THE SOCIO-ECONOMIC EFFECTS OF FOREST MANAGEMENT ON LIVES OF PEOPLE LIVING IN THE AREA; THE CASE OF CENTRAL AMERICA AND SOME CARIBBEAN COUNTRIES

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INTRODUCTION

In Central America and the Caribbean* and for the purpose of this paper, the various types** of forest management can roughly be divided into four categories according to land use:

1. Protection is the main use with two broad subdivisions:

   1a) Total protection is aimed at, and achieved such as in national parks, certain critical catchment areas and analogous well protected areas. Preservation of valuable ecosystems and protection of water flow are the main objectives. Except for some national parks, very few other areas are presently well protected. There is an interesting case of a hydrological reserve, well protected in Costa Rica.

   1b) Partial protection, usually when the responsible authority is not in position to really control land use, even if the need (and the declared policy) calls for total protection. A large amount of land falls under this category.

   Managing forest land for protection is often considered a restriction to free land use by many local inhabitants although there are of course a multitude of benefi ial effects to people, involving those depending on the water, often at considerable distance. Due to awareness of soil erosion there is lately considerable interest in this type of management but also some confusion.

   When other land uses are considered compatible with the protection, they will be examined under multiple use or in some cases under agro-forestry.

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* Central America as here described includes Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panama. For the Caribbean only Dominican Republic, Haiti and Puerto Rico will be considered, although occasional mentions will be made concerning other countries in the region.

** "Types" is preferred to "systems", since the latter term is more committal.

2. Forest management where wood production is the main object

Two main divisions can be considered: production from natural forests (including primary forests, secondary forests, swamp forests and all shades of formerly exploited forests) and from plantations.

2a) Natural forests. A very large amount of products in Central America and the Caribbean comes from natural forests and the impact on people is of course considerable.

2b) Plantations. Only small areas are in forest plantation, possibly not even 15 000 hectares in Central America and the Caribbean. However agroforestry combinations which cover considerably larger areas are not discussed here but have a category per se (see below). The impact on the lives of people is relatively small but it is likely to increase considerably in years to come.

3. Agroforestry

Some confusion exists as to terminology and many definitions are found (see ICRAF, 1979, p.4). As used for years at CATIE, agroforestry involves land management techniques implying the combination of forest trees with crops, or with domestic animals, or both. The combination may be either simultaneous or sequential in time or in space. It aims to optimize production per unit of area while at the same time respecting the principle of sustained yield (Combe and Budowski, 1979).

Trees are usually planted, or at least tended, for their products or their "services" (the latter imply soil improvement or restoration, protection against wind, erosion, excessive sunlight, etc.). Included here are large areas where coffee, and cocoa are cultivated under shade trees (that also provide firewood and other products) and other combination of trees with annual or perennial crops, as well as combination of trees with pastures or cutgrass, trees for fodder, live fenceposts, windbreaks and other uses of trees for protective purposes.

Agroforestry has a very large impact on the lives of people in the region and will be examined in some detail because of its untapped resources for promising action plans, aiming at improvement of rural communities.

4. Multiple use

Included here are combined uses not considered previously where besides forest management for wood there may be protection of watersheds, recreation in natural forests or plantations, grazing in natural forests, or hunting and fishing in forest land and all possible combinations.

The impact is spotty. The most important case of multiple use probably is found in East Puerto Rico (Luquillo-El Yunque complex) where silvicultural research, recreation, water catchment protection and wildlife protection, are successfully achieved in a national forest. Hunting and fishing in forest lands can be important in some areas of Central America although it is clearly different from the stereotyped image transmitted from the U.S., Canada and European countries.

THE IMPACT OF VARIOUS TYPES OF MANAGEMENT ON THE PEOPLE LIVING IN THE FOREST OR ON ITS FRINGES: SOME CASE STUDIES

1. Management for protection

A series of studies have lately shown the considerable impact of soil losses affecting important watersheds (Paulet Iturri, 1978; Zerbe et al, 1980: Wadsworth, 1978.) Although precise data on soil losses are still scanty there are various estimates in different reports and generally speaking, the appraisal is that this is a most severe problem. Erosion resulting from deforestation is considered the principal problem of Haiti and Ewel (1977) analyzed the complexity of remedial action and the slim chances of achieving success. In the 1960's AID and USDA estimated that 80% of the available land of this country is affected (Zerbe et al,1980). In Panama deforestation has caused sedimentation in Lake Alajuela -the main water storage to the canal system- to depths of 25 feet in 1977 and in the year 2 000 about 40% of the storage capacity will be lost (Wadsworth, 1978). With protection of the watershed the problem could be partly solved but the Panamanian Government has been requested to solve the problem without relocating people (Zerbe et al, 1980). In Honduras one USDA report (Zerbe et al 1980) stresses that "in less than two generations at current rates of forest depletion, the forest cover will be virtually eliminated. The one

third of rural Honduras who live on the edge of the forest will have no effective means for sustaining themselves through the life support system they presently have. In less than three generations, flooding in the valleys and alluvial plains, already serious, will be beyond the capacity of Honduras to manage with its own financial resources, and environment damage will be irreversible".

Let us look at a few bright sides. One interesting case is a "hydrological reserve" covering several thousand hectares in Costa Rica, under the aegis of the Costa Rican Institute of Electricity. In this mountainous area, more than 6 000 mm of rainfall a year are reported. The presence of a network of national parks can be a bonanza for biological researchers since these protected areas constitute field laboratories for natural processes. This has been particularly the case of Costa Rica where educational turism has become an important economic factor.

The establishment and management of national parks has often resulted in effective protection by changing actual or potential destructive use to protective functions. Water protection has been one fundamental reason to help create a series of parks in Costa Rica, and Panama, notably the Volcan Poás National park (4 000 ha), in Costa Rica and the Chirripo National Park covering 43 700 hectares. More ambitious is the projected binational friendship park on adjacent territories in Panama and Costa Rica covering over 200 000 hectares and including on the Panama side the projected Volcán Baru National Park, with another 30 000 hectares. Thousands of farmers who depend on the waters from these mountainous areas will be favoured.

Concerning the attitudes of people living close or in these areas, the reaction has been "mixed". It is very difficult in some rural circles to understand that clearing for pasture or annual crops (usually a sequence beginning with timber exploitation, one or two years of annual cropping and ending in pasture establishment), cannot go on ad libitum. A series of contradicting moves by Governments in the region can often be witnessed, responding to various types of pressures. Usually the official position is to condemn deforestation on steep slopes and/or on poor soils or with poor climatic condition (e.g. excessive rainfall). In practice however, such policy is not sufficiently enforced and there is usually one branch of the Goyernment, usually linked with "Colonization" or "Agrarian Reform", that is taking steps to turn in "new" property titles to prospective farmers, often on lands that are inadequate for sustained cropping

or grazing. Illegal grazing is another scourge that is a permanent source of conflict.

Only recently have some efforts be undertaken to involve local people as workers in the national parks or training some of the younger elements of the population for other chores such as guides for visitors or providing fellowships for the children of inhabitants living close to the parks. Examples are reported from Honduras and Costa Rica. A recent workshop of park planners from various countries held in 1980 in the Cahuita National Park, Costa Rica (1 100 ha in swamp forest, coconut beaches and 600 ha of coral reefs), stressed the need to consider park development as part of regional development. The group recommended that local people activilely participate in the tourist bonanza and suggested a greater involvement of parks people in solving biological, social and economic problems of the people living in the area.

The main problem however remains that most people who have been traditionally farmers (including cattle ranchers practicing extensive grazing), look at national parks, or protected watersheds as a limitation to their "traditional rights". The latter may be easiest described as their right to "use and abuse" lands that have always been plentyful in the past. Squatters are still found in many national parks and it is extremely costly and sometimes outright dangerous to try to displace them.

The next few years will undoubtedly witness increased conflicts between Governmental authorities and local people when it comes to forest management for protection. It is of course a classical dilemma: how to weigh national interests in the light of traditional individual customs or perceived rights. In some areas like El Salvador, Haiti or Dominican Republic, overpopulation and carrying capacity of the land have been so overstreched that is difficult if not impossible to find workable alternatives. Each large storm (or hurricane) is likely to produce a new tragedy with loss of lives and property because lands have being abused in the past and the accumulative effect resulting in floods and erosion is likely to cause renewed and more severe calamities.

It is clear that no simple solution will work and the subject lends itself to endless discussions among ecologically or economically oriented planners as well as social scientists. Possibly some changes of land use, involving various possibilities should be considered, all of them aimed at relieving the pressure on land that should not be cultivated, grazed, or indiscriminately exploited.

Suggested solution involve the following alternatives, many of them already applied to varying degrees: 1) intensification of land use for food production in promising areas and concentration of farmers through stable land use systems in these areas, 2) reforestation schemes coupled with an initial agricultural stage (for instance "taungya") providing new jobs and a gradual change of land use from destructive cropping or grazing to permanent forestry; and 3) different schemes such as building of terraces and other measures to control erosion. Some of these are not within the scope of the present paper, others like agro-forestry will be discussed below.

2. Forest management where wood harvesting is the main use

2.1 Natural forests

In Central America there are still considerable areas under natural forests in countries like Panama, Costa Rica, Nicaragua and Honduras covering between 30-50% of the land area. However the forest cover is quickly dwindling and this process has been described on a world and regional scale (U.S. Department of State and USAID, 1978; Zerbe et al 1980; Myers, 1980, UNESCO/UNEP/FAO/1978). For El Salvador and most of the Caribbean islands the amount of natural forests is very small and even what is left is often diminishing. Wherever natural forests are found, they are extremely important to local inhabitants who largerly depend on them for food, poles, firewood, medicines, fibers, and other products including food. Where shifting cultivation is practiced, the forest phase, provided it is sufficiently long, produces the regenerative effect that is needed to restore fertility or to break the destructive acumulation of weeds and insects that make permanent cropping impossible for low-capital, low-technology farmers.

In Central America most of the timber (and in the case of Honduras, pulpwood from natural pine stands) comes from these forests. Naturally this provides employment for local people but it often is not permanent because of the widespread practice of high-grading or "mining" valuable species, leaving the remnant forest depleted, or more commonly, ready to be transformed into grazing lands. The latter stage itself may not be permanent either, especially in areas of high rainfall where fire cannot be used to avoid encroachment of woody vegetation in grasslands.

The result is that grasslands that have replaced rainforests are often been abandoned after only 5-20 years depending on the degree of soil degradation, both chemical (nutrients) and physical (compactation) and/or the increasing invasion of weeds that cannot be controlled by hand clearing because of rising costs. In fact a large amount of secondary forests already exists in areas that went through the phase of primary forest clearing - cultivation for 1 to 3 years - pasture establishment - abandonment and growth of secondary brush - secondary forest (sometimes with valuable species) - clearing again, etc. (Myers, 1980; Unesco/UNEP/FAO, 1978).

The impact of these depleting processes is still little known. In some overpopulated countries like Haiti, El Salvador, Dominican Republic, some lesser Antilles, Jamaica, the highlands of Guatemala and west Nicaragua, it undoubtedly represent an enormous hardship for local inhabitants, usually the poorest sections of the rural population. Particularly painful are the diminishing supplies of firewood, the various sources of food and construction wood from the forest as well as medicinal products. It is likely that many of the internal migration processes can be explained by the disappearance of the forests. This is a subject that has been little studied yet.

An important aspect is the amount of hunting done in the forest by local inhabitants. In a recent speech at Yale University in April 1980, the present director of forestry of FAO, Dr. Marco Flores, made the point that in his country, Honduras, over 80% of meat consumed by rural inhabitants comes from hunting (mostly rodents, reptiles, and birds) on forest land. Other countries face similar situations and there is very little which is being done to ascertain the importance of hunting for food, let alone manage for sustained yield.

A fundamental point that raises the question of permanent employment of people living withing or close to the natural forest is that presently in Central America or the Caribbean, there is not one single example of a large area of natural primary forest that has been management over an extended period of time as part of what may be called a well conceived management plan (or working circle). True enough the same forest has been exploited several times over the years but not for the same species and the end result has always been degradation. Perhaps this is a factor that must be given serious consideration when appraising socio-

economic impacts. Unfortunately many decision makers and foresters continue to insist that natural forests must be "rationally" managed, but they cannot show a single practical success case. Apparently the more heterogeneous, the wetter, and the closer the forest to primary conditions, the more difficult it is to manage tropical rainforests on a sustained yield for timber production. This implies that better prospects are found in associations where one or a few species dominate (certain swamp forests, tropical pine stands, etc.), and of course, certain secondary forests. The latter present some excellent prospects for management in the wetter areas as has been shown in Costa Rica (CATIE, 1979).

One bright case can be found in the large María Tecum forest in Central Guatemala (over 2 000 hectares) close to the relatively large and old city of Totonicapán (population over 50 000 people). In spite of the large demand for this highland forest (mostly various species of pines and one fir), the forest was able to resist over the last centuries the pressure for firewood, poles, timber and in some less forested areas, the demand for sheep grazing. This is essentially due to the fact that the land belongs to the municipality of Totonicapán, governed by a council of elders with decisions that are very much obeyed by the predominatly Indian (maya descendant) community. Cutting permits are given and cumplied, although they do not fulfill technical criteria from a forester's viewpoint. Obviously here is a case that deserves better understanding because it implies what appears like a good balance between local decision making structures and compliance, concerning a valuable forest resources and involving a large amount of people.

2.2 Plantations

Reforestation schemes have a considerable potential for benefitting rural people. Presently they play a much smaller role than natural forests in the lives of the people but the ever increasing scarcity of forest products is bound to change this. Moreover many reforestation schemes are also justified and funded because the need to provide a protective cover for watersheds, particularly in wetter areas (at least this is the "official" justification; it can of course be argued that protection against cattle, poachers and fire can often bring about a perfectly good - and cheap - vegetation cover to prevent erosion).

Presently there are large and apparently well financed plans to reforest

large areas of degraded lands in many countries of the region. Because of the scarcity of research and well trained foresters, many failures are likely to occur, concerning the choice of species, the selection of sites and above all, adequate follow-up provisions to manage these plantations. However considerable improvements will take place in the next years and many possibilities of employment will result, hopefully not only connected with the preparation of sites and the planting the trees, but also with the harvesting of the grown wood. Although there seems to be considerable interest to finance such reforestation schemes by lending agencies such as international banks and bilateral assistance programmes, (Organization of American States, 1977), the impact on local populations is not well known because of lack of practical past experiences. At present, CATIE is carrying out a four million dollars research project funded by US/AID to ascertain the suitability of promising trees for firewood production for the six Central American countries. Initiated in 1980, the project covers six years and includes a sociologist. Many other schemes are being negotiated for Dominican Republic, Haiti, Honduras, Costa Rica and Panama.

It is interesting to notice that most of the reforestation is done on poor, often very degraded sites. Lately however many trees have been planted or at least tended, in areas with good soils perhaps because of rising prices of timber and posts and economic incentives by governments. This has brought about a considerable upsurge of various agroforestry practices which will be considered below in more detail because of its promising possibilities and large impact on rural inhabitants.

3. Agro-forestry

3.1 General consideration

As referred earlier agro-forestry implies combining trees with crops or domestic animals, either simultaneously or in sequence. It is one of the curiosities of tropical forestry (and for that matter also in the agricultural sciences) that agro-forestry has been rather blatantly ignored even if it existed all the time and played a most important role in the lives of rural inhabitants. With the exception of "taungya" which is now well over a 100 years old, very little is known concerning most agro-forestry systems, even if some of them appear to be

extremely productive and rather sophisticated - and of course stable - possibly as a result of evolution over decades or centuries. At present much of the research in various countries amounts to the "discovery" and description of existing systems. It is interesting to speculate why this is so and many arguments have been advanced: the avoidance by scientists of agroforestry systems because of their complexity and the great difficulty in setting up an experimental design, the present training of scientists in certain specialties or fields rather than in complex land use systems (how much do tropical foresters know about food plants and how do agronomists fare vice-versa?), the past reliance on cheap direct or indirect energy sources in agriculture, able to replace beneficial effects of trees on crops (fertilizing, weeding, plowing, pest control, etc.) and perhaps more than anything else, the indiscriminate transference to the tropics of capital and technology-intensive methods originated in temperate regions. Finally the socio-cultural dimension of agro-forestry, so important in many countries, still adds another dimension that complicates a better understanding of the problems, at least from the researcher's viewpoint.

Moreover there are a few mental blocks that must be overcome concerning agroforestry. Among them there is the belief that agroforestry is mostly practiced by the rural poor or that it is restricted to "marginal" lands, (see for instance table 1 below). This matter has been particularly stressed in a most stimulating publication that in a way lead to the foundation of ICRAF, the International Council for Research in Agro-forestry (Bene et al, 1979) which pointed out that "... more than half of all land in the tropics, although too dry, too steep, too rocky to be classified as arable land, is suitable to the practice of agro-forestry", and this statement in fact, was placed in an emphasis box (p.43).

Actually the more agroforestry is being studied, the more it becomes clear that it has achieved productive and stable systems on all kinds of lands, on good and poor soils, with varying relief, climatic conditions and under different socio-economic conditions. Students that have taken agro-forestry courses at CATIE report that they are now "discovering" agroforestry systems in areas they had previously visited repeatedly without noticing them.

A full discussion on agroforestry practices in Central America and elsewhere in Latin America can be found elsewhere (Budowski 1977, 1979 and 1980; CATIE, 1979; Combe and Budowski, 1979). The present discussion will only attempt to

emphasize some examples with a few speculations on social implications. A good introduction to the subject would be a comparison between agro-forestry systems and monocultures resulting from lengthy discussions and exchange of experiences between researchers in Mexico and CATIE. The following table should be considered as tentative and many of the statements found are clearly subjective. They represent mainly opinions or viewpoints by different people, not necessarily based on proven measuremeats and valid comparisons, aimed above all to stimulate discussions. It should be noticed that the second part of the table emphasizes socio-economic implications.

Table 1. Comparison of advantages and disadvantages of some agro-forestry systems (presence of trees within croplands or pastures) as compared with monocultures of these same crops or pastures.

ADVANTAGES	DISADVANTAGES
Biological and physical aspects	
A better utilization of the vertical space and cropping period is achieved and natural ecological models are simulated as to form and structure; solar energy is more efficiently captured.	Trees compete for light needed for crops or grass.
A larger biomass returs to the system (organic matter) and often is of better quality.	Trees may compete for nutrients.
There is more efficient recycling of nutrients including their "pumping" from the deeper soil layers.	Trees may compete for water (especially where there is a strong dry season).
Appropriate for marginal areas since there is likely to be a larger resistance to rainfall variability; it can also be practiced on steeper slopes.	There may be allelopathic influences.
The damaging action of rainfall and wind is reduced.	The harvesting of trees may cause damage to crops.
	There is no "rest period" (with a secondary forest stage) like in shifting cultivation.
	Mechanization is impossible or made more difficult.

Fertilizers applied go "a longer stretch" since tree roots can "capture" nutrients that move beyond the area of crop or grass roots and recycle them.

Leguminous trees (and some from other families) fix and incorporate nitrogen

There is more mulch and lesser weed growth.

The soil structure is improved (more stable aggregates) and a hard pan is prevented.

Diversity of species hampers insect proliferation.

There may be beneficial influences due to mutualism.

The greater air moisture can favour deseases (mostly fungi).

Rain drops forming in the crown of trees can cause damage.

A proliferation of noxious animals can be favoured.

There could be excessive "export" of nutrients if trees are consistently harvested.

ECONOMIC AND SOCIAL ASPECTS

The farmer (particularly poorer ones) satisfies partly at least, his needs for firewood, poles, posts, timber, food, flower for honey, medicinal products, etc., and does not need to buy these.

Trees constitute a "standing capital", an assurance against emergencies, when quick cash is needed.

Dependency on one single crop is avoided and traumas associated with irregular rainfall, market fluctuations, dependency on imported products (pesticides, fertilizers), outbreak of pests, are mitigated.

There is less need to "import" energy and/or to pay for products outside the area.

Investments to establish tree crops are reduced (such as in "taungya").

Diversity and the interdisciplinary nature can be considered an asset for quality of life.

Social cohesion and team work can be promoted.

Trees serve to mark property boundaries and constitute a safeguard device against land usurpation.

Some schemes allow to gradually change from destructive land use practices towards more stable systems, without diminishing productivity.

The system is more complex and little understood. Any experimental design with statistical analysis is likely to be more complicated.

In some cases yields of crops or grasses are smaller with less economic returns.

In many ongoing economic structures, it is considered that the system is not "efficient", because of the inherent complexity of operations needed to make it function effectively.

Normally more labour is required.

It is argued that some agro-forestry practices do not stimulate farmers in moving out of their present socio-economic status (poverty or subsistence level).

Economic recuperation may take a longer time for people with low incomes (because of the time lag in cropping trees).

There may be opposition from some political and socio-economic structures towards agro-forestry systems because of ignorance or false premises.

There is more flexibility to distribute labour during the year.

Wildlife is favoured and in some instances can be a suitable source of protein.

There is obviously considerable scope to design "new" systems by associating the most desirable species.

There is scarcity of trained personnel to improve and handle agro-forestry systems and install new ones.

There is lack of knowledge on the potentialities of agro-forestry systems among decision makers and this results in scarcity and lack of funds for research and extension programmes.

3.2 A few successful case studies of agroforestry

3.2.1 Alder in the highlands of Costa Rica

For at least 80 years, a local alder species (Alnus acuminata) has been successfully planted at elevations between 1 300 and 2 500 meters with high rainfall (2 000 - 3 000 mm) and good soils in the dairy region in Costa Rica. The presence of alder trees is said by many to increase fodder production. This is an area where milk production is high and many farmers are rather affluent. The trees are planted at wide spacing within pastures that are grazed (Pennisetum clandestinum) or cutgrass (Pennisetum purpureum and Axonopus scoparius). Most alder trees found in pastures are regularly pruned. The spacing of the alders can be any combination between 8 x 8 m to 15 x 15 m. Alder fixes Nitrogen through large nodules (Frankia sp. of the Actinomycetes). Some initial measurements indicate a mean annual diameter increment of 2-3 cm with harvesting after 15-20 years (CATIE, 1979). The easily worked wood is used for multiple purposes where durability is not a requisite. The social implications have been partly studied by Poschen (1980) through questionnaries distributed to dairy farmers and reveals a series of beliefs and assumptions among farmers that deserve more careful research. The practice of planting alder in pastures is presently increasing..

3.2.2 Coffee or cocoa with one or two strata of "useful" shade trees.

Although the trees above coffee or cocoa are usually referred as "shade trees", their function and usefulness is clearly much greater than strictly for shade. Many of these advantages are outlined in table 1. The system over coffee and cocoa are envolving over the past years and it is now frequent in

various regions particularly in coffee, to have a leguminous tree as an intermediate canopy (Erythrina spp. or Inga spp) overtopped by a tall and valuable timber tree with a narrow crown (Cordia alliodora). The leguminous nitrogen fixing trees are severely pruned back in the case of coffee, usually twice a year. Several plots of Cordia alliodora 15 to 17 years old, showed a mean annual diameter increment of 1.8 cm, a average height of 22-23 meters and a mean annual volume increment of 10-11 m^3/ha/year (Combe and Gewald, 1979). The practice is increasing and several measurements show that coffee yields are high and compare favourably with neighbouring plots without Cordia alliodora.

3.2.3 Live fence posts that produce wood, food, feed and more fence posts.

Throughout tropical America the practice of raising trees from large cuttings that root easily, to establish fences to keep cattle out, is extremely widespread. Fences can be grown by planting cuttings closely together, often mixed with low brushes or, more commonly, they serve to attach barbed wires. The practice has received very little literature coverage and is currently investigated as to their biological, social and economic effects. The following summarized analysis again should only be considered as preliminary since it covers over 50 tree species in six Central American countries over a great diversity of conditions.

Table 2. Comparison between liye fence posts and wooden fence posts (the latter either naturally durable or treated with preservatives). Both posts are being used to attach barbed wires and to prevent trespass principally by cattle.

Factor	Live fence	Wooden (dead) fence
Choice of species	Depends of ecological conditions	Many possibilities: depends on availability
Cost	Relatively low or free	Relatively high
Handling of post before placing	Needs careful preparation, transport and storage	No special care required
Placing in soil	Needs care, adequate soils	Soil not limiting
Placing of barbed wire	Special techniques in some species	Some skills required
Initial maintenance	Necessary, requires protection against some animals	None, in some cases needs fire protection
Survival	Losses possible	100%
When to place wire	Usually when well anchored	Inmediately
Increase of post density along fence	Easy and cheap	Easy but expensive
Durability	Usually very long	Variable, limited according to treatment and species
Organic matter production	Varies with species	None
N fixation	Possible in some species	None
Effect on soil fertility	Beneficial, specially when branches are pruned and some roots die off (aeration)	None
Erosion control	Can be effectively used as barrier	None
Competition for water and nutrients and light with nearby crop	Does exist but varies according to system; organic matter production compensates	None

Protection of crops and/or animals against wind	Effective but varies according to species, height, density	None
"Horizontal" rain (fog drip) from moisture ladden winds	Possible	None
Toxic effects	Possible (allelopathy)	None, (except when some preservatives are used)
Toxic fauna	Can be sheltered	None (except termites in some cases)
Beneficial fauna	Provides shelter and food (e.g. birds, honey bees)	Little
Additional economic products	Many, such as food, feed, medicinal products; also firewood, posts and more live fence posts	None
In case removal if necessary	Difficult and costly	Relatively easy
Labour for management	Periodical pruning is necessary; skills required	Skills also required to place posts and wires and replace them
Acceptation by farmer	Very popular among poorer farmers	Depends of income. More affluent farmers tend to avoid live fence posts
Special limitations	Disliked by fumigation pilots	Firebreaks must be kept clean during fire season
Aesthetics appreciation	Depends on management and cultural background	Depends on investment possibilities and cultural background

3.4 Taungya as part of a strategy to change land use

Throughout Central America and the Caribbean a large amount of lands on steep slopes have been cleared of their original forest and converted to pastures of poor yields, many of the latter reverting eventually to secondary brush. At present there appears to be great interest in converting such slopes into forest plantations for firewood, pulpwood or timber or any possible combination. Taungya has a long history in the region mostly in Trinidad (as early as the twenties) with teak, and Caribbean pine, Belice (teak, Caribbean pine, Gmelina), Surinam and at CATIE, Costa Rica, the latter with Cordia alliodora, Gmelina arborea, Eucalyptus deglupta and Terminalia ivorensis (Combe and Gewald, 1979). The latter four species and Pinus caribaea have shown particularly good adaptation in areas of high rainfall (2 000 - 4 000 mm) at elevations up to 1 200 m. The associated crops have been maize, beans, cowpeas and string beans.

A series of programmes are presently been visualized to convert large areas of degraded lands in all of the Central American countries as well as Dominican Republic and Haiti into tree plantations. Thousands of farmers are expected to be involved in the process by allowing them to combine field crops with seedlings of valuable trees for approximately two years and then having them participate in the tending and harvesting operations, therefore changing gradually land use from extensive (and destructive) grazing to forestry. The rising prices of firewood, posts, timber, and pulp and the possibilities to eventually produce large and cheap sources of biomass on lands that do not compete with agricultural crops, have generated much interest from funding agencies. In Costa Rica, the introduction of Caribbean pine 20 years ago and the ready acceptation of local farmers to plant small plots, has lead to the establishment of pines and other species and eventual grazing of these plantations under controlled conditions in presently been studied, the latter to keep the grass down, reduce wedding costs and produce additional income. There is already some experience on grazing pine plantations in Surinam and Jari (Brazil) and field trials are under way at CATIE, Costa Rica.

The obvious interest in financing such schemes lies in a combination of factors: protecting degraded slopes from erosion and regulating run-off, providing wood for an industry that is willing to pay higher prices, as well as for firewood and charcoal which are in great demand, but above all it, would

provide thousands of farmers who have become impoverished from past misuse of land, with a new source of income, without changing drastically their way of life. Clearly all these prospects need to be investigated in the light of land tenure problems, government incentives, long-term economic prospects, acceptability by the farmers, and careful planning of the relationship between wood using industries and participating local farmers. There is an obvious role for Governmental authorities to play but misunderstandings and failures can easily happen.

4. Multiple use

The possibilities of promoting multiple use of forest land, particularly as a medium to improve the lives of people living near or within the forest, have not yet been well investigated in the region although this may not be so much as a result of sufficient case studies but rather for not considering adequately the social factors.

A case in point is the Luquillo National Forest in East Puerto Rico covering an area of low and middle elevation mountain ranges, with heavy rainfall. About fourty years ago the forested area, mostly secondary, was dedicated to silvicultural research (managing the natural forest and establishing plantations) as well as watershed protection but increasingly over the years, it has become a main focus of attraction for local and foreign tourists with recently over one million visitors per year. The effect on the local nearby population has not been well studied but it certainly has produced a powerful attraction to the Puerto Rican tourist industry with various favourable economic implications.

Another interesting development has been the creation in 1979, of the Rio Plátano biosphere reserve in Northeastern Honduras, covering 180 000 hectares of rainforest (DIGERENARE and CATIE, 1978). Besides the biological and archeological interest for science, a prominent reason for the establishment of the reserve has been the maintenance of the life style of the well adapted "Misquito" Indians with their peculiar agricultural, hunting and fishing practices.

A better knowledge of the relation between multiple use and its influence on people living in the area where practiced is wide open for research and would be of great use to planners and decision - makers.

SUMMARY

Four broad categories of forest management in Central America and some countries of the Caribbean, namely for protection, for wood production, for a combination of agriculture and forestry (agro-forestry) and for multiple use, are analyzed as to their present and potential impact on local populations living within or near the forest. Many problems resulting from past and present massive deforestations and lack of management are negatively affecting local populations. In the light of experience from the region, it appears that large reforestation schemes on land that has been degraded, would provide interesting opportunities for stable forest communities in the light of shortage of forest products and needs to control erosion. Capitalizing on present widespread agroforestry practices appears to be particularly promising in some areas but a better understanding of biological and social characteristics of some of the present systems, is required to launch successful improvement programmes. Some examples of multiple uses are also described notably the use of a national forest for recreation and the establishment of a biosphere reserve where the rights and customs of local populations are safeguarded.

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