



Can farming and forestry coexist in the tropics?

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During recent years environmental agencies, particularly in the United States, have done a valuable job in drawing public attention to the :rate of tropical forest destruction and :mobilizing awareness of the need for mole effective forest protection policies. During this century the area of tropical forest of the world has declined by more than a half. FAO's latest estimates expect a further 10 to 15 percent decline by the end of the century, and it is possible that, unless something is done to reverse the present trend, by the middle of the next century, the bulk of the tropical forest ecosystem as we know it could disappear. Botanists, ecologists and environmentalists have pointed out the irreversible loss to mankind which would. result, citing, in particular, the loss of genetic material and the potential contribution to human welfare of drugs and medicines available from tropical woody plants. Many international conferences have been held to help create better political awareness of these issues.

However, a deliberate shift in the emphasis of conservation and development strategy is needed. If we are to ensure preservation of a significant part of the world's remaining tropical forest ecosystem, we should focus more on how to improve the incomes and quality of life of the 200 million subsistence farmers living in a state of shifting cultivation in tropical forest areas. Only the briefest glance at the history of agricultural settlement in Europe, North America and elsewhere is needed to suggest that any policy aimed at halting the present process of forest destruction while completely excluding people from the tropical forest areas is unlikely to succeed. Attacking the root cause of forest destruction-rural poverty in forest areas - and providing small farmers with a viable alternative to shifting cultivation are the key issue. An essential first step would be the recognition that a large part of the "forest destruction" taking place in tropical developing countries, which has generated such an emotional response from agencies in predominantly temperate-zone developed countries, is, in fact, a logical shift in land use to more productive agriculture.

Five World Bank projects are examined, from the point of view of how they answer human needs for the kind of sustainable forestry and farming that are harmonious with tropical forest ecosystems. How can forestry benefit people as weld as conserve increasingly endangered forests? These studies are taken from Malaysia Colombia, Kenya, Indonesia and, the Philippines.

What can be done in practical terms to make it possible for small farmers to abandon

forest cutting and shifting cultivation, to adopt sustainable farming systems and to become part of more stable rural communities? What are the most appropriate choices and techniques?

A few examples of project experiences, some successful and some less so, financed partly by the World Bank may help in the search for solutions for reducing the risk of continued ecological degradation.

In reviewing these project experiences, I have set up three criteria:

What impact have these projects made on rural incomes? In particular, have they been effective in stabilizing rural communities and in arresting shifting cultivation?

Was adequate provision made in project design for protection of part of the forest area or for establishment of compensatory forest plantations, and has this happened in practice?

Are the cropping patterns being developed likely to be sustainable in the light of what we know about the soil structure and capability in the forest areas being settled?

Two agricultural land-settlement projects, both of which involved forest clearing followed by, in the first case, agricultural tree cropping and in the second, livestock development, are examined below.

Malaysia: The Jengka triangle land settlement project

The Jengka Triangle in the state of Pahang covers about 120 000 ha, of which about half are considered suitable for agricultural development. The area was identified in the early sixties as favourable for large-scale tree-crop development and settlement. While earlier land settlement took place in smaller schemes scattered throughout Malaysia and close to existing infrastructure, the Jengka Triangle was to be the largest attempt at that date for the development of virgin tropical forest lands.

ROAD BUILDING IN COLOMBIA, plenty of problems

In 1965, a technical assistance grant was made by the World Bank to the Government of Malaysia to help finance a land-use study of the area and the preparation of a regional development plan. The "master plan" completed in 1967 called for comprehensive development of the Triangle, comprising settlement, in a first phase, of some 9 000 farm families cultivating about 40 000 ha of oil palm and rubber; systematic exploitation of forest resources prior to settlement; urban development, including the establishment of three new townships; and extensive infrastructure development.

A first Jengka Triangle Project, commencing in 1968, planted 12000 ha of oil palm and 1600 ha of rubber. A second project, commencing in 1970, developed a further 7 000 ha of oil palm and 6 000 ha of rubber. Physical works included clearing of forest land, construction of houses, offices and stores to accommodate settler families, and recruitment of management and support staff. A palm oil mill was constructed together with appropriate roads, water systems, and educational, health and other social services. About 300 ha were developed for crop diversification trials on a commercial scale. Each settlement comprised about 4 ha of planted oil palm or

rubber, and a house lot of 0.1 ha for growing food crops. A third loan, made in 1973, will complete the programme.

According to the three criteria defined earlier, the project can be judged successful. Rural incomes of the 9 000 families settled in the first phase have shown a four-fold increase. Settler turnover rates are low (two percent) and the village communities are expected to remain stable. By careful forward planning and the carrying out of appropriate land-use and soil-capability surveys prior to settlement, about 80 000 ha of forest, comprising 60 percent of the project area, were excluded from agricultural settlement. Cultivation was confined to the flatter areas and hill slopes, and river banks were retained under forest. The higher levels of rural income and stable communities in the project area have reduced the risk of shifting cultivation and further forest destruction. Also, it seems reasonably certain that the cropping patterns developed in Jengka, based on perennial tree crops, are sustainable, given appropriate fertilizer application. The economic rates of return have been higher than expected, and Malaysia's exports of palm oil have been a very significant source of foreign exchange earnings.

On the negative side, there were several problems. Settling families had difficulty in protecting their crops from wild pig and other animals because of the close inter-relationship of forests and settled lands; attempts to increase revenues from salvage logging in the area prior to settlement, by establishing a sawmill and plywood mill, have not been very successful. Finally, controversy arose over the relatively high cost of the project (US\$15 000 per settled family) and the extent to which this type of project is replicable. Lower cost criteria have now been introduced for future World Bank involvement in settlement projects.

To maintain at least part of the remaining tropical forest ecosystem intact, the Malaysian Government in 1976 created an Environmental Ministry and prepared a comprehensive environmental plan for the country, aiming at setting aside more than 1 million ha of forest as permanent biotic reserves and national parks. Of this, 0.5 million ha have already been reserved.

As a model for replication in other countries, the intensive land-use and soil-capability surveys carried out prior to the Malaysia Jengka project are particularly noteworthy. The perennial agricultural tree crops being grown provide an effective soil protection and catchment area cover, and the prospect of sustainable income for the farmers. Such perennial agricultural tree crops already cover about 25 million ha of the world's former tropical forest lands, market prospects for most of these crops are good and further expansion of something in the order of an additional 2 million ha can be expected between now and the turn of the century.

Colombia: Caqueta settlement project

In this project, land settlement was spontaneous, less formalized and less successful than in Jengka, and was based mainly on a livestock farming system.

Colonization of the tropical forest areas of Colombia started in Caqueta during the rubber boom, earlier in this century. In the late thirties large numbers of settlers began to move in as word spread that they could take possession of public land and that the area was very well suited for livestock. Government support started in 1959 with a directed settlement scheme organized by Caja Agraria, which failed because of poor selection of settlers and inadequate supervision of credit beneficiaries.

In 1969, the Government of Colombia requested World Bank assistance in development of a continuation of the settlement programme. A loan of US\$8 million was made in 1971 for a first-phase Caqueta Project, which was to be developed over three years and administered by a new settlement agency, INCORA. It was to benefit the 8 000 settler families living in the area. The first phase provided long-term livestock loans for 4 500 settlers, construction of 380 km of roads, 90 primary schools, six health centres and improvement of INCORA's administration. Settlement costs were estimated at US\$20 million.

In practice, the project suffered from a number of problems including considerable price increases in all fields, unexpectedly difficult physical conditions affecting, in particular, the road construction programme, and lack of participation by settlers in constructing schools under self-help programmes. Toward completion of disbursement, the project design was changed and, in 1975, a second loan was made taking into account difficulties encountered under Phase I. It was concluded when defining the second phase that, while it was premature to observe any improvement of beneficiaries' incomes, the possession of a basic livestock herd had enabled participants to maintain themselves on their current holdings (averaging 85 ha) instead of continued dependence on shifting cultivation. By importing 60 percent of the breeding cattle into Caqueta, the project had "markedly improved the development prospects of an area designed to play a major role in Government's efforts to develop livestock production".

Outstanding problems, such as the lack of technical assistance to farmers, inadequacy of road maintenance, and the provision of social services were to be rectified in the second project phase.

The Caqueta project has been controversial. Kirby, for example, has commented in *Pacific Viewpoint*:

"Not only are most farmers operating a farm unit smaller than that regarded as viable in a beef breeding/ fattening economy, but that the tendency toward a bimodal structure is accentuated by the inability of small farmers to buy cattle. Credit is available for the purchase of foundation stock, and, with an inflation rate of more than 20 percent, credit bears a negative rate of interest of 12 percent per annum after a three-year grace period. But new colonists are very wary about credit for cattle purchase, for, if animals die, or are rustled, the loan must still be repaid. Credits for land clearance or pasture are rarely sought since the value of the improved land will be directly dependent on grazing animals not necessarily available to offset its cost. In addition, the Caja de Crédito Agrario has an understandable tendency to lend money to established farmers, where supervision is easier and repayment guaranteed by the collateral security of an existing herd. In summary, the situation in Amazonia is one of very slow improvement in the lives of the new settlers. In 1971, only 55 percent of Medina's sample, in Caqueta and Putumayo, would have stayed on their farm if the possibility existed of their moving elsewhere. For the majority, life is one of shifting cultivation of subsistence crops, living on informal shopkeeper credit."¹

It would be premature to draw any firm conclusions about the project's possible long term impact on rural incomes. But this project does highlight the major issue concerning planned settlement in the Latin American tropical forest regions—that of the extremely poor quality of some of the forest soils and the difficulties of ensuring sustained livestock and crop production. Much publicity has been given to the degradation of former tropical forest lands in Brazil, caused, for example, by badly managed livestock schemes. By contrast, Sanchez has presented a body of

evidence from trials carried out by the Centro Internacional de Agricultura Tropical, Cali, Colombia (CIAT)², and other agencies that, given appropriate fertilizer treatment, stocking density and agronomic management, a considerable proportion of the acid latosols of the Amazon region is capable of sustained agricultural crop or livestock production. Several fairly large-scale pilot programmes are under way, the results of which could be highly significant for future development in the Amazon region.

The World Bank's new forestry lending policy stresses watersheds, energy reforestation and smallholder cash-crop tree farming.

Regarding the extent of adequate provision for protecting the forest resources in this settled area, the Caqueta Project experience was an acknowledged failure. At the outset of the project, a deliberate attempt was made to set aside an area of 20000 ha as a permanent forest reserve, but within a year, despite expenditure on forest guards' housing and protection services, the area was invaded by colonizing families.

To ensure an adequate supply of fuel, building poles and timber for incoming settlers and to maintain the protective role of the forests, the Caqueta Project area which was originally part of an officially declared "Amazon Forest Reserve" was made the target of special resolutions³ aimed at ensuring that colonization should take into account the need to preserve the forests. The law required recipients of more than 50 ha of public lands to keep 20 percent under forest and it allowed the Government to maintain 10 percent of the area as a protective zone. In practice, the farmers' obligation under this law proved impossible to enforce; the experience on fully developed farms showed that, on average, settlers would maintain not more than five percent of their land under forest for the protection of a spring, or for the supply of housing and fencing wood.

This experience suggests the need for greater flexibility in defining forest laws which decree that an arbitrary percentage of settlement areas should be retained as forest cover, a common feature of land-settlement projects. The Caqueta farmers' decision to protect only five percent of the forest land in order to ensure basic needs for fuelwood and other forest products would seem quite rational in the light of experience elsewhere, which suggests that an average rural family might need something between 250 and 500 trees (less than 0.5 ha) to maintain basic domestic needs. The relevant point is that the main beneficiaries of the various government resolutions aimed at protecting a larger area than this would be farmers situated downstream from the Caqueta Project area, who would benefit from protection of the river headwaters, reduced flooding and sedimentation. These "external" benefits have little relevance to farmers within the Caqueta Project area, and it is hardly surprising that they should regard the 20 percent restriction primarily as an obstacle standing between them and the possibility of increasing family income by developing additional food cropping areas or acquiring more livestock.

The broader issue raised here is whether, in fact, retention of, say, 20 percent forest cover is the only way to ensure effective catchment area protection. While there is plenty of scientific evidence to show that undisturbed natural forests provide an optimum cover for ensuring adequate soil protection and regulating downstream flow, there is also evidence from many parts of the world, including tropical areas, that other forestry, agriculture and livestock farming systems can also provide adequate catchment protection (see Kenya project below) provided care is taken over soil conservation measures, and livestock numbers are maintained in balance with the carrying capacity of the land. Seen in this light, an alternative approach to designing the Caqueta Project might have placed greater emphasis on soil conservation

measures and on the backup extension services needed to ensure adequate husbandry practices. For protecting forests on very steep slopes and along river banks in the project area, greater flexibility in selecting areas for protection and closer consultation with incoming settlers on this aspect might have produced different results. Recently, the project's forestry component has been revised along these lines and progress is being monitored to assess the impact of these changes in project design.

A second major issue which arose during the formulation of the Caqueta Project, and which has considerable relevance to settlement schemes in other parts of the tropics, was the question of how to increase returns from logging operations prior to settlement. Before 1975, land-clearing operations in Colombia had resulted in the felling and burning of 500 000 ha of forest. At the time of project preparation, clearing was proceeding at the rate of 30000 ha a year. Every year, it was estimated that 2 million cubic metres of mature timber were being cleared, only one percent of which was sawn and sold, and the rest burned. Of total standing biomass volume of something between 250 and 300 cubic metres per ha, only 25 trees averaging 40 cm diameter or more were suitable for processing into lumber or plywood-and of that, only 17 cubic metres were of species which were marketable. Although a further 30 cubic metres (40 percent) were suitable for charcoal burning and fuelwood production, they could not be used for this purpose because both local and nearest potential export markets were saturated. After intensive study of this issue, it was concluded:

"It is considered quite impractical, if not impossible, to rationalize felling at the present stage of development of the Caqueta Project. Whatever benefits could be obtained from a rationalized forest exploitation should be weighed against the delays it would cause in developing the area through spontaneous colonization. The studies carried out show that, under these conditions, rationalized forest exploitation would not be economic".

[INDONESIAN WOMEN AT TRANSMIGRATION PROJECT five hectares of land par family](#)

Kenya: The taungya system

Kenya's plantation forestry programme has a number of features of general interest including the role which plantations could play in reducing pressure on the natural forest ecosystem; the provision for the setting aside of specified nature reserves; the fact that some of the past shift in land use from forestry to agriculture was based on systematic long term catchment area studies of the likely impact of different cropping patterns on stream flow and downstream agriculture.

Kenya's forests cover about 2.5 million ha (about four percent) of the country's total area (16 percent of the land area receiving more than 850 mm of rainfall). Over the past 50 years, the indigenous forest has been continuously exploited for the production of sawntimber and other forest products. Because natural regeneration of indigenous forest species takes between 60 and 100 years to produce timber of usable size, the Government, over the last 30 years, has been replacing some of these forests with faster growing exotic softwood plantations. To date, a total of about 160000 ha of industrial plantations have been established, representing seven percent of the total forest area.

In 1969, the World Bank made a loan of US\$2.6 million to finance part of the costs of

a six-year time-slice of this plantation development programme. The aim was to establish 28 000 ha of plantations during this period and it was successful in meeting the target. In 1976, a second loan of US\$10 million financed the continuation and expansion to cover the whole of the industrial plantation programme of the Forestry Department. This project is due for completion in 1980 and a third phase will, simultaneously, concern rural afforestation and industrial capacity needs for processing the expanding raw material base.

Most of Kenya's afforestation programme has been carried out using the "taungya" system. In Kenya, forestry workers grow mainly maize, beans or potatoes for a period of four or five years, after which the plantation is grown on as a monoculture forestry crop until ready for harvesting. Pines and Mexican cypress were the main species used.

With respect to the three main criteria used in this paper the project can be regarded as successful. The forestry plantation programme provides sustained employment for some 5 000 persons. Kenya's forest villages, more than 100 of which have been established over the last 30 years, sustain stable forest communities dependent on a combination of agriculture and forestry work for their livelihood. Many of the forestry workers are second-generation forest villagers. As the forestry programme has proceeded, secondary employment opportunities have been generated in logging, sawmilling, pulp and paper and furniture factories.

The: new forestry plantations have a wood productivity some 15 times greater than that of the indigenous forest which they are replacing. The deep volcanic soils on which the plantations are being established are capable of sustained cropping, although recent research work suggests some fertilizer application may prove necessary between rotations.

Two points of general interest arise from this project experience. The first is the role which such compensatory plantations can play in relieving the pressure on indigenous catchment protection forests. It is from the 2.4 million ha of indigenous forest that most of Kenya's important rivers and streams originate. Prior to the fifties, more than 90 percent of timber production came from these indigenous forests. Timber-concession licences had been allocated under long-term contract arrangements covering most of the accessible forest area. Today, in 1980, the compensatory plantations which have been established in Kenya -and cover less than 10 percent of the former indigenous forest area -- are supplying more than 80 percent of Kenya's industrial wood demands for both domestic consumption and export. The net effect has been to reduce the intensity of exploitation in the remaining 2 million ha of indigenous forest, the primary function of which remains that of catchment protection.

The second point is that, as part and parcel of this overall forestry development programme, the Kenya Forestry Department, some 20 years ago, established 43 000 ha of nature (biotic) reserves. In the second forestry project financed in 1976, one condition of the loan was that these reserves would be extended by a further 7 000 ha, so that they would become fully representative of Kenya's biological and botanical ecosystems. This was done.

A third point of general interest relates to Kenya's enlightened land-use policies in the area of forestry. Because of intense population growth and the fact that much of the forest is situated on soils of high agricultural potential, the indigenous forest areas have always been under pressure for agricultural settlement. In the fifties, a series of

long-term comparative catchment area studies was carried out by EAFFRO⁴ to compare the impact on stream flow, soil erosion and downstream sedimentation of alternative land-use systems, including natural forest in an undisturbed state, plantation forestry, tea plantations, livestock and intensive food cropping. It was clearly established, given appropriate soil conservation measures, planting spacement and other husbandry techniques, that tea, for example, could provide an effective catchment cover without adversely affecting downstream flow and sedimentation. This long-term experiment was used as a basis for a deliberate decision by the Government of Kenya to excise some 10 000 ha of forest land in the southwest Mau Forest for subsequent tea production. Tea exports have now grown to be Kenya's second largest export earner after coffee, generating foreign exchange earnings which account for 25 percent of agricultural exports and 10 percent of total exports. Most of the tea industry which has enabled some 20 000 farmers to move from a subsistence to a cash-crop farming system is located on what used to be indigenous forest land.

Indonesia: Transmigration II

The Indonesia Transmigration Project, as the Colombian Caqueta Project, concerns the settling of small farmers on acid tropical forest latosols. In Indonesia, the emphasis is on arable crops, whereas in Colombia it is on livestock.

As part of a long-term transmigration programme, the Government of Indonesia requested World Bank assistance in 1973 for a project to help resettle incoming families from Java and Bali on four sites along the trans-Sumatra highway in the Province of Jambi and to upgrade the standards of living of existing families already settled at a site in the same area.

The Indonesia Transmigration scheme is one of the largest resettlement programmes in the world. Since 1905, successive governments have sponsored the migration of poor farmers from the overcrowded islands to relatively under-utilized neighbouring islands, particularly Sumatra. All told, government programmes have transferred nearly a million settlers, and an estimated 2 million Javanese residing in the Outer Islands are there as a direct result of government resettlement and associated population growth. Much of the earlier settlement provided workers for rubber estates in Sumatra.

In January 1974, FAO undertook a study to identify a possible transmigration project suitable for external assistance, and in 1976, based on the results of this study, the World Bank undertook a first-phase transmigration project intended to upgrade the living standards of 12 000 settled families and to establish a new community for 4 500 new settlers. New migrants were provided with five of land, of which 0.5 ha was already cleared and 1.0 ha already planted to immature rubber. A second phase project is now in progress, building on the experiences gained. A smaller farm size (3.5 ha) is being adopted.

Some observations about agricultural plantations and agri-silviculture

Because of uncertainties in some of the traditional smallholding cocoa-producing countries, cocoa cultivation is becoming geographically more widely distributed and is increasingly being grown on a plantation basis, either as a monoculture or under coconuts. In Malaysia, the traditional tree fruits may follow a similar course and black pepper is also seen as a target for the specialist-producer.

This trend cuts right across the emphasis in current international forestry literature on the potential for "agri-forestry", that is, simultaneous inter-cropping of trees and food crops. It is important, therefore, to clarify the difference between these monoculture farming and forestry systems and the integrated food and tree inter-cropping farming systems practiced, for example, by small farmers in Java, in the Kerala region of India, in Sri Lanka (the Kandy Garden System), and so on. The very small farmer of the humid tropics with less than two hectares of land, typically grows a variety of food and cash crops around and near his house. In Java, the farmer is highly skilled and cultivates rice, cassava, maize, beans, groundnuts and vegetables in association with bananas, plantains, citrus, cloves, cinnamon, pepper, coffee, cocoa and a variety of tree fruits, all under a thin stand of coconuts.

The homestead tree lot, so typical of the humid tropics, reaches its highest expression in Sri Lanka, where the "tree gardens" round Kandy present a complex association of cassava, bananas, ginger, plantains and others under a mixed stand of tree fruits, coffee, cocoa, pepper, cinnamon, cloves, areca palm and coconuts. In West Africa, this sector is represented and vegetables are grown in association with a mixed stand of coffee, cocoa, tree fruits, kola and oil palm.

These small-farmer systems contrast sharply with the simplicity of mono-cropped agriculture and forestry plantations and by comparison would be more difficult to modify and improve. Improvement of smallholdings such as those in Java and Nigeria may only be possible by the provision of better planting material over an extended period of time, but a catalytic effect might be achieved by better roads and marketing facilities. These would stimulate the larger and more progressive farmers into modifying their cropping systems to take advantage of the better circumstances, but for the very small subsistence farmer, the element of risk could still be too high to permit change; under these circumstances, some degree of land consolidation and cooperative farming might be essential before improved cropping systems could be introduced.

As a broad conclusion, it seems that the "agri-forestry" farming systems used by small farmers in Java and elsewhere in the humid tropics are well proven and provide a diversified combination of subsistence, food and cash crops which reduce the risks of starvation and, at the same time, offer some small surplus cash income. However, it seems possible that where small farmers have room to manoeuvre and expand the scope of their cash-cropping operations, the trend is likely to be toward monoculture rather than away from it. In other words, in the humid tropics agri-forestry combinations may not always prove to be the most productive small farms.

The distinction between monoculture and inter-cropping (agri-forestry) farming systems deserves attention because recently there has been a tendency for foresters to jump on the agri-forestry bandwagon and promote indiscriminately agri-forestry systems in all areas of forestry development as a means of increasing the productivity of tropical forest lands. A more selective approach seems to be warranted with emphasis on those small farming systems or phases of development in plantation forestry where inter-cropping of food and tree crops can be of definite technical and economic benefit.

An associated issue is this: if we take a closer look at the potential for introducing agri-forestry in the humid tropics outside the well-established taungya plantation model and study the cropping pattern being used in such places as Java, Kerala, and Sri Lanka, we find that most of the trees which are being grown are fruit trees or horticultural crops which traditionally have fallen outside the foresters' province. Clearly, if foresters are to play a more active role in this area, we need to broaden our knowledge of the range of tree crops which can be used in forestry and to work in closer association with tropical agronomists who are familiar with such crops. We will also have to accept that this is an area in which the forester may often have to play a supporting role to the agronomist and agricultural economist rather than the converse. Investment in traditional forest tree crops will frequently, but not always, be a relatively low proportion of the cropped area and of farm investment costs.

The most controversial issue has been the question of the sustainability of the cropping pattern, taking into consideration the highly acid nature of the forest latosols, deficient in nitrogen and phosphorus and possibly low in potassium. Earlier research showed that soil structure is favourable to plant root formation and that by adding regular fertilizer inputs some of the forest soils would become suitable for upland food crop production. To combat the high phosphate fixation, the initial phosphate application should be heavy. Nevertheless, no technical package involving a high degree of dependence on annual food crops has yet been proved over a long period of time.

The cropping pattern originally envisaged under the project allocated 3.5 ha of land per family, of which two ha were for food cropping and about 1.5 ha for tree crops (mainly rubber), the latter to be grown as a monoculture. Land clearing was to be carried out by a combination of mechanical and hand methods and 500 kg per ha of rock phosphate harrowed into the soil just prior to settlement. The main food crops to be grown were rice, maize and cassava and it was assumed that settlers would establish house gardens containing vegetables and tree crops such as coconuts, cloves, coffee and bananas and different fruit trees. Special provision was made in project design for ensuring that farmers would have adequate supplies of fertilizer, that there would be a framework for close coordination of the various government agencies involved in providing extension support, and that seed and planting materials would be readily available for the farmers as and when needed. A staffing ratio of one agricultural extension worker per 500 families was planned (higher than in similar projects elsewhere), as well as a strong emphasis on training.

Despite these provisions, a recent review of project progress has highlighted the fact that incoming settlers are having difficulty in producing enough food crops to ensure subsistence and in securing the necessary inputs, such as fertilizer and improved seeds.

The key policy issue is whether there is any practical alternative to forest settlement in Indonesia in the light of increasing population pressure on the limited areas of good soil. The "alang-alang" grassland⁵ areas and the "Cerrado" region in Brazil, for example, could in theory provide a short-term alternative to continued forest settlement and allow more time needed to develop sustainable farming systems for the tropical forest latosols. However, in practice, a sustainable farming system for the "alang-alang" grasslands has not been developed. The scope for more intensive research in this area is a matter of high priority.

The question has sometimes been raised by environmental and other agencies as to why the World Bank supports such settlement projects in situations where there are significant ecological risks? Part of the answer is that spontaneous settlement as a result of population pressure is a fact of life in many tropical situations, has been going on for many years and in some cases is beyond government control.

By actively working toward improvement of existing farming systems, upgrading of extension services, assurance of a ready supply of agriculture inputs, and supporting more intensive agricultural research, the chances of preventing ecological degradation should be enhanced. The alternative -allowing spontaneous settlement to proceed unchecked - would leave farmers with inadequate inputs, and without extension services, roads, social services and marketing and other facilities.

As was noted earlier when dealing with the Malaysia Jengka project, it seems important to keep in perspective the fact that part of the remaining tropical forest

ecosystems could be put to more productive and sustainable land use, for example, by converting it to perennial agricultural tree crops and thereby providing thousands of small farmers with a viable alternative to shifting cultivation.

Philippines: A smallholder tree-farming project

The unique feature of this smallholder tree-farming project is that, with the exception of a project in Gujarat State, India, it is the only one -financed by the World Bank, to date, where small farmers are growing forest trees as a cash crop. This is a second-phase project and it has two main components: smallholder tree-farming through a supervised credit scheme operated by the Development Bank of the Philippines; and pine plantation development by the Bureau of Forest Development.

The smallholder tree-farming component is encouraging farmers on marginal agricultural lands throughout the country to take up tree farming (associated with food crop production) for establishment of firewood, charcoal, pulpwood and leaf-meal plantations. The project is innovative and experimental and is based on the Bank's experience of an earlier US\$2 million pilot project which provided funds for the development of pulpwood resources around the PICOP Pulp Mill. The first-phase pilot project was successful and has led to a quantified and readily perceivable improvement in the participating farmers' income and way of life.

Under the second-phase project, out of 28 000 ha of tree-farm development to be financed, 10 000 ha will be located in Mindanao, 5 000 in Visayas and 8 000 ha in the Ilocos region of northern Luzon. Tree-farm size ranges from two to 15 ha. Fuelwood and charcoal plantations, which account for a high proportion of project farms, average about five ha.

In relation to the likely impact of the project on rural incomes, experience under the Philippines I Project is well documented and it would seem reasonable to anticipate sustainable net revenues of something between US\$78 and US\$100 per ha from tree farms of *Albizia* producing pulpwood, something in the order of US\$ 140 per ha for tree farms producing fuelwood and charcoal, and US\$300 per ha for farms producing leaf meal (based on Giant *Ipil-Ipil*).

The financial rates of return to farmers are high and the project's economic rate of return is something in the order of 23 percent. The second project is experiencing difficulties related to land-tenure constraints, and the need for greater flexibility in this area is under review.

As for ensuring that forests are protected, the most interesting feature of the Philippines smallholder tree-farming experience is that it is mobilizing shifting cultivators in the reestablishment of forest cover in formerly degraded catchment areas. The profit incentive of tree farming is helping to encourage reforestation of eroded catchments.

Despite the obvious attraction of this formula, there are limitations to its wider application. One of the main problem areas in planning for expansion of the first-phase project proved to be the economic radius for haulage for pulpwood. Smallholder tree farmers situated outside a 100-km radius from the mill were excluded because of the transportation cost factor. Projects of this type are particularly suitable for establishment of plantations around a central processing plant (whether for the production of pulp, charcoal, power generation, alcohol, lumber or leaf meal) where there is a guaranteed market price for wood. But all of these different

industries have upper limits of delivered wood cost beyond which it is not possible, profitably, to process the raw material. In other words, they are primarily suitable for concentrated resource development within the command area of a processing plant. For this reason, this approach could not be adopted as a "blanket" solution for all proposed forest areas in which shifting cultivation is a serious problem.

The scope for extension of the Philippines experience to other countries is, nevertheless, considerable and the World Bank is reviewing prospects for helping some of its other member countries to undertake similar schemes.

One of the most effective ways to slow down the rate of tropical forest destruction is to attack the root cause of the problem—rural poverty. If we continue to depend only on exhortations to logging companies, multinational corporations and developing-country governments to "stop tropical deforestation", it is my own personal view that we will be no more successful in arresting the pace of forestry destruction than was King Canute in trying to stop the advancing waves by using equally futile tactics. A deliberate shift in conservation strategy is needed to focus more on positive approaches to rural development and alleviation of rural poverty, if we are to preserve effectively what is left of the tropical forest ecosystems.

To save the tropical forests from further depletion the focus should be more on how to improve the incomes and quality of life of the 200 million who practice shifting cultivation throughout these forests.

I have attempted to show that a considerable part of the so-called "forest destruction" taking place in the developing world is, in fact, a logical shift in land use to more productive crop or farming systems. Provided that these are adequately supported with technical extension, agricultural inputs and other resources, land-settlement projects can provide a sustainable land-use alternative to retention of the land under virgin forest cover. There seems to be convincing evidence that many of the agriculture and rural development projects already initiated in tropical forest areas have resulted in a quantifiable increase in rural incomes; have enabled the small farmers involved to settle in more stable communities; and have eliminated their former dependence on shifting cultivation. In other words, settlement of small farmers and forest protection need not be mutually exclusive objectives.

In some of the projects undertaken in the past in which land-use and soil capability surveys were carefully carried out in advance of settlement, and agricultural development channelled into the flatter lands, it has proved possible to exclude a large part of the remaining forest from agricultural settlement and this has remained unexploited (Malaysia, Jengka). In other cases, inadequacy of forward planning, or too high a degree of dependence on non-enforceable forestry protection legislation, has failed to protect the forest. This means that project design must be flexible and take into account the needs and aspirations of incoming settlers or small farmers (Colombia, Caqueta).

Because of the wide variation of tropical forest soils, climatic and physical conditions, it is impossible to generalize about appropriate farming systems for tropical forest areas, but what seems to emerge from this analysis is that perennial agricultural tree crops such as oil palm, coffee, rubber, cocoa, tea and coconut can be an ecologically sound alternative to natural forest management and, secondly, that whatever agricultural crop or livestock or forest plantation crop combinations are envisaged, the capacity of governments to ensure adequate support services, inputs, such as fertilizer and seeds, agricultural research services, feeder roads, social infrastructure

and marketing outlets constitute a decisive factor in determining whether a particular farming system is sustainable. Even in the most intractable soils, such as those of the Amazon, evidence suggests that, given appropriate attention to soil conservation measures and crop husbandry techniques, it may prove possible to sustain arable, and even livestock farming, systems on at least the better endowed of these low-fertility soils where, in the past, all such attempts have failed.

Because market constraints for plantation grown agricultural and forest tree crops will probably limit their development to something less than 10 percent of the remaining tropical forest ecosystems between now and the turn of the century, high priority should be given to agricultural research and to pilot-scale development programmes aimed at improving the present state of knowledge of sustainable food cropping systems as an alternative to shifting agriculture and, in the interim, directing settlement to better soils.

In watershed areas, an integrated rural or "area" development approach which offers the small farmer an alternative to his ecologically destructive way of life can help to preserve the remaining forest and, thereby, reduce the risk of soil erosion and downstream flooding. Investment in such infrastructural "inputs" as a supply of seeds and fertilizers, torrent-control structures, soil-conservation measures, provision of credit, training of extension staff, feeder roads, marketing services, schools, shops, hospitals and other social services is the quickest and most certain way to ensure that farmers abandon shifting cultivation and adopt a more sustainable farming system. Some agricultural and live-stock farming systems with appropriate husbandry practices can also provide effective catchment protection. In other words, forestry is not the only solution.

It is clear that compensatory forest plantations have an important role to play in ensuring protection of part of the remaining tropical forest ecosystem because they can provide an alternative source of timber and take the pressure off further exploitation of indigenous resources. Reforestation programmes in the developing countries are currently proceeding at less than 20 percent of the rate needed to ensure domestic self-sufficiency by the year 2000 and a massive increase in the annual rate of establishment of fast-growing species is called for before smallholder tree-farming can play a significant role in situations where the forest lands or catchment areas to be protected are situated within an economic haulage distance of a processing plant or cash market.

Concerning the problem of the preservation of biotic reserves, the environmental agencies of the world has done a masterly job in alerting international awareness on this matter. It is becoming widely accepted that the arguments in favour of preservation of forest-dwelling hunter/gatherers, wildlife, botanical genetic resources and potential future drug and medicinal plants are irrefutable and the governments of some developing countries (e.g., Malaysia and Kenya) have expressed their willingness to increase efforts to protect such resources and have created environmental agencies. But the only certain way we have of ensuring that these designated biotic preserves will be protected in practice is by increasing support for rural and agricultural development programmes in adjacent areas.

Foresters might regard some of the projects described here as agriculture rather than forestry projects, and it is precisely at that point that problems can arise. Foresters in the past, have tended to be highly parochial about defining what constitutes a forestry project and to assume that their responsibility starts and ends with the cultivation of forest trees in forest reserves. In fact, forestry investments are likely to comprise a

relatively small proportion of many of the rural and agricultural development projects which will be needed to bring the current process of tropical deforestation under effective control. In the area of catchment and agri-forestry, in particular, foresters will have to be prepared to work more closely with agricultural settlement and other agencies, playing a complementary and supporting, rather than a predominant, role in the development process.

Concerning the World Bank's role in forestry projects, we are conscious of the fact that the Bank's efforts in this area can only be marginal and that the main impetus must come from within the developing countries themselves. Following publication of a Bank Forestry Sector Policy Paper in 1978, the Bank made a major shift in emphasis of forestry lending toward environmental and rural forestry, and set as a goal a five-fold increase in the level of forestry lending to achieve a target of US\$500 million within the five-year period 1979-83. The response of the developing countries' forestry services has been encouraging. Since 1978 we have made loans to forestry projects in about 35 different countries, and more than 60 percent of these have been for programmes aimed at environmental protection and provision of fuelwood, fodder, building poles and other forest products needed both for basic subsistence and development. The US\$500 million lending target has been achieved somewhat ahead of schedule.

In future forestry lending, we intend to give special emphasis to watershed protection, renewable energy-related reforestation programmes with fast-growing species, and to smallholder cash-crop tree farming in rural areas. Of the US\$3 thousand million a year which the Bank is currently lending for agriculture and rural development, part will continue to be directed toward agricultural settlement and watershed protection. Although primarily aimed at reducing rural poverty, such settlement projects should make a contribution to preserving part of what remains of the world's tropical forest ecosystem.

Footnotes

1. See "Land use in Amazonia." *Pacific Viewpoint* (19), 1978.
2. See *Pasture production in acid soils in the tropics*. CIAT, 1978.
3. See Nos. 015 of 1963, 141 of 1964 and 216 of 1965; and articles 14 and 15 of Special Decree 2278 of 1953.
4. East African Agriculture and Forestry Research Organization located in Nairobi, Kenya.
5. Forest lands formerly under shifting cultivation now abandoned and which have reverted to a coarse grassland.

