Symbiosis of agriculture and forestry

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It is generally agreed that when genus Homo first appeared on earth, the greater part of the planet was covered with forests. At that time, man was a food-gatherer, living by hunting, fishing and gathering the plant materials he needed for survival. Then, he developed agriculture, learning to use fire, felling tools and simple farming implements which enabled him to clear forests and to cultivate systematically. This development, of course, moved at different rates in the various climatic zones of the world. In fact, still today, in the tropical forests of Latin America, Africa, and Asia, there are many who live at or near the aborigine level.

Probably, in the tropical as well as in the temperate climates, agriculture was based in those days on the use of forests as fallow between two agricultural crops.

At a later period, which varied according to the level of technical development, in the temperate climates agriculture was established on the best lands won from forests, which man had learned to enrich with manure produced by his domestic animals. However, the forest fallow system survived in the temperate zones, which today constitute the industrialized world, into the beginning of this century.

To be sure, in tropical countries today there exist permanent forms of agriculture and animal husbandry (irrigated paddy fields, tree plantations, and on very good alluvial soils); but we find above all shifting agriculture on forest land cleared by burning which, according to some, may involve 200 million inhabitants and affect 20 to 40 million hectares each year. In drier tropical areas, we also find extensive forms of animal husbandry using burned clearings.

In the temperate countries, deforestation, due to population growth, developed in Europe during the Middle Ages and at the beginning of the colonization of the New World. It stopped only when man was able to increase agricultural yields. Such increases occurred in two stages First it was a result of the first agricultural revolution in the 19th century (characterized by the elimination of forest and other fallows), and then especially in the 20th century thanks to the very low cost of petroleum which made it possible to use inputs with high energy consumption, such as fertilizers, pesticides and heavy machinery. Such inputs led to spectacular increases in yields. And now the rich countries are preparing to readjust their agricultural production systems in order to save energy: this is the beginning of a new era.

A rapid flight over tropical landscapes pockmarked by countless fields of shifting agriculture or showing a sort of agricultural front penetrating further into dense forest every year might lead us to believe that the tropical world is today in the same position as was the temperate world at the time of its large-scale land clearing. But such a conclusion would be a serious mistake, for several reasons:

- First of all there was no population explosion when land was cleared on a large scale in what became the

industrialized world. This is why some balance could be achieved between agriculture and forestry even before the introduction of fertilizers and machines.

- Tropical soils are much more fragile than the soils of temperate countries.

- Tropical countries will never be able to use as many energy-requiring inputs, i.e. petroleum, as the wealthy temperate countries which, moreover, are about to modify their energy wasting agricultural systems.

- Lastly, poor countries in general still have neither sufficient institutions, nor financial resources, nor personnel to quickly bring about a "new order" in their rural landscape.

At this point, we may ask, what is the place of forests (and trees) in the rural landscape? This is a question which, as we have already seen, must be placed in a totally different perspective depending on whether it concerns the wealthy, temperate, industrialized world or the poor, tropical, little-industrialized world.

A hasty reply might be that, since the temperate world has a fairly stable balance between the forest and agriculture naturally, that is, without the intervention of planners, economists, agronomists, forestry experts and other technocrats, why not let the tropical world also develop naturally? Furthermore, what can a handful of technocrats, whether international or national, do to oppose the action of the millions of people who nibble at forests?

Leaving aside the rich world, where the area occupied by forest is relatively stable and which, in any case, has sufficient human, technological and financial resources to solve such problems, we shall concern ourselves only with the poor world, in general having a tropical climate and little industry. In this world, the "laissez-faire" attitude is more unacceptable than elsewhere. Evolution is too quick and the disruption of so-called natural equilibriums leads straight, and very swiftly, to disaster. The forest is in danger of disappearing irremediably in a short time if nothing is done to arrest its degradation or destruction. Yet the forest is indispensable not only to raise the already very low standard of living of the rural population in poor countries, but also, quite simply, for their survival.

It is not necessary here to dwell on the essential and indispensable nature of forests; suffice it to repeat that the destruction or degradation of original forest, unless it is replaced by one that is more productive but has the same environmental value, can cause irreversible damage to the general environment and contribute to what is called the death of our planet. But the millions of poor and ignorant small farmers are little concerned with the long term: they and their families are obliged to live from day to day in order to survive. And if they are not assisted technically, informed, convinced and trained and if they are not allowed to participate, they will continue their work of destruction. Certainly, the same crisis occurred in today's rich countries, but, for the four reasons listed earlier, it did not produce the disastrous consequences - for example, desertification - which it has already brought about in the poor countries of the tropics.

In these countries, the forest must, in spite of everything, be preserved where it exists and, where it has disappeared, be restored or replaced by better forests. To achieve this, the forest, and trees in general, should be integrated into the rural landscape in ways appropriate to the ecological, social and economic conditions of the region or the local area concerned. It is necessary - and this is where the major difficulty arises - to reverse an accelerating trend and make the very people who are the agents of the present disorder, the poor farmers of tropical countries, accept a "new rural order."

Thus, the problem is to integrate, to harmonize within the same management unit (a local area, a watershed or a sub-watershed) the possible land uses such as animal husbandry, agriculture, forestry, industrial plants, roads, towns and villages. Naturally such local integration must itself be harmonized with general development on a national scale. As a result, integration of different land uses can be defined as follows: Use of a territory or part of it simultaneously, or sequentially, to achieve several different objectives, while seeing to it that the interactions between the different uses (e.g. agriculture, animal husbandry, forestry) result in sustained and increasing production of goods and services. In short, integration of the various possible uses of rural areas, and hence determination of the place of the forest in those areas, is a task of economic and social optimization.

Such integration involves a fundamental social and human dimension in the sense that it is possible only to the extent that it is accepted and, if possible, provoked and requested by the rural communities themselves.

Whe repeat we are dealing here primarily with tropical countries, that is, those located between the tropics of Cancer and Capricorn. But our considerations can also apply to dry or arid Mediterranean countries sharing such important aspects with tropical countries with low or irregular rainfall, as extremes of climate and fragility of soils. Furthermore, in these countries special attention must be paid to mountain areas, because the last remaining forests have to be maintained there since the plains (as in the wealthy countries) would have to be reserved for intensive, relatively mechanized and more or less modern agriculture; because those are the regions where the destruction or degradation of forests can have the most disastrous consequences for the environment; and because it is in those areas that the poorest population, those least concerned with long-term effects, take refuge.

In this context, forests and trees can be integrated into the rural landscape in three main ways; as permanent forest or estate forest; as fallow forest; and as forest in symbiosis with agriculture.

Permanent forests. This is the type of forest primarily, although not exclusively, known in rich temperate areas and to which traditional forestry services are accustomed. In the tropical countries, it has so far been very difficult to make farmers who are hungry for new humus-rich land respect such permanent forests. Forests have barely survived only where poor farmers (who often follow loggers) could not yet penetrate, for example in Amazonia, in the heart of central Africa and in some remote areas of Indonesia, the Philippines or Malaysia. However, even in those areas destruction or degradation has already started as a result of immigration from poor and overpopulated regions, accelerated by the construction of access roads.

In theory, it is possible to determine the part of the territory where the forest should remain stable, be it the more or less managed original forest or a new forest which is more productive but provides the same services. This is a matter for economic analysis, but in forestry it is complicated by the characteristics of this form of land use, i.e. long-term considerations and indirect benefits which are hard to calculate, including the intangible benefits connected with recreation. But even the best land-use plan is only feasible to the extent that it is freely accepted by those concerned, that is by the poor farmers, and we shall return to this point later.

Fallow forest. Forests served as fallow areas in the temperate world that is rich today, as we have noted. They continued to play this role in vast regions of the tropical world (200 million people, involving 20 to 40 million hectares per year). In the face of this accelerated destruction, whose rate increases with the number of people living around the forest, there are two possible approaches: either settle the population now engaged in shifting cultivation on permanent agricultural plots in the future (which also means determining the areas to be maintained as forests) or preserve the forest as fallow, but using a better forest, a manmade forest, between two crops. The latter is the agrisilviculture system.

The choice must be made for each particular case in line with the specific technical, economic and social conditions of the area concerned, particularly on the basis of the following criteria:

- It may be dangerous to replace shifting cultivation which has proved its worth despite all its faults by a new, still untried system. We may also ask whether we can at this stage safely recommend permanent cultivation methods of the type used in wealthy temperate countries, except possibly for rice cultivation and tree crops (see symbiosis below). In fact, it is not certain that our technical knowledge is adequate everywhere.

- Even if the methods of establishing permanent agriculture were known, they would have to be applied. This presupposes the creation of institutions and training of qualified personnel at all levels, including especially extension workers living in contact with farmers and willing to accept the hardships of life in remote tropical rural areas.

- For lack of adequate technical and financial resources, farmers in poor tropical areas cannot afford to use, let alone purchase, the inputs (fertilizer, pesticides, etc.) winch have enabled wealthy temperate-zone

countries to increase agricultural yields considerably and therefore to reserve non-agricultural areas for forest. In poor countries fallow forest, together with the utilization of forest litter as humus and nutrients for agricultural crops, is today the main known and practicable way to restore soil fertility while pre serving the environment, at least as long as population density remains below a certain threshold. The application of forest litter - leaves and humus - for farm crops can also serve, before such use as litter for livestock, thereby becoming enriched by their excreta.

THE COLTURA PROMISCUA OF A TUSCAN FARM IN CENTRAL ITALY aesthetic, agriculturally productive and ecologically balanced

Agrisilviculture, regarded as an improvement on shifting cultivation, is the easiest and most immediately applicable method known at present, considering the possibilities of the characteristics of the social context concerned. However, it is recognized that it is only a stage toward a more stable type of agriculture which will probably not be copied from the wealthy and temperate countries, as we shall see below. Thus, all efforts to improve this system of shifting agriculture or agrisilviculture should be encouraged.

Forests in symbiosis. In tile two previously described systems, the forestry sector was relatively distinct from the agricultural sector both in space (permanent forest) and in time (fallow forest and agrisilviculture). The system we call "forest in symbiosis" involves co-existence of the forest with agriculture both in time and space. In this system, we must distinguish what is traditional and what is less so (which concerns primarily the tropical countries).

Loose symbiosis: a traditional pattern. This refers, in the first place, to hedges and windbreaks which also regulate micro-climate areas, constitute refuges for wildlife and produce wood for common uses (firewood, stakes, posts), but also to plantings along roads, rural irrigation canals and anti-erosion terraces. It also applies to small groves a few hundred square metres in size, located around dwellings or scattered in the fields where domestic or wild animals take shelter in periods of extreme heat, extreme cold or on windy days.

Close symbiosis: a less traditional pattern. People who have visited Tuscany have been struck by what the Italians call *coltura promiscua* (mixed cultivation). The same field has trees (generally maples and elms), vineyards supported by tree trunks and branches and, between the rows of trees, one or two crops during the year.

This system is not only productive but creates a landscape or environment which is considered one of the most harmonious in the world, in any case more so than the wide wheat plains of the Paris region or the flat expanse of vineyards of southern France. As for the poor tropical countries, any attempt to copy so-called modern agriculture symbolized by the great plains of the American Middle West is out of the question. That type of agriculture is based not only on a relatively low population density but also on a very high technical level and, above all, on high-energy inputs (fertilizer, pesticide, heavy machinery) which farmers of tropical countries have never been able to purchase and generally speaking, will be even less able to afford in the future. The only solution seems to be a type of agriculture as self--reliant as possible, based on the natural (but intensified) production capacity of natural resources which, themselves, cost nothing. These resources are soil, water and sun: that is, chlorophyll assimilation. This type of agriculture must try to lose nothing, to recycle all its wastes, whether vegetal, animal or human. Therefore, the association of animal husbandry, aquaculture and, as we shall see, forestry with agriculture is indispensable to make the most of all the production factors (sun, water, soil, etc.).

Rethinking agricultural systems

The rich countries themselves, knowing that they will be unable to afford as much energy in the future, are thinking of re-adjusting their agriculture along these lines. This is all the more reason for the poor countries to do so as quickly as possible.

In fact, this type of agriculture already exists in some parts of the tropical world, as for example, in Tanzania among the Shambalas in the Usambura Mountains and the Wakaras on Ukuru Island in Lake Victoria or - a classical example - the Chinese communes.

In this symbiosis, the tree has an important role to play through its crown and its roots. First, through its crown it protects the soil and the crops over which it stands both against too much exposure to the sun and against the impact of violent tropical rain, the two main factors in the degradation of tropical soil. Furthermore, by constituting an additional level of photosynthesis, it allows for the maximum utilization of sunrays for productive purposes, provided that the mixture of trees and crops is suitably formed. Second, through its roots draws from the deeper soil layers the nutrients which restored to the surface layers, and thus to the crops and plants. The falling dead leaves, moreover, reconstitute the stock of organic matter in the surface soil.

This "coltura promiscua" already exists in some tropical areas. It is the typical "tropical garden" which seems like a tangle to the inexperienced visitor but has good reasons for its existence. This method of integrating trees with agriculture deserves to be improved, disseminated and recommended.

Because of the goods they produce and the services they provide, it is generally acknowledged that forests or trees have an essential and irreplaceable role to play in the rural context. We have first reviewed a wide range of types of integration of tree vegetation into the rural landscape. We believe that one or another of the methods described here, or several of them combined, can be suitable for practically all technical economic, social and financial conditions of tropical countries, even those where population density is too high (for example, rice cultivation on the island of Java).

Accordingly, such integration is our objective but, at the same time, it is its own means. In other words, the poor peasant destroys the forest and trees because they compete with his agriculture, including animal husbandry. Therefore, the poor farmer will accept the forest or trees only if they are integrated or harmonized with his agriculture and are advantageous to him. Finally, greater respect for the forest and trees can only come from better use of natural resources directed toward higher food production which is the daily, acute concern of poor farmers.

We believe we have shown that there are technical solutions; however we acknowledge the need to improve and refine them. Research and experimentation should certainly be pursued and intensified, but it seems to us that we already know enough to take action. However, a serious constraint hampers the dissemination of sound methods for the integration of the forest in agriculture or simply the intensification of agriculture is a prerequisite. With certain exceptions, this is the under-administration or understaffing of the poor rural world.

The establishment of suitable institutions for training competent personnel who work as closely as possible with poor farmers is a fundamental problem. It is also out of the question to impose ready-made solutions, prefabricated outside, on rural communities

That explains the importance FAO attaches to forestry for rural community development, carried out for communities and by communities.

In this connection, we may quote Pierre Gourou, the great geographer, who wrote, in 1968, after 40 years of a career devoted to careful and minute study of the problems of the tropical world:

"Economic backwardness in the tropics is due to technical lag. Under the present conditions, the most depressing technical lag is that of organizational techniques. Their improvement is a necessary condition of progress in the tropical world. The administration of a backward country requires no less attention, personnel and competence than does the administration of a developed country. The agriculture of a backward country calls for as many soil scientists, entomologists, geneticists and agronomists as does the agriculture of a developed country. The first condition for economic progress is not economic but administrative; a backward country will make economic progress if it has a sufficient number (i.e. personnel of the same level as those in the developed countries) of administrators, physiscians, entomologists, agronomists, etc."[1]

1 Pierre Gourou, *Leçons de géographie tropicale*, Mouton, Paris. p. 242. (FAO translation.)

AGRISILVICULTURE IN CHINA: WINDBREAK TREES, MAIZE AND SHEEP a harmonious landscape