most of the data from the chosen community will have an opportunity of gaining a deep knowledge and understanding of the local people and the situation and problems in the community. He may find it worthwhile to enlist the assistance of local leaders, school teachers, students, etc., for some appropriate investigation, thus establishing, early in the project, an atmosphere of local

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1/ This appendix has been prepared essentially on the basis of the publication "A practical approach to rural development" (Virone, 1969 (G)) and on the FAO document, "Guidelines for the development of less favourable environment areas: a comprehensive integrated watershed development approach". (FAO, 1977 (a)(P) and FAO 1977(b)(P)).

participation and cooperation. The field worker should, however, refrain from advising the farmers or venturing on development operations during the survey period, since the comprehensive picture of local conditions will only be available on completion of the survey, allowing for the formulation of action programmes.

The initial survey should bring out and record the bulk of the basic data and problems of the community, the environment and the resources, but it does not represent the end of the investigation. In fact, specific investigations will have to be carried out as a part of the development programme to analyse individual problems and prospects and to find suitable solutions. Finally, investigations will be required at future stages, to examine the changes in the community and to evaluate the impact of the project.

An indicative check-list follows, covering the main topics to be considered in the project area survey.

1. SOCIO-ECONOMIC SURVEY AT THE COMMUNITY LEVEL

A. Socio-demographic characteristics

a) Population: origin, total number and number of households, sex, age groups, migrations (tables and graphs);
b) economic activities, unemployment, underemployment;
c) villages, road and telegraphic connections (map with human settlements and road network);
d) the family, the clan, the council, political parties;
e) the religion, traditions, attitudes to change;
f) habitat, housing, water-supply, fuel sources, etc.;
g) social amenities and services: transport, communications, power, medical care (including witch doctors), education (illiteracy), markets (including shops, craftsmanship, ceremonies, leisure, folklore, clubs, associations, cooperatives, credit unions).

B. Tenancy

a) Land ownership, rights and regulations (exploitation units to be indicated on map);
b) ownership distribution-size groupings;
c) values and land market;
d) sharecropping, communal land use, State land leasing/permit systems.

C. Capital investment (Values if possible to be indicated)

a) Housing and roads;
b) land clearance and reclamation, irrigation, permanent crops, agroindustrial plants, home and cottage industry;
c) forest lumbering and industrial enterprises;
d) warehouses, public and freight transportation.

D. Exploitation units

a) The farm: relationship between farm and land property;
b) total number of farms, farm distribution (map), size groupings (graph);
c) types of exploitation units;
d) use of farm area, rotation of crops.

E. Labour

a) Relationship between farm management and labour;
b) quantity and type of labour;
c) hired workers, corvee, exchanges of labour in the community;

d) specialization of labour by age and sex;
e) seasons and hours of work;
f) employment, underemployment and unemployment, by sex and age group.

F. Working capital (Community statistics)

a) Tools and equipment: production, maintenance, repair and market;
b) livestock: type, quantities, values;
c) other working capital: feedstuff, seeds, fertilisers, their quantities and market.

G. Crops, cultural practices

a) Cash crops: total area, varieties, cultural practices, inputs and other expenses, yield, production per unit and total production;
b) subsistence crops: total area, varieties, soil preparation, rotation, cultural practices, yields, production per unit and total for the community;
c) need and fodder production: total area, grass species, cultural practices, yield;
d) permanent crops: total area, cultivation practices, yield, total production;
e) livestock breeding: types and quantity of livestock, breeding practices, inputs, production per unit and total for the community;
f) poultry: types, total, production;
g) staple diet and techniques of preparation.

H. Forestry and forest-related activities (avoiding duplication with the pertinent survey)

a) Timber output: species, unit prices, production costs, markets;
b) wood processing industries;
c) other forest products: fuelwood, charcoal, etc.

I. Other economic activities (earning values)

a) Fisheries, hunting;
b) handcrafts;
c) non-agricultural labour;
d) skilled workers and professionals.

J. Production

a) Gross production (values per unit and for the community);
b) gross saleable production (processing, marketing, prices);
c) products consumed by the peasant.

K. Expenses (other than for productive activities)

a) Food;
b) housing and power;
c) clothing;
d) education;
e) transport, communications;
f) taxes and contributions;
g) ceremonies;
h) leisure;
i) debts.

2. FARM AND HOUSEHOLD SAMPLES

The community level socio-economic survey should be supplemented by a farm and family level survey, comprising 30 to 40 percent of the exploitation units/families of the project area. Again, for particular situations this outline should be adapted to secure all relevant information.

a) Information on location, tenure, type of exploitation, name of surveyor, area, topography and aspect of the land, road access, membership of cooperatives or associations;

b) information on the family (including employment, education,etc.), labour units and how they are spent, hired workers, labour distribution during the year, labour peaks, exchange of labour, wages, diet and food preparation;

c) information on land use, indication of the production per unit and the total value as well as the value of fixed assets, livestock (by type) and their value, machinery and equipment and determining the value per hectare;

d) information on farm production (and total value) will include: total production for each product, saleable production (stating price per unit and total value), family consumption and its value;

e) information on farm expenditure, specifying (per unit and total) expenditure on seeds, fertilizers, organic manure, pesticides, machinery (including hired), trees or stumps for planting, fodder, feedstuff, litter, veterinary and drugs, servicing of livestock, restocking, operation, repair and amortization of machinery and equipment, insurance, electricity, irrigation water, processing of product, transport, repair and maintenance of buildings, roads, tracks, fences, channels, etc., adding the total value;

f) information on indebtedness, stating the nature of the debt and its repayment;

g) information on family expenditure, specifying food purchased, fuel, clothing, medical, education, transport and visits, house repair and maintenance, household and furnishing, social events, personal taxes, fees, etc. The total amount of debts should be indicated;

h) family earnings outside farm (source of earning), indicating the annual total.

A balance of income and assets should finally be obtained, determining:

i) net farm product (total, value per hectare and value per labour unit) as the difference between the saleable production and the farm expenditure;
ii) net farm income as a result of deducting from the net farm product the wages, the rent (in the case of tenancy) and the repayment of farm debts;

iii) final balance as the difference of the net farm income (plus other income) and family expenditure and the consumption in the household of farm produce.

The 'balance' may often show a deficit because it is normal for family expenditure to be adjusted to family income, but without allowing for the amortization of machinery, replacement of livestock, replanting of trees, all of which have been taken into account in the questionnaire outline.

The assets will be obtained by deducting the total indebtedness from the total family assets (saveable income, plus land and fixed assets belonging to the family, plus livestock, machinery and other assets), the total indebtedness being the sum of the debts on the farm and the family debts.

3. EXISTING AND POTENTIAL DEMAND FOR WOOD AND OTHER FOREST PRODUCTS

Current consumption of forest products may be taken to fix one point on the demand curve. To assess the level of potential effective demand, given certain assumptions about future changes in income and way of life, is a more complex procedure, especially in the case of products that are not currently available. It implies decisions about the price or perceived cost of goods delivered to members of the community. All that can be done here is to suggest the main heads for a survey:

A. Fuelwood and charcoal

a) Current consumption, total and per caput;
b) possible savings by improved efficiency or substitution;
c) projected demand at assumed prices and incomes.

B. Poles and construction wood

a) Current consumption;
b) possible savings;
c) projected demand.

C., D., etc. Other forest products

Similar rubrics to A and B, for as many products as are considered, each being studied separately; e.g.,

Fodder
Nuts
Edible palm products
Fruits
Gum arabic
Tannins
Honey
Fungi
Medicinal and other economic plants
Tasar silk.

N. Soil conservation and erosion control

a) Needs for protection as currently perceived by local people;
b) needs as perceived by conservation experts;
c) possible costs and benefits to inhabitants of projected conservation works.

O. Climatic effects

a) Needs for shade and shelter locally perceived;
b) needs perceived by experts;
c) possible costs and benefits.

4. INVENTORY OF FOREST AND RELATED RESOURCES

This section is bound to vary enormously in nature and complexity, from the study of natural forest ecosystems in or around which some forest communities live, to an assessment of plantation possibilities in the totally deforested lands occupied by many grazing peoples. In considering natural forest, the standard procedures of forest inventory may be followed, but with more attention than usual to associated forest products. In considering possible plantations, little will need to be added to the data on possible sites, collected above, as a basis for the search for suitable species.

5. CLIMATE, HYDROLOGY AND WATER RESOURCES UTILIZATION

Depending on the type and reliability of the available information on rainfall and other data regarding the meteorological parameters, analysis should be made, firstly, of the distribution of rainfall in time (hyetograms or curves showing monthly rainfall throughout the year) and space (isohyetal maps). Rainfall intensity will be necessary in connection with erosion studies and the design of soil and water conservation measures. Frequency analysis of rainfall may be useful in areas affected by long dry periods, as well as in areas affected by heavy rainfall and floods. Monthly temperature distribution charts may be prepared and the mean, minimum and maximum monthly values should be computed. When daily temperature range is relevant it should be noted, as well as frost occurrence. Potential evapotranspiration studies will be required where selection of crops for dry farming or irrigation are envisaged. Information on wind direction frequency will be necessary for shelterbelts, firebreaks and sand dune fixation.

If the project has some connection with watershed protection, flood control, water harvesting or irrigation, accurate information will be necessary in all the parameters of the hydrological cycle, including a water budget and an analysis of the various uses of water. Ground water surveys and well inventories may also be applicable. If water for domestic and agricultural use is affected by important seasonal variations or by droughts, a frequency analysis of the flow in the rivers, channels or sources will be essential. Water quality analysis may be also necessary particularly where water-borne diseases are affecting the health of the people.

6. GEOMORPHOLOGY, SOILS AND EROSION

If geomorphological maps are available or may be made by photointerpretation, they may facilitate the task for soil surveys, soil erosion inventories and land system classification. They may also allow the preparation of hydromorphologic maps indicating the response of the different land units to runoff, subsurface flow and phreatic flow. In soil surveys the most important parameters to be obtained are slope, soil depth, texture, stoniness, rock outcrops and hard-pan presence. For crop and forest species selection, laboratory analysis of soil samples will be desirable, indicating organic matter content and mineral composition, in order to recommend fertilization, application of lime and other soil management measures. Erosion and erosion hazard maps will be useful in the design of afforestation and other conservation measures, as well as in setting apart areas which should have restrictions concerning land use. Clinographic (slope) maps are also very useful for general land management planning.

7. ECOLOGICAL ZONING, WILDLIFE, VEGETATION AND LAND USE

In order to provide a sound basis for decision making on the various land uses and as a guide towards an optimal multiple-purpose use of land units, an ecological map may be desirable. The Holdridge system of life-zones is widely used for this purpose, particularly in Latin America. Vegetation maps may also be obtained from aerial photos and a combined vegetation-present land-use map may be drafted from recent aerial photographs. If these are outdated and no time or funding for a new flight are available, it is necessary to check the land-use survey very carefully on the field, since the accuracy of this information will be essential for suggesting changes in the land-use pattern. Wildlife, because of risk of extinction of certain species or because of commercial hunting or farming possibilities may be a significant element within the FLCD Project: an assessment of the population of the relevant species must be made, considering the spatial and temporal distribution of the species. Other environmental facets, such as sites of interest for recreation and the protection of water quality, quantity and timing, should also be examined taking into consideration its utilization in areas located downstream and other effects, such as floods.

8. ENVIRONMENTAL IMPACT ASSESSMENT

On the basis of the available information on the environment and its resources, on the one hand, and on the goods and services which may be affected by current or future human activities, on the other hand, the environmental hazards should be assessed, quantitatively if possible. Some of these hazards may be:

- erosion and depletion of soil resources because of improper cropping and grazing methods;
- erosion due to logging and road construction;
- degradation of water quality, yield or timing because of inadequate land management practices;
- sedimentation in reservoirs, intakes, canals and agricultural lands;
- water pollution because of the use of fertilizers and pesticides, affecting fisheries and water supply for human use;
- waterborne diseases;
- eutrophication in water impoundments;
- floods and doughts caused by changing land-use patterns or by engineering works;
- air pollution, affecting particularly visibility for air-traffic, because of the use of fire;
- depletion or extinction of wildlife species.

Appendix 2

CASE STUDIES

This appendix summarizes the case studies presented at the Second Expert Consultation on Forestry for Community Development held 21 - 22 June 1977. Six of these were presented by participants (the Sahelian and Senegal papers are summarized jointly), and twelve were combined in the FAO Desk Study. The seventeen papers are arranged alphabetically by country and are detailed below:

1.	China	- Integrated Village Forestry
2.	Colombia	- Forestry for Local Community Development
3.	Ecuador	- Legislation and Organization of the Social Afforestation System
4.	Ethiopia	- Forestry for Community Development in Tiro
5.	India	- Forestry for Community Development (Village Forestry)
6.	Indonesia	- Upland Forest and Fodder System on Private Lands
7.	"	- Community Development Programme in the State Forest of East and Central Java
8.	Kenya	- The Shamba System
9.	Republic of Korea	- Village Fuelwood Plantation System
10.	Nepal	- Fodder Tree System in an Integrated Rural Development Project
11.	Nigeria	- Farm Forestry
12.	Philippines	- Smallholder Tree Farming
13.	The Sahel	- Forest/Cattle System
14.	Sudan	- *Acacia senegal* Gum and Tree Fallow System
15.	Tanzania	- Village Afforestation - Dodoma District
16.	Thailand	- Forest Village System
17.	"	- An Approach to Integrated Watershed Management - Mae Sa

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1. China - Integrated Village Forestry

Agricultural planning in China is fully integrated with forestry, animal husbandry and fisheries, so that maximum benefit can be derived from the land and water resources of the country. The development of agriculture is aimed at strengthening the collective economy of the communes which have extensive financial and administrative autonomy and responsibility for many aspects of economic and social life.

One of the resources China possesses in abundance is manpower. Massive efforts with the involvement of millions of peasants have gone into protection and productive afforestation, dune fixation, shelterbelts, catchment afforestation, dyke consolidation, farm woodlots and scattered trees. Mass approach is adopted even in research activities.

The combination of widespread education and the steady accumulation of visible benefits has helped to develop the spirit of mass participation by the people. This is, in effect, a manifestation of the spirit of self-reliance and the desire for action. Massive activity also is part of the class struggle reflecting the advantages of a communal society and feelings of shared interest with benefits reaching not just the few but the community as a whole. This is the main motivation for mass participation.

The underlying technical principle in China is rational use of land for agriculture, forestry and related activities with the object of maximizing productivity. The following systems are employed:

- types of 'taungya plantation' with inter-row cropping of such crops as melons, cassava, groundnut, ginger and soyabeans;
- raising of fodder crops and grazing under forests;
- growing of non-timber forests using food, fodder, medicinal and oil trees and other economic crops such as walnut, chestnut, fig, camphor, tea oil, tung oil and bamboo;
- 'four around' forestry, around houses, villages, along roads and waterways using such fast-growing trees as poplars, willows, pines, firs, eucalypts, and other types of vegetation such as bamboo;
- forestry farms with the primary objective of timber production, which often have subsidiary activities yielding minor products such as medicinal plants, mushrooms or basket fibres.

In all of the forest systems, state policy and wood scarcity ensures complete utilization of the forest resources as timber, pulpwood, fuel and even prunings are salvaged for fuel or compost. Multiple use is extended to forest nurseries, where pig rearing or vegetable growing is associated with raising tree seedlings (in Chanku Tai nursery, edible Chinese cabbage was grown at the edges of seedbeds).

Mass participation in forestry by communes is fundamental to local forestry. Article 3 of the Forest Regulations of 1963 states:

> 'Revolutionary committees at the various levels must strengthen propaganda and education in order to promote forest consciousness and forest education and [redacted] trees.'

Most of the plantation techniques employed are labour intensive. Professional foresters and technicians provide guidance to men and women engaged in afforestation and logging. Forest research also provides a backing up service. Aspects of silvicultural management are the responsibility of 'professional teams'.

Regional forestry bureaux are directly involved in communal forestry. The regional forestry bureau of Tailin, for instance, controls 31 production units in 11 forest farms, and a full infrastructure organization. The bureau is responsible for providing such social services as health, education, recreation and shopping facilities.

One of the 11 forest farms, of some 3 000 ha, provides employment for some 48 people, including teachers, doctors and maintenance workers. The farm facilities include housing, schooling, bath houses, clinic and a dormitory for working middle school graduates.

Reports on forestry in China give a generally favourable impression of rapid and dynamic forest development and of enthusiastic commitment to forestry by the people and leaders at village or commune level.

Integration of forestry and agriculture, which has occurred at all levels in China, has had a positive impact. A shelterbelt project, for instance, in the northwest, 1 500 km long by 12 m wide, was executed in two seasons by some 700 000 farmers from nearby communes. In Fu Kou county, from 1958 to 1975, 74 million or some 140 trees per head of population had been planted and some 10 000 ha of windbreaks were established. Between 1970 and 1975 thinning yields in the county contributed to the construction of 80 000 housing units. In Min Chin county 30 000 ha of sand dune planting and shelterbelts doubled food production per unit area over a protected area of 150 000 ha. In Chouchou county extensive forestry programmes, including planting 16 million trees in 'four around' systems, were closely associated with the doubling of agricultural yields over a ten-year period.

Key Factors

- The complete integration of forestry with agriculture in the broadest sense;
- The ability to motivate the people and develop a strong national and communal commitment to create and conserve forests as part of an integrated agricultural programme;
- The commitment of the State to forest and agricultural development;
- That despite initial disappointing plantation results, the motivation and enthusiasm of the people is such that, employing improved techniques, they were able to continue developing planting programmes without any major check.

2. Colombia - Forestry for Local Community Development

Forestry activities could become one of the most important possibilities in generating direct employment in rural areas and assisting employment in urban areas. Until now the main forestry activities have not been integrated into the rural development process though there has been some community participation in forestry work both in the agriculture dominated lands and in the forest areas.

Examples in the agricultural areas include:

a) The growing of Inga spp as shade for coffee, on which many small farmers have been dependent for their living for more than a century. This species also provides fuelwood, increases soil fertility and assists in preventing erosion on high steep areas. Diversification in the coffee producing areas by planting cypress, pines and Cordia spp either in areas not suitable for coffee or as shade trees with coffee. Some 3 100 ha have been established under a special coffee based diversification fund, one of the objectives being to satisfy the fuelwood and charcoal needs of the rural communities. A interesting example of diversification for watershed protection may be found in the Rio Blanco watershed where plantations of Alnus jorullensis are combined with Kikuyu grass.

b) A form of agrisilviculture in the Pacific Coast region in which private farmers plant trees in pastures, and cacao and banana plantations. The main trees are cedar and Cordia spp and are planted at some 200 per hectare. The tree seedlings and technical assistance are provided free of charge by a private lumber company, which requires that the trees be correctly planted and maintained. The trees are the farmer's property, but it is probable that they will be sold to the lumber company for timber.

c) The INDERENA (National Institute for Natural Renewable Resources and Environment)/WFP (World Food Programme) reforestation project in Ayapel aims to establish fast-growing species such as eucalypts. People working in the plantations received food in addition to wages. Some 1 860 ha were established over 5 years, which represented only 20 percent of the target planting area. The main constraint was land availability, as there was considerable pressure for grazing land.

d) An Integrated Rural Development (IRD) programme was set up to improve rural incomes by such measures as improved agriculture, better marketing facilities and improved infrastructure. The forestry components are small and on private land and involved reforestation on small farms. Farmers were granted credit for such operations. Other forestry components included the creation of protective forests and the establishing of productive forestry plantations. The programme also provided technical assistance in the form of plantations. The programme also provided technical assistance in the form of research, surveys and the setting up of demonstration plots. The programme aims to establish over 10 000 ha of plantation in seven different regions over the next 5 years.

Examples of community participation in the management of forest areas include:

e) An integrated project for development of community forestry (PRIBOCO), which was initiated in 1976, is based on a tradition of communal work and has a recognized legal base. PRIBOCO attempts to link rural communities with the conservation and development of forestry, wildlife and fishery resources. INDERENA provides technical services and physical inputs with the following main objectives: (i) increasing family income by employment; (ii) reducing agricultural pressure on forest reserves; (iii) integrated management of resources, with particular attention being paid to marginal areas. Programmes are implemented through communities to whom INDERENA pays a planting and maintenance subsidy. In relation to forestry, community inputs are labour, tools and land whilst the agency contributes nurseries, seedlings, technical assistance, incentive payments and work supervision. Funds resulting from harvesting are evenly shared between the community and the agency. INDERENA cash is funded to continue further programmes. Projects are selected on the basis of those having the soundest physical and social possibilities for implementation, and a number are sited in areas where forests are being destroyed by agricultural activities.

f) Development of agrisilvicultural systems in the wet regions under CONIF (National Corporation for Forestry Research and Development) and the Matia Mulumba Institute cover five community projects. The combined agricultural/forestry activities are programmed to produce steady annual incomes, and dominant crops include timber trees, fruit trees, palms and bamboo. Social and resource surveys are carried out and research is an essential element of each project.

g) The colonization project in the Amazonian watershed attempts to reduce the harmful effects of uncontrolled settlement. Phase I of the project aimed to resettle 4 500 farmers by granting secure land titles, supervised credit, roading, schools, health services and technical extension. Phase II has continued the programme since 1975 and particularly attempts to implement a programme of natural resource utilization and conservation. The watershed forms three main zones, the mountains where protection is necessary, the foothills which are allocated for grazing but where some protection is necessary, and the jungles of Caquéta where shifting cultivation is destroying forest cover. Extensive forestry programmes and research are required as part of an integrated programme to reduce the problems in the different zones.

3. Ecuador - Legislation and Organization of the Social Afforestation System

The Ecuadorian social afforestation system aims to develop local forestry and, where possible, to involve local communities. There is only very limited information available on the programme, and this indicates that some 6 000 to 8 000 ha of plantation

were established between 1965 and 1974. The main reasons for devising the programme were to protect natural resources, to create opportunities for permanent and seasonal employment, and to provide additional sources of income for rural populations.

The 'Social Afforestation System' was established by Presidential Decree in 1964. The Decree contained the following articles among others:

'Art. I Reforestation of idle lands suitable for forestry is of national interest. Reforestation will take place through the Social Reforestation System, that is the formation of forests in which the workers participate as joint owners.

Art. 3 For the purpose of this Law, the following are considered lands suitable for forestry:

a) Those which should have forest cover to protect natural resources.
b) Those idle lands which are not adequate for agriculture or artificial pastures, but which may considerably increase production by the establishment of forest plantations.

Art. 5 The owners of lands suitable for forestry shall be obliged to afforest such lands, employing one of the following systems, in this order of priority:

a) Through the Social Afforestation System.
b) On their own account, under terms and conditions specified by the Ministry of Development.
c) At the expense of the Ministry of Development.'

The law implicitly refers to different possible contracts and designates the responsibilities of and the benefits to the contracting parties. After promulgation of the law, the Forest Service implemented afforestation through 'contratos', 'consorcios' or 'cooperatives', which terms are defined as follows:

'Contratos' - The landowner provides land and pays the Forest Service the costs of planting. The entire planting operation is the responsibility of the Forest Service, but the plantation and its produce belong to the landowner.

'Consorcios' - Planting is carried out by the Forest Service but the landowner contributes no funds, providing only the land. The distribution of yield is 30 percent to the landowner and 70 percent to the Forest Service.

'Cooperatives' - Planting is carried out on private land belonging either to an individual or to a cooperative. All labour is provided by members of a cooperative and the Forest Service provides supervision and planting stock. Future yields are divided 25 percent to the landowner, 65 percent to the cooperative and 10 percent to the Forest Service. If the cooperative is also the landowner it consequently receives 90 percent.

After initial success, there are recent indications that the programme has lost some impetus. It is suggested that this is due to lack of trained personnel and leadership for organization and administration of the system, logistic problems created by the diffuse nature of the small land holdings and too ambitious a spread of activities by the Forest Service in promoting the system nationally, and inadequate financial resources to provide incentives for community participation.

Despite these constraints, however, with some foreign aid inputs, 6 000 - 8 000 ha of forest plantations have been established. What has been achieved may, to some degree, be attributed to the following factors:

- pertinent forest legislation;
- a traditional and deeply rooted custom prevailing since Inca times, called 'minga', which consists of voluntary unpaid work provided by the members of a community;
- willingness of the Forest Administration to promote social afforestation systems;
- land availability, both denuded and in process of accelerated erosion;
- availability of a few species, mainly eucalypts, suitable for the range of climatic and soil conditions in the country;
- foreign aid to provide incentives to the communities.

4. Ethiopia - Forestry for Community Development in Tiro

This pilot project is very much in the initial stages and full implementation lies in the future. The Tiro Subworeda comprises a mountainous valley with a population of 15 000. The people are mainly Oromo who have been sedentary agriculturists in the area since the nineteenth century. Deforestation is prevalent, but Tiro Forest of 5 000 ha of mainly Juniperus procera and Podocarpus gracilis remains. A 50 km all-weather road has been constructed to allow logging of this forest. The road has had some community inputs and is associated with the forestry project. There are local shortages of fuelwood and poles, but it is considered that the situation will continue to worsen over the years.

Prior to the 1974 revolution there were extensive farm owner occupiers, but since then all land is vested in the state. Many of the former owned cattle, sheep and goats. The land-use pattern in the valley has not been studied. The main aspirations of the people are reported to be for clinics, schools and employment. The objectives are:

- to initiate and encourage sustained self-reliance in forestry within the context of rural development;

- to test and evaluate a methodology for rural development in Ethiopia.

Land-use and wood-use surveys are preliminary requirements. It is envisaged that 5 - 40 ha blocks will be available on steep slopes; 1 - 5 ha blocks will constitute minor areas, and 0.1 - 1.5 ha areas around dwellings. As only an initial 1 ha is planned for development, no technical details are given.

The State Forest Development Agency (FWDA) provides the main management and technical inputs. Within the project area there are 14 Peasant Associations (PAs) who elect a representative committee. All land is nationalized but the people have rights of utilization. The PAs control land and labour. Forests over 80 ha in area are state forests controlled by the FWDA; forests of less than 80 ha are generally classified as for the community and are controlled by the PA. The project is carrying out social studies to understand the local population's attitude to forestry.

The PA contributes land, labour and community organization. The FWDA contributes technology, seedlings, training, transportation and tools. All of the material benefits are intended to acorue to the community and the state benefits from environmental effects.

The project is at too early a stage for any achievements to be recorded.

5. India - Forestry for Community Development (Village Forestry)

Historical customary rights to forest produce are discussed and it is noted that these were vested in basic village units. The past intensive forest reservation programme is seen as a natural consequence of agricultural pressure on forest lands. Forest destruction has intensified in recent years partly as a reaction to freedom and as an assertion

of rights but also due to population growth, over-exploitation of resources and diminishing forest areas. Communal rights have tended to be misused and shortage of productive community forests is sufficiently critical as to be a national not a local problem.

Examples of approaches to community forestry are given. The destruction of traditional societies, more accelerated in recent times, had made it difficult to maintain successful local organizations. Even in northeast India where tribal culture still persists, Village Councils have been unable to control harmful shifting cultivation. In the Punjab it was thought that a programme of planting roadsides, canal banks and wastelands was uneconomic, but when financial returns and benefits were assessed it was found to be profitable and the programme was extended. Farm forestry, which would be a natural development consequence of wood shortage, has been constrained by agricultural and forestry conflicts, and the peasant farmers dedicated priority to agriculture. In Dinajpur, however, boundary planting of a light crowned tree (Dalbergia sissoo) has been successfully carried out, as has the planting of Casuarina on sandy soils in south India.

The effect of higher per caput urban fuel consumption on forest resources is discussed. Increased oil costs have affected this issue and such alternative fuels as gas and soft coke are expensive possibilities. For rural areas, the initial development of methane gas from organic wastes may prove a useful alternative to fuelwood.

In an attempt to improve local forests, legal limitations were put on the use of the forest, whilst conserving local rights. The legal status of local forests was centralized for national decision-making, and removed from the local arena where it was often difficult to make the necessary progress in forestry. The application of cheap individual forest licence rates tended to be abused by exploitation for sale. The employment of local people in improving degraded forests met with some modest success. Clearing of forests for agriculture is a major problem and sometimes this approach was used as a subterfuge to exploit timber.

The National Commission for Agriculture has stressed the need for more intensive use of forest land. A national programme is being developed on a sound land-use base. The rate of forest deterioration, however, puts a constraint on the time available to effect meaningful programmes. Customary leadership at community level is rare, yet leadership, either customary or statutory, is essential for implementing programmes. Local government is based on a three tier elected Panchayat System, at village, area and district levels. Whilst the Panchayat is responsible for village forests, such elected bodies tend more towards immediate problems with short-term solutions rather than long-term forestry projects. The Panchayats have experienced great difficulty in attempting to control the use of forests.

Part-time forest employment of people formerly living on forest pilfering has a beneficial effect. The organizing of collection of minor forest products on an individual basis, rather than on a contractual basis, has increased community benefits. The setting up of purchasing centres paying fair prices improves cash crop possibilities. 'Taungya' by making fuller use of land can constitute a benefit, as can full employment in large-scale plantation projects.

Community participation in village forestry has not, in general, been successful. While it is accepted that state forestry programmes cannot provide for all local needs, responsibility for village forests has been assumed by the forest department which undertakes plantation planting and maintenance, and the usufruct is shared between the forest department and the Village Panchayats. The causes of failure are not analysed, but by implication, the main faults are attributed to communities, but the following may be contributory:

- poor institutional framework;
- lack of forestry traditions and lack of traditional organization;
- incentives insufficient to encourage participation;
- initial government inputs and planning inadequate.

Despite these difficulties, farm forestry is being promoted at the national level. In Uttar Pradesh there are signs that communities wish to participate in local forestry. The Forest Department is looking for ways to diversity forestry and create more benefits for local communities.

6. Indonesia - Upland Forest and Fodder System on Private Lands

The Solo River System is the largest in Java. Like in many other parts of the island, erosion and flooding are widespread in the Solo basin and have reached such a critical stage that more than 100 000 ha have been virtually abandoned for agriculture in the Upper Solo area alone. There, the intensive population pressure on the land is estimated at 870/km and is increasing at a rapid pace. Farm income is low and the great majority of the rural population are subsistence farmers. Degradation of natural resources and population growth are anticipated to continue at such a rate that if no drastic measures are taken, the production of food energy in one sub-basin of the Upper Solo will drop from 93 percent of acceptable nutritional requirements at present to 36 percent in 40 years.

Realizing the need for soil and water conservation measures, the Government of Indonesia set up in 1973 a multidisciplinary project to study the deterioration of watershed resources, develop remedial measures, demonstrate these techniques in pilot areas, develop planning procedures and make recommendations for strengthening the administrative machinery. Substantial food inputs from WFP, fertilizer from FFHC and technical advice from UNDP/FAO have been provided.

Reforestation is seen as an important component of a comprehensive watershed management programme. Four forest systems are proposed:

i) permanent protection forest on state-owned forest land;

ii) permanent protection forest on private land along riverbanks;

iii) temporary soil regeneration plantations on private land, critically eroded and nearly abandoned, below 50 percent slope, which after one or two forest rotations will be returned to agricultural use;

iv) permanent protection/production forest on private land over 50 percent slope (As the local population often depend solely on that land for their survival, a silvipastoral system has been developed comprising trees, grass and animals, the grass/animal component providing the land operator with a yearly income almost immediately after forest establishment. Tree spacing is 2 m x 2 m, aiming at early canopy closure. The choice of tree species depends mainly on climate, particularly rainfall, and elevation, and the main species are Pinus merkusii interplanted with Albizia falcataria, or Eucalyptus alba. Pines are given no fertilizer as Albizia, a legume, is included to improve the fixation and recycling of nutrients. Eucalyptus is fertilized in the first two years for good establishment. The estimated rotation is 30 years for the pine, etc., system, Albizia being clear-cut in year fifteen and pine being tapped for resin from year ten. On other sites, the Eucalyptus/grass system is managed as a coppice stand on a 10-year rotation.

Underplanting of elephant grass (Pennisetum purpureum) is carried out at 0.80 m x 0.80 m. The elephant grass density is increased by the farmer by planting cuttings in the first two years and full production of 30 to 60 t/ha/yr, depending upon site condition, is attained in year three. The grass oroprequires 200 kg/ha of urea. A financial compensation is provided, sufficient to maintain the owner and his family during these three years. This system would allow the farmer to raise at the stable 1.5 to 3.0 cattle per hectare (zero grazing) and to generate an adequate and steady income from year four.

The Pinus/Albizia/grass system would employ two men on a full-time basis per hectare while the Eucalyptus/grass system would employ one man per hectare continuously. Estimated I.R.R. for the pine/Albizia/grass/cattle system varie from 16 to 21 percent and for the Eucalyptus/grass/cattle system 13 to 14 percent, depending upon site conditions.

The silvipastoral component on private lands is at the recommendation and pilot stage only, no single organization exists to execute a large-scale scheme. Since 1974, some 300 ha have been planted in four sub-watersheds).

Besides forest or silvipastoral systems, the Upper Solo project is also envisaging to improve the traditional homegardens where multi-storied and multipurpose vegetation already prevails and forms from time immemorial a quite stable ecological system. This concept, still partly on the drawing board, would consist of rationalizing the production of annual food and cash crops, establishing in each garden a fruit tree section and a fuelwood species section and building a small pond for seasonal fish culture. The aim is to improve soil conservation practices and the diet of the local population, to increase farm income through the sale of production surplus, to provide badly needed fire wood and therefore to prevent over-exploitation and illegal tree cuttings in the forest.

Key factors:

The pilot stage of the reforestation and silvipastural activities have pointed up the need for credit for cattle, and for credit for fodder crops in the Government fertilizer credit programme; for diversification and intensification of extension and education programmes to ensure understanding on the part of the farmers; for participation of the population at the planning stage, and by farmers in the improvements made by the project on their own land; and for some of the support to be paid in cash, which has more incentive value than food.

This experience points to the key factors for the success of the programme in the future:

i) to apply a well-defined multidisciplinary approach to comprehensive watershed management with forestry as one of the many components;

ii) to create a single organization for planning and supervision of, and continuing technical assistance to, watershed management programmes and, at the execution stage, to develop effective operational linkages between the various branches of the Government machinery to ensure the timely delivery of complementary inputs, particularly credit, fertilizers, extension and training;

iii) to secure the people's active participation, from planning to execution and management, so as to ensure a self-propelling development process in the local community.

7. Indonesia - Community Development Programme in the State Forest of East and Central Java

The forest area covering almost 2 million ha in East and Central Java is managed by the State Forest Corporation, Perum Perhutani. The forests are mainly planted with teak which covers some 845 000 ha. The area enjoys an extensive infrastructure. An important feature of the area is a population density of 570 persons/km^2, which puts some pressure on land and the forest areas. One of the aims of Perhutani is to improve the life of people in the vicinity of the forest in an effort to reduce demands on forest land. The families are close knit and there is significant social ranking and a particular respect for elders. Whole family units assist in harvesting agricultural crops. Perhutani employs an extensive labour force. The planned programme to improve community life is mainly directed at increased production through agrisilvicultural systems. The main system is 'tumpangsari' (taungya) combining food production and planting of forest trees, mainly teak. A further system involves raising grass fodder under teak, with the fodder used for a zero grazing cattle fattening programme. Other projects involve the growing of red kaliandra (Calliandra calothyrsus) fuelwood belts, to provide firewood for industry and communities. Pilot projects in beekeeping and sericulture have also been introduced recently.

The main objectives are firstly conservation of the forest resources and secondly raising the standard of living of the local community by increasing food production from forest land by using agrisilvicultural systems. This latter objective aims at having an annual programme of 50 000 ha of taungya plantation by 1978/79, as well as establishing 10 000 ha by other plantation methods.

The main tree species is teak planted at 3 x 1 m, and the silviculture of this tree is well known and techniques are well established. The 'taungya' system which is restricted to comparatively fertile flat or gently sloping sites is also well established, but improved agricultural crop varieties and fertilizers have increased yields threefold. The fertilizer applications also appear to have increased teak growth rates.

In 1973 Perhutani began investigating the productivity of elephant grass, Pennisetum purpureum, under teak, mahogany and pine plantations in the forest area. The grass is being sold to farmers and no cattle are allowed to graze in the forest.

The Pennisetum fodder grass is productive for 4/5 years and can be cut 10 - 11 times per year if irrigated, giving up to 150 t wet grass/ha/yr and up to 75 t rainfed. Average yields of 60 t/ha/yr are expected.

All activities are controlled, organized and take place on state-owned forest land managed by Perhutani, which provides a number of inputs:

- loans for fertilizers or cattle,
- improved non-teak wooden housing in temporary (5 - 6 year) forest camps with the houses being dismantled and given to labourers after 6 years,
- social inputs including health facilities,
- training and extension for forest workers and farmers.

The participants in the schemes contribute their labour and in return enjoy increased incomes from cropping and fodder and the payment of an incentive bonus after 2 years.

Loans and extension allow the development of improved agricultural methods.

Perhutani puts in a range of inputs and the main benefits which accrue are reduced plantation establishment costs, increased tree growth and security from squatter activities.

Most of the projects are at early stages and achievements are slight at this stage. Some 5 000 ha are under intensive taungya cultivation with application of fertilizers, superior seeds, etc., and a rapid rate of development is projected. For grass fodder 881 ha were established by 1976 as were 733 ha of red kaliandra fuelwood. There is a waiting list of people eager to participate in these projects.

Key Factors:

- The main factor is land hunger which allows the extensive development of 'taungya' plantation systems.
- The recognition by the forest authority of the need for good public and local relations, by the promotion of a number of projects which will benefit local communities.
- The forest estate has been established for a considerable period, and consequently forest management takes precedence over other factors.
- Inputs and benefits require some quantification to determine the relative return on inputs to the community and forest agency.

8. Kenya - The Shamba System

The Wa Kikuya tribe, finding itself faced with land shortage, readily accepted employment as licensed cultivators under the Forest Department's Shamba System, the first recording being in 1910.

Since then the number of people employed under the system increased steadily and by 1975 was estimated to be 9 000.

The Wa Kikuyu and some related tribes are industrious agricultural people having a considerable demand for land to cultivate. In 1966 the Forest Department considered that there remained some 140 000 ha of existing forest reserves, mainly in the Kenya highlands, suitable for this sytem, and the soils are generally productive under agricultural crops.

The main difference between the 'shamba' system and many 'taungya' systems is the considerable integration of the cultivators into the Forest Department. Under the 'shamba' system as organized in the 1960s the resident workman agreed to work for the Forest Department for nine months each year, to clear in his own time the low value cut over indigenous bush cover from a specific area of land (0.4 - 0.8 ha) each year, to allow the Forest Department to plant trees in the cleared land (the shamba) after 18 months, and to keep these trees weeded for 3 years. By tradition, the men carry out the initial clearing, but the subsequent 'shamba' cultivation is by women.

The Forest Department guaranteed the resident workman nine months of work per year, supplied a house and land for shamba cultivation, assisted in felling large unmerchantable trees during clearing, allowed the growing of annual crops (maize, potatoes, beans, peas and other vegetables) and the pasturing of 15 sheep. The resident worker's duties included nursery work, planting, weeding, pruning, house and road construction. The produce from the participant's shamba was considered as part of his emoluments. An assessment made in the 1960s showed that depending on distance from areas of demand and the state of

the market, and after providing for his family needs, the surplus agricultural produce could be worth up to 2.8 times the annual minimum agricultural wage applicable in the area. The apparent savings to the Forest Department, by considering the 'shamba' as part of emoluments, were to some extent offset by the necessity to employ a labour force large enough to prepare adequate areas of land for reforestation. The surplus 'shamba' produce made a significant contribution to national food requirements. In 1962 and 1963 the maize marketed by this 1 percent of the population contributed 6 - 10 percent of the total smallholder production and it was estimated that potato production formed an even larger proportion of national production. In the mid-sixties, increased agricultural production from smallholdings, created by splitting larger farms, reduced vegetable prices and had an adverse effect on the income from the shamba system.

In 1976 there was a radical change in the system. All the resident forest workers are employed for a full year and have the status of civil service workers. If they wish to cultivate crops they have to rent the land from the Forest Department. This virtual elimination of the 'shamba' system has resulted in significantly increased direct establishment costs. It was estimated that of the 9 000 shamba workers, only 6 000 full-time workers were required to meet the labour needs of the plantation programme.

Key Factors:

- Land hunger and the availability of industrious traditional shifting cultivators.
- The facility with which shifting cultivation could be developed into the 'shamba' agrisilvicultural system and good fertile soils in forest areas.
- The sharing of agricultural preparation and cultivation between men and women permitted men to take up paid employment for nine months each year.
- Increased government inputs of housing, social services and settled forest villages have assisted in the continuation of the system. On the other hand, the creation of settled communities has created problems of transport as the distance between village and shamba has increased.

9. Republic of Korea - Village Fuelwood Plantation System

The supply of fuelwood in the Republic of Korea is inadequate to meet the demands of the rural population, and leaves, grass and forest litter are collected for fuel. Rice straw, maize stalks and other agricultural residues are also consumed in large quantities. The removal of forest litter has caused erosion and downstream flooding and also the lowering of soil fertility, whilst the burning of agricultural residues deprived individual farmers of a potential source of income and the country of valuable raw materials.

Recognizing the seriousness of the situation, the Government introduced a number of measures in 1973 to strengthen the forest service, make the rural population aware of their own predicament, enforce regulations forbidding disturbance of forest floors and initiate a national reforestation scheme to create village fuelwood plantations through village labour. A national survey was made to determine fuelwood requirements by location, and establish priorities of action.

The village fuelwood plantations come under the Saemaul Movement, which was initiated in 1971 as a nationwide comprehensive self-help programme to improve living conditions in the rural areas, to achieve greater decentralized economic growth and to slow the flow of rural people to the large metropolitan centres.

At the village level, each village has a Saemaul Committee of about 15 elected members who decide on needs and priorities and send requests to District and County Committees. The execution of forestry work is the responsibility of the Village Forestry Association (VFA), part of the Saemaul Movement. The VFA can call on technical guidance from both foresters of the VFA Union and of the Office of Forestry. A government legal requirement affecting availability of private land is that all steep land has to be put under forest cover and most private owners find it convenient to have such an afforestation scheme taken over by the VFA or Government, who fully subsidize seedlings, fertilizers and other materials.

The annual planting rate attained over 40 000 ha in 1975.

Key Factors:

The main feature of this programme is the villagers' commitment to rural development and the community spirit directed towards improving standards of living and quality of life which has led them to undertake, on a voluntary unpaid basis, a wide range of rural improvement activities, one of which is the establishment of fuelwood plantations. The creation of such plantations is an integral part of the overall Saemaul concept, and the villagers are committed to forestry development through their Village Forestry Associations.

A further positive factor is the Government's awareness of the demand for fuelwood, requiring urgent control of forest areas and increased development of plantations, and the creation of a policy to upgrade forestry and actively to encourage and support the establishment of fuelwood plantations. This policy, aided by strong and effective supervision, assists in motivating the villagers' well-disciplined social structure implement community forestry programmes. Relevant legislation has been enacted.

Other important factors:

- Early returns from the plantation system, resulting from a species yielding fuelwood and cash after the first year.
- The existence of a reasonable infrastructure.
- Strong government pressure for over 10 years for small private landowners to give up or afforest non-agricultural land. This has been accepted by landowners and there is little difficulty in securing such marginal hill land of low agricultural potential.
- The technical knowledge of suitable species, site preparation, sound techniques, together with such factors as efficient extension services, particularly through mass communication media.

10. Nepal - Fodder Tree System in an Integrated Rural Development Project

Some 60 percent of the population of Nepal lives in the hills, 30 percent in the Terai and 10 percent in the Himalayas. The national density average is 620/km^2 of cultivated land rising to 1 100/km^2 in the hills. Estimated per caput GNP is US$90 - 100 and Nepal is classed as one of the least developed nations.

Agricultural development strategy seeks to balance economic growth with income distribution and provide more equitable regional development. It proposes to correct declining agricultural productivity, and control spontaneous settlement in lowland forests by large numbers of marginal farmers from the hills.

As part of this strategy a pilot rural development project has been drawn up to develop part of the hill districts where 29 000 families (a total of 191 000 people) reside, 96 percent of whom farm less than 1.0 ha, with holdings averaging about 0.3 ha. Only 4 percent of the population is landless. Present farm production in the area is only capable of meeting family subsistence for two-thirds of every year, with the balance being made up by wages from employment outside of the district.

The full rural development project aims at intensive agricultural extension, improving crop yields, farmer and staff training, livestock development, improving marketing, improved land use and control of soil erosion, provision of small warehouses and credit, providing health centres and developing village water supplies, reforestation, providing tracks and bridges and improving cottage industries.

Forestry is part of a wide restructuring of the rural economy, which makes it possible to reduce cropping and grazing pressures on land that should be regenerated or replanted to forest cover.

The forestry components of the project are:

- reafforestation for fuel and fodder on government land,
- regeneration and protection of forest areas,
- forest erosion control.

The total forestry programme covers some 8 600 ha over an initial five-year period and all of the functions are interrelated. Fuel and fodder plantations total 2 100 ha, but of this 25 ha blocks of fodder plantation will be sited in each village Panchayat area. Some 6 000 ha of degraded forest would be regenerated by the provision of fencing and guards whilst 470 ha of planting would be sited on bare erosion sites. The forestry programme is to be preceded by a first year survey to determine precise areas for development. All of the forestry programme has a protective function, but apart from the areas designated for specific local production, the protection forests are also expected to yield fuelwood and, more importantly, fodder. There is a large livestock population which, as has been already noted, is highly prized by the village communities and, as a consequence, fodder is a most important forest product. A buffalo will eat up to 7 metric tons of leaves which comprise 41 percent of its feed in a year, and a cow will eat up to 2.5 metric tons, comprising 27 percent of annual feed.

In Nepal, local development programmes are planned and implemented by institutions set up under the Panchayat system which is a structurally integrated four-tier system of administration. Legislation introducing the system was enacted in 1962 and the first election of office bearers was held in 1963. The four levels of this local government system are elected Village Panchayats, District Panchayats, Zonal Panchayats and the National Panchayat. The main aims of the system are to secure grass root level participation in local development and welfare schemes, to make higher levels of government administration responsive to the needs of the people, and to decentralize administration to utilize more fully local resources of men and materials.

To attempt to secure the required level of cooperation and coordination between district Panchayats and technical ministries, they have been put into a secretariat under the control of Chief District Officer (CDO) for local development at district level. The CDO's function will be to promote the smooth implementation of district development plans and he is also responsible for law and order. When a plan has been approved, the individual components are implemented under the direct supervision of the technical functionnaires of the concerned ministries, but under the overall guidance of the CDO with the support and cooperation of the District Panchayat.

The Nepalese Government has recognized the need for community involvement in forestry. The recent 1976 policy provides for the vesting of responsibility in the local community for small woodland areas in agricultural zones together with rights to produce from these areas. Forestry development will be carried out by the forest department with the cooperation of District and Village Panchayats.

Key Factors:

As this analysis is based mainly on a pre-project appraisal, the identification of key factors must be conceptual rather than actual.

- That forestry as part of an integrated rural development programme could contribute to raising the standard of nutrition of the local community from below subsistence level.

- Realisation of the importance of forestry, to the extent of transferring cultivated land to forestry by increasing agricultural yields using improved methods on the remaining farmlands.

- The recognition that not only community production forests but local protection forests should make some contribution to local needs, provided the main protection function is attained.
- In an area of high livestock population, the established importance of the forests as a valuable source of fodder for supplementary feeding.
- Directing rural development strategy, including that of forestry, through the Panchayat (local government) system so that both planning and implementation are discussed and approved at the village level.
- The recognition that technical weakness in the Panchayat at district level requires to be made good by Government and external technical inputs and training.

11. Nigeria - Farm Forestry

The problems in three different locations which typified the differences in ecological zonation, peoples and objectivesof farm forestry were described in general. The term 'farm forestry' was used to mean the raising of forest and fruit trees in private and community lands outside forest reserves. Such trees and wood were owned and managed by the farmer or community, with or without technical, financial or other assistance from Government or non-government agencies but preferably with such assistance. Farm forestry could be practised on farmlands, compounds and unused tracts of community land. Forestry played a further important role in rural development in Nigeria through many other programmes within forest reserves such as taungya, shelterbelts, pulpwood and other plantations and through traditional employment generating activities of exploitation and regeneration.

Three examples where farm forestry was started are cited:

a) Shelterbelt project in Northern Nigeria - This is an area with urgent need of environmental improvement with a low annual rainfall averaging 700 mm. Earlier attempts at establishing some form of shelterbelts had met with mixed success. Seedlings of fruit trees had been distributed free to all interested persons and organizations. By 1976 over 760 000 seedlings had been planted. There was a certain preference for fruit trees since they had dual advantages and were traditionally protected in farmlands by rural communities.

b) Soil erosion control in Eastern Nigeria - This is an area short of wood with a serious erosion problem. The Forestry Services of the two states had been establishing forest plantations through agrisilvicultural methods, whilst recently seedlings of mainly fruit trees had been produced and sold at reduced prices.

c) Rural forestry development project in Western Nigeria - Here, there is a high demand for wood both for domestic and for industrial purposes. The State Forestry Service, in cooperation with the Federal Department of Forestry, was involved in a campaign to encourage rural inhabitants to grow *Gmelina arborea* and teak for fuelwood, timber, transmission poles and as raw material for a pulp and paper mill. As in the shelterbelt project, seedlings were given free of charge to farmers. Within its first year of operations, 1976, about 700 ha had been planted and over 700 000 tree seedlings had been distributed. In this particular area much initiative had come from the local communities themselves, and the Forest Department concentrated its efforts mainly on extension and public information. The Ministry of Information had helped to disseminate information on the project through television and radio.

It was noted that the availability of markets in nearby large urban areas and wood requiring industries had created particular conditions favourable to farm forestry. Although the primary use of the wood product would be for the farmer himself, any excess to his own needs could easily be sold outside the community thereby providing an additional income.

The need for cooperation between the various ministries involved was recommended. Since this is a forestry project, the centre of activities would be the Forestry Service. However, as resources would have to be developed within the community, inputs by other government organizations would be necessary. The Forestry Service would have an executive role and a coordinating committee of people representing other branches would be established to review periodically the progress made.

12. Philippines - Smallholder Tree Farming

In the late 1960s, in line with government policy and with government financial support, the Paper Industries Corporation of the Philippines (PICOP) launched a combined agriculture and tree farming development plan, firstly to ensure a constant supply of raw material for its pulp mill and secondly to improve the socio-economic position of farmers on the periphery of its forest concessions and at the same time to strengthen its relationship with them. The farmers are generally squatters or poor smallholders who had migrated to the Bislig region of eastern Mindanao from other parts of the Philippines some time previously, and who were cultivating the land in an extensive fashion. Many of them had no title to the land, which was classified as alienable and disposable by Government. When such land has been surveyed by the Bureau of Land, it is open for settling and a claim for legal title of up to 24 ha can be filed after 20 percent of the holding is cultivated. The original land survey subdivided most of these lands into 10 ha units.

Under the tree farming scheme a participating farmer devoted up to 80 percent of his land to growing Albizia falcataria on an eight-year rotation. PICOP provided seedlings (at cost) and technical assistance both for pulpwood production and for the agricultural crops on the remaining 20 percent of its land. The development of the agricultural portion of the farm was given full priority. In 1972 the Development Bank of the Philippines (DBP) undertook the financing of credit-worthy farmers. Eligibility for a loan required having title to at least 10 ha of land.

This scheme was expanded in 1974, when the World Bank participated financially. The conditions of entry to the scheme were relaxed; the minimum land holding was reduced to 5 ha; farmers with ten years' land occupancy who did not have title but who had applied for a homestead lease became eligible; and a grace period of seven years on loan interest and capital repayment was allowed. The other conditions remained as before, with PICOP providing technical assistance, a contractual agreement to buy the wood and setting a minimum price. The farms are sited within a 100 km radius of the pulpmill, which is considered the maximum economic distance for transporting timber and for extending technical assistance.

The average small-holding size is 10 ha, of which 2 ha are utilized for crops and livestock and 8 ha for growing trees. The farm family clears and plants some 4 ha of Albizia falcataria in each of the first two years. Albizia is chosen largely because it is suited to the area, is easy to establish and maintain and the wood is suitable for pulping.

The general topography is gently undulating and generally below 200 m elevation. Soils are typically rich clay loams of limestone origin. Sloping areas are considered marginal for bananas, coconuts or maize but are eminently suitable for Albizia planting.

As the land has been heavily logged, the bushcover is light and clearing is done manually. With a rainfall of 4 830 mm planting can be carried out during most of the year and lining out, staking and digging of planting holes should be done about one week ahead of planting. Spacing is 4 m x 4 m, i.e. 625 seedlings/ha. Seed is collected locally. Seedlings are raised and transported to farms by PICOP who have nurseries of 5 million plant capacity. The potted seedlings are planted and a 50 gm application of NPK fertilizer per seedling is applied. Replanting of failures is carried out as early as possible after planting. Albizia has rapid initial growth and a broad crown and a weeding regime of three spot weedings at one, three and seven months after planting and a blanket weeding at eleven months is usually sufficient to allow establishment. As the species is free from pests and diseases and as fires are rare, no special precautions are necessary.

Although a possibility, thinning regimes have not been introduced. The rotation is eight years and a total average yield of 240 m^3/ha is readily attainable. Harvesting is by the farm family labour force supplemented by hired labour and using oxen for extraction. The Albizia regenerates profusely from coppice and unnecessary suckers are removed.

The rate of planting varies with the size of farm. At an early stage it was envisaged that tree planting on a 10 ha farm would be at the rate of 1 ha per annum, but this is no longer considered practical. Sometimes a second application of fertilizer is given seven months after planting.

Calculations made in 1974 indicated that a 5 or 10 ha farm should show a financial rate of return over 20 years of 25 percent and an economic rate of return of about 14 percent.

It is fundamental to the scheme that the farmer should have an assured supply of agricultural produce before commercial tree planting. For this purpose the extension service concentrates on the agricultural development of the participant's farm in the first instance.

Loans are for 15 years and security is generally a mortgage on the farmland. Interest charged is at the rate of 12 percent and a grace period of up to seven years is allowed before commencing repayment of interest or capital. It is possible to participate in the scheme and enjoy the technical services without taking up a financial loan.

Key Factors:

- The smallholder secures tenure of his land, changing his status from landless to land owner.
- A guaranteed market for the pulpwood at a guaranteed price; a period of monetary recession underlined the importance to the farmer of these guarantees.
- A strong technical extension service which inter alia first ensured that the farmer's food situation was secure.
- The species grown was well known. Albizia falcataria had been grown successfully in the area for over 15 years and costs and yields had been thoroughly studied.

The provision of finance through loans proved not to be a key factor. The facilities provided by the Corporation proved sufficient to enable the bulk of the participating farmers to proceed with the scheme whilst only the wealthier farmers with large areas took out loans.

13. The Sahel - Forest/Cattle System

The Sahelian zone is a loosely defined area across Africa lying within the 100 - 600 mm mean annual rainfall limits. The limited rainfall, on particular sites, can produce and support only a limited biomass, so that there is an ecological balance sensitive to biological or climatic stresses. The main domestic demand on the forest is for fuelwood with a lesser demand for poles and lumber. For the bulk of the inhabitants of the region, wood is the sole source of energy for heating and cooking. Population growth over the last 50 years has meant ever-increasing demands on the forests. Some 15 million m^3 are currently cut and used as fuel each year, constituting some 90 percent of the total timber consumption of the Sahelian countries.

Intensity of demand for wood has increased around new urban concentrations. The areas in the vicinity of large towns have been largely stripped of trees and such deforestation is reaching serious levels. Other areas of extensive deforestation are those in the vicinity of wood-using industries such as drying and smoking fish. In some areas the fuelwood shortage is so great that for part of the year people are reduced to eating uncooked foods.

Forest areas also meet a considerable demand for grazing, much of it uncontrolled and, in certain countries, illegal. The lopping of trees for fodder is a common dry season practice.

The problems of the Sahel are not recent, they have been brought to light periodically in the past and have led to measures, always localized in their application, to alleviate periodic critical situations. Localized interventions, limited to certain sectors, without any overall direction, have frequently given only temporary solutions, and on many occasions have created new and worse problems.

History, population pressure and changing economic and social trends have impelled stock farmers to increase their herds and to grow crops while, of greater consequence, arable farmers have been forced to increase the cultivated area and move the Sahelian agricultural frontier further north. This has resulted in an even wider use of the land in the Sahel without any appreciable improvement in soil productivity.

The disastrous effect of a series of dry years combined with the sharp unforeseen increase in the prices of energy, cereals and modern agricultural inputs during the period 1970 to 1975, were of such a scale that they radically disrupted an already changing economic and social life of the population. The drought reduced millet and sorghum production by one-third and cattle herds by 30 percent. The drought, however, merely aggravated the problems which had long been facing the Sahelian countries.

Two projects have been started in the zone. One at N'Djemena in Chad which concerns the regeneration of degraded natural vegetation, and the other in Senegal where the objective is to stabilise sand-dunes to protect the 'Niajes', or inter-dune area of the valuable agricultural land. Both are at an early stage but initial results are reported as promising and the demonstration targets have been achieved.

Key Factors:

- The need to consult and cooperate with the local people in carrying out forest programmes for their benefit.
- The economic status of the community is such that their participation is confined to part-time employment.
- Where the ecological balance has been severely damaged, despite local forest needs, protection is paramount.

14. Sudan - Acacia Senegal Gum and Tree Fallow System

Gum arabic has been a known item of trade for over 2 000 years and records of the Sudan gum trade show sales increasing from 126 tons in 1825 to 52 000 tons in 1965 after which exports fell to 42 000 tons in 1970.

Gum was originally tapped from wild trees. Subsequently, in areas close to temporary villages or centres of population, the acacia trees were grown and later a system of permanent villages with agriculture employing an Acacia senegal fallow was developed. With recent increases in population, the value of land for cultivation is so great that in certain areas Acacia is forced out of the fallow, as there is insufficient time for the establishment of gum gardens. Apart from affecting gum production, the shortening of the tree crop fallow rotation adversely affects soil fertility and stability, and this can affect food production and the peasant economy. Apart from its value in producing gum as a cash crop, Acacia plays an important function in many other facets of peasant life, for example:

- thorny branches are used for fences or enclosures;
- the trunks are used as house-building poles, or, with the branches, provide firewood or charcoal;

- the trees markedly increase soil fertility;
- blocks of trees protect the soil from wind erosion;
- small shoots, in leaf or leafless, are a source of fodder for camels and goats;
- when in leaf, the trees provide dense shade for grazing animals;
- the roots are utilized for rope making and for lining wells.

Other than land pressure, adverse factors affecting the tree crop are fire and overgrazing. Fire reduces yields of gum and kills off established trees, whilst overgrazing in the forms of browsing or pollarding has a similar effect but seldom causes tree death.

The peasant family averages an annual income from agriculture of S£ 66 and some gum tapping is economically necessary to supplement this income. In 1966 the average return from gum would represent a 25 to 28 percent addition to this agricultural income.

The sole species is Acacia senegal and its silviculture is widely known and methods of regeneration, growing and utilization are well established. The generally accepted land requirement figure is 25 ha of which one quarter is for food production, one quarter under Acacia from 0 - 4 years, and one-half under productive Acacia from 5 - 12 years old. Grazing among the trees is incorporated in the fallow cycle. The rotation should ideally be so arranged that a normal series of age classes is established in the Acacia fallow. Acacia regeneration needs to be supplemented by sowing of seed and a stocking of 600 trees/ha is desirable.

It is the policy of the Government to allow the gum trade to continue on the local basis that has evolved and the main intervention in the last 60 years has been to regularize the system of sales to the benefit of the producer. Government can stimulate production under the 'Minimum Price Agreement' by stabilizing or raising prices when market conditions allow. This Agreement, which was introduced in 1962, is the formulation of the gum price structure. The Government reviews prices annually and fixes a minimum auction price to the producer and a minimum export price.

In theory all land is owned by the Government, but in practice individuals have acquired rights over land allotted to them and entitled to the income from such, irrespective of whether they work it themselves or hire it out.

Key Factors:

- The main factor is the strong and continuous demand for gum arabic. The industry is based on a single and well-known species, Acacia senegal.

- With the development of settled agriculture in the Acacia areas, the species has been incorporated into an agricultural system suited to the ecology of the region in which, during the tree fallow period, not only is soil fertility replenished but production of gum is promoted. The local community has shown considerable self-reliance in organizing gum collection and developing the agrisilvicultural system.

- With increasing population and scarcity of water limiting the opening-up of new agricultural land, the ecological status of the agrisilvicultural system has become finely balanced. Any reduction in the period of fallow produces stress in the system, with consequent reduction in gum production and soil fertility. The Government is now taking an active interest in both the gum production and the agricultural system.

15. Tanzania - Village Afforestation, Dodoma District

Community forestry is part of the 'Ujamaa process', wherein the state wishes to mobilize all resources towards the elimination of poverty, ignorance and disease. The

basic unit is the 'Ujamaa Village' and forest policy requires the encouragement and assistance of forestry by local and village organizations. Dodoma District contains some 120 villages with some 500 families in each. The people are mainly farmers and per capita income is T.sh. 34 - 45 per annum. There is an average per capita holding of five head of cattle, and this creates considerable pressure for grazing land. Community plantations commenced in 1967, but have been placed on a sounder planned basis since 1973. Fuel and other forest needs are taken from an ever-diminishing natural savanna forest.

The primary objective is to establish local woodlots for fuel and poles for local needs. Other aims include tree planting for soil and water conservation, and to reclaim depleted land.

A preliminary general soil survey was carried out. Some eight tree species are used including Cassia, Eucalyptus, Grevillea, and neem, with eucalypts being the main woodlot trees. Eucalypts are grown on a ten-year rotation with an m.a.i. of 12 m^3/ha. Plants are raised in departmental nurseries in polythene pots. The seedlings are transported to villages and villagers carry out planting and tending with technical advice from the Forest Department. Tending has proved a constraint in particular areas.

The project comes under the dual control of the District Commissioner or Party District Secretary who is a political appointee and the District Development Director who is a civil servant. All of the land is state owned. The Forest Department provides technical advice, extension, nurseries and transport for plants. Villagers are trained in forestry practices but no financial incentives are paid. The forestry staff of one professional, two foresters and nineteen others is insufficient for the required programme. The scheme also involves the Ministries of Agriculture, Land and Education.

The community provides labour and the Government provides land, technical services and extension. The main community benefits are:

- fuel and poles,
- increased agricultural production due to reduced erosion and from time saved by not having to travel distances for fuelwood,
- income from sale of surplus products,
- technical knowledge of forestry.

Some 650 ha of plantations were established between 1972 and 1976, and this represents approximately 40 percent of targets. Some of the plantations are already producing and meeting needs. Some areas have been lost due to insufficient tending, fire or grazing.

Key Factors:

- Government's sustained commitment to raise the rural standard of living.
- Need for integrated approach to land use to reduce the conflict between agriculture and forestry.
- The 'Ujamaa process' has replaced the traditional system with a new 'non-tribal' approach, but the development of local forestry appears to require greater extension or incentives to encourage participation.
- The technical requirements for the local woodlots require to be more clearly defined and the number of species is perhaps greater than necessary.
- Community inputs and benefits have not been quantified so it is difficult to convince people that their labours will be adequately rewarded. Failed plots must have an adverse effect on participation.

16. Thailand - Forest Village System

Destruction of forests by shifting cultivation is a serious problem in Thailand, particularly in the northern and northeastern regions. The evolution of a Forest Village

System is an attempt to relate the work of forestry and public welfare, to promote rural development, reforestation and sound land-use.

The objectives of the forest village scheme are: a) to attract landless people to establish themselves in forest villages, which offer improved facilities, a better standard of life and greater stability than nomadic life; b) to encourage village people to establish 'taungya plantations' to reforest areas of the forest estate which have been degraded by over-exploitation or shifting cultivation; c) to create, in so doing, opportunities for long-term forest employment.

A forest village comprises approximately 100 families and each family unit is allotted 1.6 ha per annum, for clearing and taungya cultivation for 3 years. The scheme and the village programme is supervised by an officer of the Forest Industries Organization (FIO). Other inputs by the Government include the land, tools, social services and infrastructure and a cash bonus of up to US$ 155 per year for a good performance. Besides this cash bonus the forest villagers get some income, which may be up to US$ 500 per year, for the agricultural crops they grow between the forest trees. The programme is assisted by an extension service.

Progress with the forest village scheme, which commenced in 1968, has been gradual, and at no time was it anticipated that there would be rapid development. Taking Mae Moh village as an example, involvement was gradual with 31 families joining during the first four years, 55 families in year five, and 14 families bringing the number up to the planned total of 100 in year six. During this development and settling-in stage it was not possible to meet the annual target of 160 ha of taungya plantation without hiring outside labour to make up area deficiencies. By 1973 the Forest Village System was achieving some 2 000 ha of taungya plantation per year which is well short of the possible rate of 32 000 ha/year, but is a useful beginning.

In 1976 the whole reforestation programme of FIO had some 30 units and trees were planted on an area of 10 600 ha. There were 21 forest villages with 817 families and 4 325 persons. FIO provided 11 permanent primary schools for 886 pupils.

In 1977 35 units of reforestation were under FIO control. These units are expected to increase to 40 in 1978. The projection is that 5 units will be added every year up to 1980.

(One unit of the FIO reforestation programme is a working group for reforestation of 160 ha/yr over the whole area of the rotation of a specific species such as teak. The whole area of a unit for teak would be set at 9 600 ha for a 60-year rotation, and for Parkia spp, at 4 800 ha for a 30-year rotation, etc.).

Key Factors:

- The absorption of shifting cultivators into permanent forest village communities by providing incentives which should improve their standard of living, at the same time providing cash incentives for the development of 'taungya plantations' with prospects for long-term employment in forestry.
- The relating of forest village planning to Hill Tribe Welfare Studies which determine, in depth, the needs and possibilities of the local people.
- Teak, the main species planted, is indigenous to Thailand and its silviculture is well defined.
- Adverse features include low income and periodic distributions of cash often causing financial hardship to participants, transport problems as taungya areas become more distant from the village, and the unsatisfied aspirations of the participants to have a permanent farm area of their own. Attempts are being made to eliminate adverse factors through the establishment of resettlement villages of 200 - 500 family units, provision of 2.4 ha leases for permanent farming and long-term loans to assist house construction costs and initial

farming investments. These recommendations take care of the main adverse factors noted, but the provision of farmland creates some conflict between the farm and the taungya plantation for the available cultivators'input.

17. Thailand - An Approach to Integrated Watershed Management, Mae Sa

The major problem in this catchment area is the steady and uncontrolled destruction of the protective forest cover. Most of the land belongs to the Crown, and although there are lowland private agricultural areas, no private ownership is allowed in the upland areas. The agricultural activities of the hill farmers, therefore, are technically illegal. Until 1975, hill tribesmen were not allowed to become Thai citizens and since the law was changed in 1975 few have adopted citizenship. Their traditional agriculture includes no concept of inputs to the land to improve conservation and long-term fertility; consequently they show little regard for the land they cultivate.

A project was set up in 1973 to carry out a pilot and demonstration programme of integrated watershed management in the Mae Sa catchment area. The project covered several fields, such as watershed management, horticulture, conservation farming, road construction and maintenance, reforestation, fire control, rural sociology, plus many other secondary activities.

The project carried out detailed surveys of natural and human resources, including land capability classification, a forest inventory and socio-economic surveys. Each of these surveys yielded important information but the socio-economic survey showed up a number of factors including different tribal methods of agriculture, and the limitations and misuse of resources. The Meo are practising an extensive and destructive type of clearing at around 1 000 m elevation with upland rice as a subsistence crop and opium as a cash crop. Thai clearing is usually much less intensive, and involves lighter forest and less thorough tree felling. It was found that 30 percent of the Thais and 97 percent of the Meo are landless in that they have no legal ownership of any land.

Following land capability surveys, allocation of land is considered critical if the land-use situation is to be improved, but in practice in a pilot scheme it was found that survey and allocations were a slow process to be carried out on a large scale with limited funds and manpower. The basic pilot land allocation was carried out in one village on the basis of the requirements of the individual farmers, and was of the following order:

i) 0.25 rai (0.04 ha) with less than 35 percent slope for household and garden;

ii) 1 rai (0.16 ha) irrigated or 2 rai (0.32 ha) rainfed or the combined equivalent on less than 35 percent slope for subsistence cropping;

iii) 1 rai (0.16 ha) with less than 85 percent slope and proper soil and conservation measures established for fruit and food tree crops;

iv) 3 rai (0.48 ha) with less than 85 percent slope as a share of communal village woodlots managed under the supervision of the forest officer and the village headman.

It is proposed that a temporary land occupancy certificate be issued for five years and, upon satisfactory performance over this period, a leasehold certificate or ownership title will be issued. Lease rentals will be nominal and transfer will only be possible under strict conditions. To prevent the more undesirable activities of money-lenders,'leases' will not be valid as mortgage securities. In the initial stages, Government will have to arrange low interest loan facilities to finance the participants during the establishment phase. The villagers were kept fully informed of objectives of the land allocation scheme and their agreement to the scheme was secured.

Key Factors:

The project is at an early stage in developing integrated watershed management, but nonetheless sufficient information has been determined for work on a large scale to be

advanced. The project has an extensive list of proposals for larger scale operation in the immediate future of which perhaps the most important are those given below:

- The development of sound technical and organizational institutions.
- The carrying out of human and natural resource surveys as a basis for allocating areas to the correct land uses.
- The allocation of land suitable for permanent agriculture to inhabitants of the area who are currently landless and practising shifting cultivation; the provision of technical advice on land layout and permanent agricultural techniques.
- Strict control of sale or transfer of leases or individual land allocations and prohibition of outsiders obtaining land and the development of land speculation.
- Incentives such as compensation for labour inputs and fertilizers to encourage and assist farmers to establish conservation works on their lands.
- The concept of land allocations requires inputs from the participant who should benefit from his ownership and status. The concept also attempts to build up community awareness, by having community woodlots and requiring inputs from the individual to certain community activities.
- The setting up of an area or regional fire control system and organization.
- The setting up of forestry working circles to provide for local demand. Such working circles would probably incorporate community village woodlots as permanent agriculture develops.
- In plantation establishment the standards of post-planting maintenance should be improved.
- The use of taungya plantations and forestry pasture systems should be developed.

Appendix 3

OTHER FOREST PRODUCTS

This appendix gives examples of a range of species and products from many countries with some notes on their distribution, production and uses. It is arranged as below:

I. FOOD

A. Food direct

1) Seeds and nuts

2) Fruits

3) Edible products from palms

4) Fungi

5) Animal protein

B. Fodder

II. FOREST PRODUCTS PROVIDING EMPLOYMENT OR CASH INCOME

1) Bamboo

2) (a) Rosin and turpentine (naval stores)

(b) Resins and gums from broadleaved species

3) Tannin

4) Tasar silk

5) Gum arabic

6) Medicinal and other economic plants

7) Raw material for the manufacture of handmade paper

III. FOREST PRODUCTS WHICH INCREASE LAND PRODUCTIVITY BY CROP DIVERSIFICATION

1) Honey and beeswax

2) *Acacia senegal*

3) *Thea oleosa*

4) Others

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I. FOOD

A. Food direct

1) Seeds and nuts

Anacardium occidentale provides the popular cashew nut and is also a species often introduced for windbreaks or firebreaks; it is an excellent source of nectar for beekeeping. Bertholettia excelsa, the source of the brazil nut which contains about 66 percent fat, 17 percent protein and 7 percent carbohydrates and vitamin B, originally from the Amazon forests, can reach a height of 30 - 50 m, a diameter of 1 - 2 m and yield 250 - 500 kg of nuts annually: the annual export of nuts from Brazil is 30 000 - 40 000 tons. Macadamia originally from Australia, yields up to 150 kg/ha/year of nuts. Castanea spp — the chestnut - (C. sativa in Europe, C. crenata in Japan, C. mollissima in China and C. dentata in North America) has had a very important role in the economies of several countries and particularly in France and Italy where the annual yields are as high as 2 000 kg/ha and 3 000/kg/ha, respectively. A large number of wild chestnut trees (Castanopsis spp) are found from India through to Indochina. Wild hazels are used for food particularly in Asia (Corylus chinensis, C. heterophylla). Pistachia vera is grown extensively in some regions of North Africa and the Near East for its nuts, and Ceratonia siliqua in semi-arid to sub-humid areas of North Africa produces a fruit which contains 40 - 50 percent of sugar. Canarium spp in southeast Asia and the Pacific region provides a nut which is eaten raw, cooked or salted. Edible pine kernels are obtained from Pinus pinea, P. cembra, P. gerardiana and P. koraiensis. Araucaria from Brazil, Chile, Australia and Papua New Guinea has several species which are highly appreciated because of their edible seeds. Terminalia catappa and T. kaernbachii produce important cash crops of the sea almond.

2) Fruits

One of the best known examples is the bread fruit tree, Artocarpus incisus, which is planted for shade and for fruit; other species such as A. integra, A. nobilis and A. attitis provide edible fruit and seeds. The leaves are used for fuel and the branches and stems are utilized for building and furniture. Another well-known source of edible fruit is the mango family, Mangifera indica being the most widely planted; besides the fruit, the young leaves of M. zeylanica are eaten as green salad. Another widely cultivated tree yielding edible fruit is Prosopis juliflora (algaroba, mesquite), originally from America but extensivly introduced in Africa and Asia. At 4 years it gives substantial yields of algaroba beans which are cereal substitutes. The beans or pods also provide animal feed and the tree exudes gum of commercial quality, while the flowers are a satisfactory source of honey. Good varieties of algaroba provide up to 50 tons of flour per hectare annually. Similar yields of flour may be obtained from Ceratonia siliqua (carob or St. John's bread), another species suitable for semi-arid zones (Sholto Douglas, 1972 (0)). Other trees yielding edible fruit which are widely cultivated belong to the genera Garcinia, Diospyros, Durio and Zizyphus. Some other widely distributed species which are well known for their fruit are Mammea africana, Tamarindus indica, Balanites aegyptiaca, Cordyla pinnata, Parinari macrophylla, Parkia biglobosa and Butyrospermum paradoxum. Special mention should be made of Adansonia digitata, known as the baobab; the fruit gives a pulp which can be powdered (cream of tartar) and mixed with milk for children; the seeds (2 000 per kg) provide oil and the young leaves are eaten as salad or cooked. There are also tree species which provide gum for cooking, such as Sterculia setigera and several Ficus spp.

3) Edible products from palms

A number of palm trees provide food and oil, among them Jessenia polycarpa and Orbignya mariana, originally from the Amazon basin. The buriti palm, Mauritia flexuosa, and the oil palm (Elaeis guineensis) provide edible fruit, oil and shoots (hearts of palm). The sap of Borassus aethiopum is rich in sugar, palm wine may be produced from it, and the fruit may also be eaten. Phoenix paludosa also produces edible palm heart and the great palmetto-worm which is considered as a delicacy by some communities.

Euterpe edulis is a Brazilian palm which produces palmito palm heart which may be exported. In 1975 exports from Brazil reached 7 012 223 kg at US $ 1 294/ton, the internal market being three to four times the exports. The edible portion of the plant, the palmito constitutes 50 percent of the stem, the rest of it being utilized for both poles and pulpwood.

Sago palm (Metroxylon sagu, M. rumphii, M. salomonense) produces a starch extracted from the pith of the trunk.

4) Fungi

With their quantities of decaying litter, forests support many fungi, some of them edible. There are also many tree species that harbour mycorrhizal fungi on their roots, and, where there is a choice of the latter, it may be possible to introduce edible strains onto nursery stock. Because of the fear of poisonous fungi, many people do not eat any species, or limit their attention to one or two; the existence of a local tradition of fungus eating is necessary if any hopes are to be placed on this resource. Even where such a tradition exists, fungi do not constitute a major food source in terms of calories or protein. The greatest contribution they can make to a village economy is by providing an expensive delicacy that can be marketed. Many species can be dried and thus require little outlay for preservation and packing.

Some of the main mushrooms which are cultivated are Lentinus edodes in Japan, Volvariella volvacea in China and the oak and black mushrooms in the Republic of Korea. Since ancient times the Greeks and the Romans have cultivated Pholiota aererita on poplar. In France most of the oak forests in the Massif Central are now oriented towards the production of Melanosporum truffles. The price of truffles is around US $80/kg and its cultivation may produce higher returns than lumbering. In Italy another variety of truffle has been successfully inoculated on the roots of Pinus strobus. The Japanese fungi, shiitake, has been tried successfully in wood residues in Chile, the prospects of producing it with residues of Nothofagus dombei being quite attractive since this fungi species multiplies 300 percent in a period of 5 years and the international price is US $14 per kg. Mushrooms represent a very important source of income in the Republic of Korea, their cultivation being promoted by the Village Forestry Associations. The 1977 exports of pine mushrooms amounted to about US $9 million and oak mushrooms to about US $6 million.

5) Animal protein

Traditionally rural communities have depended on forest lands as a source of animal protein. A great variety of animals is still being consumed, ranging from insects, reptiles, amphibians to fish, birds, and mammals. Unfortunately, conventional nutrition and socio-economic surveys have often underestimated, or even ignored, the impact of wildlife on the day-to-day life of rural people. However, although accurate data have yet to be obtained, it is clear from the indications of limited in-depth studies that wildlife and fish constitute the principal sources of animal protein in many rural areas, particularly those where there are constraints to domestic livestock husbandry. In Africa, surveys have been carried out in Ghana and Nigeria which showed that as much as 70 percent of locally produced meat may come from wild animals, particularly from some of the smaller types, such as grasscutters (Thryonomys spp), hares (Lepus spp), giant rat (Cricetomys gamlianus), snails and insects. In South America the capybara, a giant rodent weighing between 40 and 60 kg, has long been the object of intense exploitation. In Argentina they are hunted everywhere for their meat and hides, while several ranches in Venezuela raise them commercially.

Equally, in Asia many rural communities utilize wild animals as food, but other products from wildlife do contribute to the development of local communities. A typical example is the management of deer for the production of antlers. The average yield of antler is 2 kg per stag, which dried can be sold for US $200 - 250/kg. In Papua New Guinea juvenile crocodiles are captured in the wild for rearing in village pens until they attain optimum size for skinning.

In order to set figures for a sustainable harvesting from the various wildlife species in an area, whether for food or other animal products, an assessment of their populations must be made. This assessment must be of a dynamic nature that not only estimates population series, but also the distribution of the species within the habitat. With such information it is then possible to set quotas for harvesting and select the most appropriate methods and times for carrying it out.

The processing of wildlife for food meets with many constraints imposed by health and veterinary regulations in some countries. While harvesting of wildlife remains on a traditional basis, there is usually no problem, but once it becomes official, regulations and restrictions designed to cater for domestic livestock can come into play and preclude the adoption of traditional methods of meat preservation. With this in mind, the easiest procedure for the preservation of meat in tropical situations is an adaptation of the traditional drying/smoking techniques.

Fish production in swamp or mangrove forests is an important protein source. Mangrove and swamp forests offer a most valuable protective habitat to fish. In the Tonlesap area, Democratic Kampuchea, during the high flooding period, the fish population disperses in the surrounding swamp forest which provides food for them to develop very rapidly. Fish production there was said to be 10 times more than the Atlantic fishing grounds (10 t/km^2 as compared to 1 t/km^2). The mangrove serves mainly as an area in which many marine organisms breed; for example, fish molluscs or crustacea which play an important part in the local economy and diet. The mangrove forests in the Ganges delta and in the Indochinese and Malaysian peninsula are particularly rich in fish, mussels and shrimps, which give rise to a flourishing industry. Deterioration of the mangrove forest ecosystems means deterioration of the foodweb and breeding grounds for marine organisms and this will cause a decrease in fish production.

B. Fodder

The foliage or fruit of many tree species may be collected and used for animal fodder, either raw or after simple processing.

Species for fodder production should meet the following requirements:

- adaptability: the species should have the ability to establish and maintain itself in the selected environment;

- palatability: a fodder species, be it a tree or a shrub, should be readily accepted by animals. Palatability varies from one animal species to another and is influenced by the inter-relationship of plant, animal and environmental factors;

- nutritive value: palatability influences feed intake, but some plants may be of low nutritional value even if their palatability is high. This means that besides palatability and resultant feed intake, fodder plants should have high levels of various nutrient components of which protein is considered to be the most important. This nutrient is usually recorded as crude protein. *Acacia arabica* pods and leaves contain 15 percent crude protein. Leaves of some other species contain as much as 20 percent of crude protein (*Albizia lebbeck*, *Prosopis specifera*);

- production and growth: production of substantial amounts of fodder in the early years after planting is an important economic consideration. In the Near East and North Africa areas, this requirement was satisfactorily met by using fast-growing and high-yielding drought-resistant genera such as *Atriplex*, *Opuntia* and *Acacia*;

- resistance to utilization: fodder species can be grazed either directly or indirectly (lopping, cut-and-carry method). The capacity of the species to recover quickly by producing new buds from the browsed and cut stems is important;

- not harmful to animals when eaten: toxicity possibilities should be carefully checked before trees are introduced to provide animal fodder.

II. FOREST PRODUCTS PROVIDING EMPLOYMENT OR CASH INCOME

1) Bamboo

Several species of bamboo are widely cultivated in many countries, mainly in southeast Asia. The various species have innumerable uses: shoots for human consumption, fodder for horses, building material, furniture, fishing poles, pulpwood, fibre for paper-making, in addition to their role in windbreaks, riverbank stabilization and erosion control. A valuable and expensive medicine, tabashee, is found in the joints of several species, Melocanna bambusoides being one. The most popular species in cultivation are Phyllostachys edulis and P. pubescens. In temperate climates, Phyllostachus spp may yield annually up to 15 m^3/ha whereas with tropical species such as Dendrocalamus, Bambusa and Melocanna, the yield is lower. Bamboo shoots, if canned and exported, provide a good source of income. A market for the canned shoots is readily available in America and Western Europe where demand is higher than supply. Properly fertilized and managed, one hectare of bamboo can yield annually from 500 kg - 1 ton of shoots in addition to 2 or 3 tons of dry bamboo. Bamboo cultivation can bring a good annual income to farmers 3 or 4 years after planting.

2)(a) Rosin and turpentine (naval stores)

Pines (Pinus spp) produce an exudate from the cambium region when they are injured. This exudate is a complex mixture of terpenes and fatty acids and is known as crude gum. This gum can be refined to produce turpentine and rosin which are important commericial products. Pine species vary in their yield of gum. Important commercial species are P. elliottii, P. palustris, P. silvestris and P. merkusii, but many other pine species are used in specific areas. Yields must be found by experiment.

The refining of the crude gum is not difficult, but requires a certain minimum quantity to make an installation economic. If refining facilities are not available in a country, marketing of the crude gum might be difficult. The prices of rosin and turpentine on the world market are subject to considerable fluctuation and must be carefully taken into account in considering the value of gum tapping. The industry has the advantage for developing countries in that it is labour intensive and requires a minimum capital investment to produce crude gum. The refining operation is not complex technically, but significant investment is required to build a refinery of economic size.

(b) Resins and gums from broadleaved species

Many broadleaved species, specially those from the tropics, yield marketable resins and gums. Notable examples are the Acacia spp which yield gum arabic, Dipterocarpus spp which yield damar-type resins and Manilkara spp which yield balata.

As with the naval stores industry, collection of resins is labour intensive and usually requires very little capital investment. Generally, resins are exported in their crude form as collected, to be worked up in the larger centres of consumption. In some cases, however, resins have traditional local uses and this should always be encouraged, since it reduces the need for imported industrial products.

3) Tannin

Tannins are complex polyphenolic substances found in the bark, wood and seeds of certain trees. They are mainly used for the preserving of leather but smaller quantities are used for dying and in chemical industries. There are two broad types of tannins: the hydrolysable tannins and the condensed tannins. Both are used for tannage. Tannins are produced commercially by extracting the soluble tannin with water from the ground or chipped wood or bark and then evaporating the water to produce the solid tannin or, in some cases, a concentrated solution for direct industrial use.

Some species which produce industrial tannins are the bark of acacia species, specially Acacia mearnsii (black wattle), the fruit pods of Acacia nilotica, the bark of various mangrove species (Rhizophora, Avicennia, etc.), bark of oak (Quercus spp), chestnut (Castanea spp), and the wood and leaves of certain eucalypts (E. redunca, E. exserta), the wood of quebracho (Quebracho colorado), and the bark of certain pines, specially Pinus radiata. To be economic, at least 10 percent yield of tannin in the wood or bark is required; the species listed give yields of 10 - 30 percent of tannin.

Where the tannin is required directly for use in tanning leather at the village level, it is practical to harvest bark or wood and make an extract of tannin from the chipped material. A tanning liquor of sufficient strength is then prepared and used directly. Preparation of solid tanning extracts for the market is complex and technically difficult and should not be attempted on a small scale.

4) Tasar silk

Most commercial silk is produced by the domestically reared caterpillar larvae Bombyx mori which must be fed exclusively on the leaves of white and black mulberry trees (Morus spp). However, raw material comes increasingly from the so-called tasar silkworms that feed on the leaves of a variety of trees of tropical, sub-tropical and temperate zones. Tasar silk, having uneven tan filaments which are coarser, stronger and shorter than the normal cultivated silk, has been produced for centuries by upland and forest tribes.

Tasar silk culture is known as wild or forest sericulture, the silk being secreted by several species of the genus Antheraea (Saturniidae), 36 species and 40 forms being recorded. A. mylitta is at present the only species exploited commercially in the tropics. The temperate tasar insect is an interspecific hybrid, A. proylei; it produces the finest tasar silk.

The tropical A. mylitta feeds primarily on Terminalia tomentosa, T. arjuna, Shorea robusta, but also on two dozen other species, including Zizyphus mauritiana, Terminalia paniculata, Anogeissus latifolia, Syzigium cumini, Careya arborea, Lagerstroemia parvifolia and Hardwickia binata. The temperate hybrid A. proylei is mainly reared on oaks — Quercus serrata, Q. incana, Q. dealbata and Q. himalayana.

5) Gum arabic

Of the many species of Acacia, only A. senegal and A. laeta secrete gum arabic, a substance in which there has been an active trade for over 2 000 years. Gum arabic is used in medicine, in textile and food industries and in the preparation of paints and printing ink.

The gum is tapped during the dry season by cutting and peeling a piece of bark on the branches, 2 - 3 cm wide and 30 - 40 cm long; the gum leaks out three weeks later and a ball of 5 - 10 cm in size is formed. The average number of balls per tree is 10 - 15, and the yield per tree is 100 - 200 grams, maximum production being obtained from trees between 7 and 15 years old. (Booth, 1966 (O); Giffard, 1975 (O)).

6) Medicinal and other economic plants

The health of a very large proportion of the population of developing countries — said to be as high as 84 percent in India and Pakistan — depends almost exclusively on indigenous medicines, and there is a rapidly increasing global use of homeopathic drugs that gives medicinal plants very good prospects for development. Careful survey and research should be made of the plants existing in the forest, including the systematic study of their clinical, pharmacological, toxicological, chemical and pharmacognistic aspects, in view of their commercial exploitation.

In order to avoid the possible extermination of plant species by too thorough collection of wild-growing specimens, specially when the reproductive structures are

collected, it is convenient to: i) cultivate the plant in enclosures, setting aside areas in the forest where cultivation and eventual irrigation can be done profitably; ii) propagate the plant in its natural wild habitat, closing certain areas for collection; iii) induce the peasants to leave behind a remnant of the root system of the plant (as is done with ipecacuanha in Brazil) and limit the size of plants which are harvested.

There are several thousand species of trees and shrubs which are of economic interest for pharmacological and broad chemical purposes. In India alone over 700 species have been identified and described (Kanny, 1973 (0)). Some of the most appreciated medicinal plants in the world market, which may be planted and cultivated are: Artemisia mantina, A. vulgaris, Colchicum lutem, Digitalis purpurea, Atropa belladona, Crocus sativum (saffron), Coriandrum sativum, Cephaelis acuminata (ipecacuanha), Foeniculum vulgare (fennel) and Zingiber officinale (ginger).

Plants yielding dyes can also be of interest in community forestry, such as the indigo (Indigophera spp) which has a large export market and is being increasingly planted in El Salvador. Spices may also be a source of income to the community; Cardamon, which produces a spice with a very large market is cultivated in Sri Lanka under forest canopy.

7) Raw material for the manufacture of handmade paper

A great shortage of paper for educational purposes exists in the rural areas of many developing countries. At least part of this need could be met by the local communities themselves producing handmade papers which could be used for school exercise books and other writing purposes.

Its manufacture requires a minimum amount of chemicals, equipment and skills for developing a production of low grade papers. Because the whole operation would be manual, it would be labour-intensive, with no outside power source required.

The necessary fibrous raw materials could be supplied by local forests. Bark from some woody plants such as Broussonetia papyrifera could be used while bamboo, palm leaves, banana stalks, reed and grasses would provide plentiful raw material for the purpose.

In the Republic of Korea, villages produce handmade wallpaper made out of kudzu grass, particularly for export. The revenues for 1977 were estimated to be US $ 27 million.

III. FOREST PRODUCTS WHICH INCREASE LAND PRODUCTIVITY BY CROP DIVERSIFICATION

1) Honey and beeswax (Crane, 1975 (0); Razafindrakoto, 1972 (0); Smith, 1960 (0)).

The most universal non-fibre crop of tropical and subtropical forests is undoubtedly honeycomb, a convenient combination of honey, a valuable and much desired carbohydrate food, and beeswax, an exportable cash crop. Beekeeping is an industry well suited to developing countries, requiring little capitalization and making virtually no demands on natural resources. It may be carried on in conjunction with subsistence or modern agriculture at any convenient scale of operation.

Beekeeping should not be considered as an isolated industry, but rather as an integral part of a forest management system which utilizes an otherwise wasted forest resource.

The total amount of honey and beeswax produced from a given area of land depends on (a) the nectar and pollen yield of plants in the area, (b) the foraging ability of the bees, (c) the number of bees, and (d) the weather, which determines how plant and bee potential can be realized. Of this total production, the partition between the bees and the beekeeper depends on environment and management. In poor areas with no management the beekeeper harvests less than 5 percent of the total production; in good areas with modern management, 30 - 40 percent of the total production may be harvested. With a given bee, in a given environmental situation, the harvest production of bees can be dramatically increased by the introduction of minor improvements in the equipment and management skills of the beekeepers.

With traditional, fixed combhives honey yields rarely exceed 7 kg/hive and the average is much less. The world average in honey production with modern framehives is 15 - 20 kg, though in some countries such as Australia, average yields of 200 kg/colony and even as high as 350 kg are consistently reported. Recently several designs of "transitional" hives have been developed for labour-intensive management which incorporate the moveable comb advantages of the framehive without the complexity and cost of manufacture.

Experience to date indicates that honey yields with these hives can be almost as high as yields with framehives, though handling cannot be easily mechanized. The ratio of beeswax to honey production in traditional hives is 1:15; it is much lower in framehives using modern honey extraction methods.

There are several species and many ecotypes of bees which are presently 'kept' in the tropics and subtropics. Bees are not domestic animals in the conventional sense in that they cannot be kept in captivity. It is impossible for the beekeeper to prevent introduced bees from breeding with wild stock. The first stage in the development of beekeeping programmes is therefore the introduction of improved equipment designs and the development of management skills suitable for the indigenous bees. The gradual replacement of indigenous stock with improved varieties to develop easier to manage strains may then be considered. In areas where no indigenous honeybees exist, carefully selected improved stock may be introduced.

A knowledge of the nectar and pollen source plants in the area is necessary before initiating a beekeeping programme. Since the knowledge of melliferous plants of the tropical and subtropical forests is at present limited, the best source of information is usually the local traditional beekeeper. Crane (1975 (0)) has recently summarized the most important 150 honey-producing plants of the world. In Central and South America the most important trees presently utilized are: Roystonea spp, Piscidia piscipula, Gymnopodium antigonoides, Haematoxylon campechianum, and Citrus spp. In Africa Citrus spp, Eucalyptus spp, Brachystegia spp, Julbernardia spp and Acacia spp are most important, while in Asia Tilia spp and Nephelium litchi produce most of the marketed honey. There are many other melliferous trees which have not been mentioned due to their more restricted distribution.

When planting multipurpose trees, it is possible to take into account bees in several ways: a) Firstly, species or provenances which produce plentifully, high quality nectar can be selected. Most eucalypts are good sources of honey if selected for the right ecological zone. For instance, E. maidenii and E. paniculata are best in certain semi-arid zones while E. saligna and E. grandis yield small quantities of low quality honey under the same conditions. Prosopis juliflora can be a good source of nectar in semi-arid zones. b) Secondly, species which bloom at different times can be planted adjacently to extend the honey production period. c) Thirdly, the beneficial effects of bees in pollinating fruit and nut crops can be catered for by planning appropriate apiary sites in the plantations.

The capital outlay for beekeeping is very small with traditional hives made out of straw, hollowed logs, tree bark, clay or reeds which require only the labour of the beekeeper to construct. One man may manage up to 50 hives part-time with an investment of US $25 - 30 for protective clothing and a smoker and an equivalent amount for honey containers. Modern framehives may cost as much as US $25 - 40 per unit and may or may not be used with modern honey extracting equipment which could be shared amongst several beekeepers in a village. Transitional hives vary in cost from US $5 - 15 depending on the materials used and the skills locally available for manufacture. The early stages of a beekeeping development programme should combine an intensification of traditional beekeeping with the introduction of modern equipment and methods.

2) Acacia senegal

This tree, as well as yielding gum arabic as discussed in II (5), provides fodder, fuelwood and poles, and tannin is obtained from the bark. It is a nitrogen-fixing species valuable in soil rehabilitation.

3) Thea oleosa

This plant has a wide adaptation to varying climatic and ecological conditions provided the site is below 33° parallel north, 800 m in altitude with a rainfall of 700 mm. It begins to yield after 4 - 5 years and thrives for 100 years. Each hectare of T. oleosa can yield annually 75 kg of oil and 225 kg of oilcake which serves as feed for pig raising. Refuse from pigs is a good fertilizer, increasing the yield of agricultural crops. Hundreds of thousands of hectares of T. oleosa are now planted in China.

4) Others

Among a wide range of species which have multipurpose uses and which have not been mentioned previously are the following: Argania spinosa from Morocco which provides fuelwood, leaves suitable for fodder and a nut that yields edible oil. Leucaena leucocephala which is nitrogen-fixing and yields fuelwood, poles and fodder, and is also used for land boundaries in northern Thailand. Sesbania aculeata, which is a semi-annual legume and is nitrogen-fixing, provides green manure for land reclamation of both saline and alkaline areas; its seeds, leaves and branches are suitable for fodder; the seeds yield gum for industrial use; and it produces bast fibre for cordage and first-grade short-fibre pulp for paper and rayon manufacture. Sesbania grandiflora is nitrogen-fixing; it provides poles and is good for pulping; the bark produces tannin and the flowers are eaten as a vegetable. Tamarindus indica is a good shade tree and provides construction wood as well as leaves and fruit for human consumption; the pulp of the fruit has several medicinal uses.

Appendix 4

NOTES ON TAUNGYA PRACTICE AND SOME AGRICULTURAL CROPS AND TREE SPECIES GROWN

Teak (Tectona grandis) is by far the most popular tree species used in taungya and is planted as stumps or seedlings. Gmelina arborea is also widely used. Apart from the growth of tree crops for the production of timber and other traditional wood products, the taungya system may be used to raise cash crops such as cashew (Anacardium occidentale). This species has been successfully introduced on poor sites in the savannas of southern Guinea, sown at a spacing of 2 x 4 m with maize, or sometimes cotton, between the rows of trees. The cashew begins fruit production about the fifth year; the average production in the Ivory Coast [illegible] kg/ha at the age of 15 years, which provides the farmers with a very good return.

There is some evidence that where tree crops are planted with agricultural crops, a wider espacement of the tree crops reduces mortality, increases the rate of growth and, at the same time, the presence of suitable agricultural species effectively reduces soil exposure. In addition, the farmer obtains higher yields per unit of plantation. Closer tree espacement frequently reduces early tree growth because of the increased competition, and necessitates earlier silvicultural tending.

The agricultural crops which are grown in conjunction with the forest trees are generally chosen because of the agricultural and feeding habits of the cultivator. The most commonly cultivated are bajara (Pennisetum typhoides), barley (Hordeum vulgare), beans (Phaseolus spp, Vigna spp), bhajee (Amaranthus spp), brinjal (Solanum melangena), cabbage (Brassica spp), castor (Ricinus communis), chilli peppers (Capsicum spp), coco yam (Colocasia antiquarum), cotton (Gossypum spp), cucumber (Cucumis sativus), dasheen (Colocasia esculenta), dhal (Cajanus spp), ginger (Zinziber officinale), groundnut (Arachis hypogaea), lady's fingers (Anthyllis vulneraria), linseed (Linum usitatissimum), lucerne (Medicago sativa), melon (Citrullus vulgaris - Cucumis melo), millet (Pennisetum spp, Panicum spp), mustard (Brassica spp), oats (Avena sativa), ochra (Hibiscus esculentus), papaya (Carica papaya), pineapple (Ananas comosus), potato (Solanum tuberosum), pumpkin (Cucurbita maxima), rye (Secale cereale), sesame (Sesamum indicum), sorrel (Hibiscus sabdariffa), soyabean (Glycina soja), sweet potato (Ipomoea batatas), tannia (Xanthosoma sagittifolium), tomato (Lycopersicon esculentum), tumeric (Curcumalongg. spp), wheat (Triticum spp).

There are several agricultural species which are controversial and are excluded in plantations in some countries, such as bananas and plantains (Musa spp), cassava (Manihot utilissima), maize (Zea mays), rice (Oryza sativa), sugar cane (Saccharum officinarium), tobacco (Nicotina tabacum) and yam (Dioscorea spp). Limitation or exclusion of bananas and plantains is due to various reasons, among which are: to avoid human interference in the plantations (since the farmers are reluctant to cut or abandon a plant which continues to produce foodstuff), to conserve soil fertility, and to prevent young trees from being deformed. However, at Mayumbe, Congo Brazzaville, bananas combined with Terminalia superba seedlings are exploited during four or five years in state sylvo-bananiers, the spacing of the trees being 12 x 4 m with bananas in two or three intervening rows. Cassava is excluded in Dahomey and Uganda because it exhausts the soil, it has a long life and it attains a height of 2 - 3 m rapidly, thereby retarding the development of the tree crop. The same reason, fast growth, is given for the exclusion of maize in Malawi, Mauritius and Senegal. However, maize has had no significant effect on the mortality of teak (from stumps and seedlings) in plantations made in Gambari in Nigeria, but may have an effect on height growth according to the type of planting stock used. Tobacco may be excluded because it has a deleterious effect on soil nutrients and because of its inability to provide adequate soil cover and therefore the liability of the land on which it is planted to erode.

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Hill rice is grown with tree crops particularly in Malaysia, Senegal, Assam and Kerala, the growth of trees being enhanced because rice suppresses the weeds. However, in Sri Lanka it is felt that the returns from rice are so high that farmers are likely to exert their influence to convert the land to single use agriculture. Sugar cane is generally excluded because it is a long-growing crop, because of fear of soil depletion and because it casts a heavy shade. Nevertheless, where it has been cultivated with considerable success in Assam, India and in Burma, the presence of the cane led to increased height growth of the tree seedlings.

In China intercropping is generally applied in forestry. There are examples of agricultural crops being planted between rows of poplars, Cunninghamia lanceolata and Pinus spp (massoniana, taeda or elliottii) for a period of two years. In some plantations, particularly pine, tung oil trees (Aleurites spp) are interplanted concurrently with the agricultural crops; they yield oil from the fourth to the tenth year after which they are felled leaving the pine as the final tree crop. Intercropping is not only regarded as a tending operation to replace weeding but also a multiple land-use practice for joint production of wood and food. Depending on soil quality, crops may be sweet potatoes, soyabeans, peanuts, watermelons, or maize. In general, intercropping with legumes is preferred as it enriches the soil, provides green manure and also feed for animals. Depending on crops and on the management skill, intercropping may yield 1.4 - 4.0 tons of food per hectare. In some places, it may yield 20 tons/ha of green leaves which are used as feed for animals (pigs) or as manure. The effect on tree growth has been observed as very favourable. Survival rate of Cunninghamia is 5 percent higher than that of non-interoropped plantations and plant height is 33 percent greater.

A further example of mixed cropping can be taken from the southern Pacific coast of Colombia where Cordia alliodora and Cedrela odorata are planted on small landholdings concurrently with the traditional crops of plantain, maize and cocoa (Theobroma cacao).

Although mixed cropping may be contrary to the thought of many foresters, accustomed to the tidy and regular appearance of their plantations, this system is practiced not only for traditional reasons, but because it suits the environment, maintains soil fertility and combats erosion and leaching. There is also an economic justification, since more production may be achieved from mixtures of crops, thus making full use of the space available. Good management is an important factor in intercropping with strict enforcement of any rules that may be laid down. In cultivating and in harvesting the agricultural crops, and particularly tubers, great care must be exercised in order not to damage the roots of the tree crop. If creeping species are used, against the general rule, the farmers should provide bean-stakes or poles (in the case of yams) to prevent strangulation of the tree seedlings. It is important to emphasize that growth and yield of the agricultural crops are directly influenced by the spacing and density of the tree crop. Concommitant with these two factors are the rate of growth and relative crown size of the tree species.

The taungya system is a way to reduce the costs of forest plantations, and at the same time to contribute to solving social problems. In Campeohe, Mexico, where Cedrela mexicana, Swietenia macrophylla and Cordia ciricote were the main species planted, the net costs per hectare for planting and tending during 5 years, with 2 weedings per year, were reduced to as much as 27 percent (to US $ 58.4) of the normal costs because of the revenues from the maize harvest. If mechanization is used, the costs drop to 18 percent (to US $34.3/ha).

Appendix 5

SIMPLE SAWMILLING EQUIPMENT

The equipment detailed below would be suitable for use at the community level. References have been made to this appendix on pages 36 and 54.

1. Horizontal Frame Saw. A single blade reciprocating saw with a simple carriage with dogs. Cost is approximately US $10 000 - 20 000. Power consumption is between 10 - 25 kw. This machine particularly lends itself to the conversion of large diameter logs. It can, however, also be used for smaller logs if few cuts are made (squares, flitches).

2. Vertical Frame Saw. This is the traditional saw for Austrian conditions and is the one upon which the Austrian sawmilling industry was built. It is easy to maintain and suitable for logs up to 1.0 m diameter. It is slightly higher in cost and has approximately the same power consumption as 1.

3. Scandinavian Rack Bench Circular Saw. This saw is very suitable for converting plantation-grown trees up to a diameter at breast height of approximately 35 cm.

4. A new type of saw suitable for small-scale operations is being developed at present. If tests prove successful this could supercede other types.

   All these saw types could be manufactured locally.

These types of mill require some sources of energy. While electric energy from the grid is available in most cities, it is not normally supplied to rural communities and fossil-based fuels, such as diesel oil, are often beyond the means of villagers. The solution would be the use of a forest product — wood waste. Two possibilities, among others, present themselves:

a) a wood-based power plant, such as a boiler and 'steam motor' supplying the sawmill and the village with electric energy. This would be a substantial investment;

b) an old-fashioned 'locomobile' which is still manufactured in some countries, notably in Brazil, and which is relatively cheap but very uneconomic in its fuel consumption.

Appendix 6

ANNOTATED REFERENCES

These selected references are divided into six groups with a reference letter for each as below —

G - GENERAL

I - INSTITUTIONAL AND ORGANIZATIONAL ASPECTS

S - SYSTEMS AND TECHNIQUES

E - EXPERIENCES AND CASE STUDIES

O - OUTPUT OF FOREST LANDS

P - PROJECT AREA SURVEY AND PROJECT FORMULATION

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GENERAL (G)

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