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## Agri-silviculture in Uganda

### A case study

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Agri-silviculture is a production technique which combines the growing of agricultural crops with simultaneously raised and protected forest crops. This practice, called agri-forestry, has been in existence in various primitive forms since man learned to clear forests and cultivate land, and has different names in different parts of the world. In western and central Africa, the age-old habit of swidden agriculture, or "shifting cultivation," involving continued destruction of forest areas by cutting and burning and then raising the agricultural crops on the ashes of the destroyed forest, seems to be the beginning, however crude, of this practice. In Kenya they call it "shamba"; in parts of Europe and a large part of Latin America it is called "squatter planting". A similar practice involving forest villagers and tribesmen is known as the "taungya system" in Asia. The origin of the taungya system can be traced back to 1862, when the colonial British employed Burma's taungya tribes for raising teak plantations along with their paddy (rice). In Indonesia, Malaysia and other tropical countries of southeast Asia, the practice is remarkably similar to that of shifting cultivation in Western Africa. In the local vernacular of Bangladesh the practice has been most appropriately called "jhooming," which means going round and round and never standing at one place; the farmers would change the site every year moving, year after year, throughout the available area. Various forms of shifting cultivation are still destroying forests, degrading land and causing erosion in many parts of the world on a vast scale. There are an estimated 3.6 thousand million hectares currently under shifting cultivation throughout the world, and it is believed that some 250 million persons live by it.

The present-day concept of agri-silviculture is in fact a way of reconciling conflicting interests of native cultivators and foresters and also is seen as a valuable and workable means of diverting the pernicious systems of shifting cultivation into constructive channels. This involves the establishment of an agricultural-cum-silvicultural cycle so as to use the labour of shifting cultivation to establish and maintain trees. It has come to be a valuable symbiosis and it is being accepted as a very popular system, wherever conditions are suitable, for promoting the economic and social development of the people living within or near the forest area, and simultaneously preventing the degradation of soil and vegetation.

The technique holds a significant position in tropical silviculture. As a form of land use, it aims at an integrated use of the available land resource to obtain a maximum amount of goods and services (Davis, 1968).

In various ways agri-silviculture seeks to create harmony between crop farming and tree

farming. Decidedly, the system is not an easy one and at times the plans may not fully materialize. indeed, those patient, flexible and intelligent administrators who understand and sympathize with the forest farmers, their traditions and their human needs are among the most important elements of success of any system of agri-silviculture.

In Uganda, the system does not have a long history. It started as a form of tree farming when the hardwood species *Maesopsis eminii* (Musisi) was raised in combination with cocoa to provide partial shade to cocoa in its initial years of growth and to produce Musisi timber into the bargain. Later, a small-scale taungya system was applied in the Kifu forest to regenerate some indigenous trees. Taungya plantations were also developed for planting exotic pines in the Mwenge plantation, near Fort Portal, and at a few other sites with varying degrees of success and the system is being currently applied in the Sebei and Lira Districts where large-scale plantations of pine and cypress have been taken up under agri-silviculture. One such site is the Kachung Forest, the focal point of this study.

The Kachung Forest Reserve with an area of 35.4 km<sup>2</sup> is located 27 kilometres south of Lira town along the Lira-Soroti road in Uganda. The area has two peak rainfall periods and three to five months of dry season every year. The wet spells last from April to May, and from August to September. The relative humidity at midday is estimated to be 30-65 % during the dry season and 60-95 % during the wet season. The temperatures are quite high, maximum 29.5-35°C' during the dry season and 21-29.5°C' during the wet season. The minimum temperature never falls below 15.5°C. The soil is mostly lateritic with reddish brown sandy clay loam at few places overlaying the laterite. Before its establishment as reserve this vast savanna area was being used as a communal grazing land. Subsequently in 1938, abortive efforts to plant *Chlorophora excelsa*, *Khaya grandifolia* and *Gmelina arborea* continued until 1950. The emphasis then shifted to trials of softwood plantation which showed their results around 1970. Soon after, fairly large-scale plantation work started with *Pinus caribaea*, and on a limited scale with *Pinus patula* and *Pinus oocarpa*.

There is no definite record indicating exactly when the agri-silviculture (taungya) practice was started in this plantation. According to verbal reports it is generally believed that it started around 1966/67 when the villagers living within the forest area, urged by some teachers from a neighbouring primary school, were encouraged to take up some land for cultivation by the Forest Department. They quite willingly took up the land, though on a quite e small scale. That state of affairs continued up to the end of the sixties when the Forest Department decided to expand the operation by developing a new strategy. The local village chiefs were approached to convince the local people around to extend cooperation to the Forest Department by taking up plots for taungya practice. At first the call met with a mild response from the local people, with just a handful of farmers joining the older lot. However, by 1970/71 there was a great inpour of people who took up plots. This was mainly due to the realization by the farmers that the area was agriculturally very productive. Since then the interest of the people has grown year after year.

Generally, the people use the land around the forest in two basic ways:

- Raising crops, mostly for food, such as millet (*Eleusine coracana*), pigeon peas (*Cajanus cajan*), cotton (*Gossypium* sp.), sorghum (*Sorghum vulgare*), simsim (*Sesamum indicum*), groundnuts (*Arachis hypogaea*), several types of beans, cassava, sweet potatoes, various local vegetables and some sweet bananas.
- Keeping cattle, and some other domestic animals like goats, sheep and poultry. The cattle graze usually in communal grounds set aside for the purpose, away from agricultural areas. Because there is no risk of their trespassing into anybody else's cultivated garden, the cattle herds are let free every morning to graze on their own and are collected in the evening. The sheep and goats are not usually

herded but are tied near the homestead except during the dry season when they are also left free. The use of grazing land is unplanned.

People work the land with a hoe -called locally the "lango hoe" because most of the inhabitants of the area belong to the Lango tribe. It consists of a flat heart-shaped blade fitted onto a rather long handle. Such hoes are exclusively used in the Lango area. Very few farmers possess ox-drawn ploughs.

There exists a customary land tenure system in the area, both for cultivation and grazing. The land usually belongs to a tribe, clan or family. In some cases it belongs to various individuals in the family, later inherited by their offspring, and this often leads to possible fragmentation.

Any land which has been lying unoccupied for ten years can be occupied by an individual, a family or a clan. The occupation must last for a long time and the land put into effective use during that period without anybody else claiming it, before ownership can be proclaimed. Despite the system of customary tenure, the lands under Uganda laws are known as public lands, vested in the land commission of the Government of Uganda., and are administered by the District Land Committees. Because of a rather light population pressure there seems to be no serious land problem in the area at present. However, there is a great hunger for fertile lands, which are shrinking.

The method of cultivation consists of clearance through repeated burning of all the existing vegetation, next digging, then sowing or planting, digging for weeding, harvesting and clearing the remains again. by setting fire.

The Langos have a communal system of land cultivation known as "Wang tic" in their language. The system carries many local nicknames in various parts of the Lango district. For example, around the forest reserve it is referred as "Alulu". This is quite an old form of cultivation. All persons, male or female of all age groups capable of carrying out cultivation work, belonging to a homestead or a group of homesteads, organize themselves into a "Wang tic". The leader of the group is chosen by the members. He is responsible for the organization of the cultivation, and fixes the order of cultivating the "gardens". The area covered depends upon the size of the "Wang tic". During the digging, each person is allocated an area to complete and the stragging members are usually helped. After every such cultivation the owner of the garden has to provide local beer ("Kongo ceke" or "laco") or occasionally a meal.

After the demarcation of annual planting coupe, the initial clearing of land is carried out by the Forest Department toward the end of the dry season. This involves cutting down the entire existing savanna vegetation, except for a few valuable tree species. The cut trees are either sold as fire-wood or converted into charcoal and then sold. Usually fires are avoided as a precaution against any possibility of a serious outbreak of forest fire.

The planting operation is completed by the Forest Department before the farmers are allowed in. The forest species are planted at 3 × 3 metres spacing soon after a reliable rainfall, that is, when the wet season has really begun. The land allocation to farmers is usually done on a first come, first served basis. The maximum area allowed per tenant, usually a family, depends on the capability of the tenant which is judged by the size of the family and his social status. The bigger the family and the better its social status, the greater is considered to be the capacity of the tenant. While the allocation of plots is proceeding, tenants who wish to be neighbours can choose to have adjacent plots.

The tenants are not allowed to burn anything at any time in their plots. They can grow any annual crops but no perennials are allowed which are liable to cause suppression of the tree seedlings. The number of years for which a tenant can keep a plot are not stated at the outset. The maximum allowable period is dependent on the degree of crown closure of the forestry

crop, the type of agri-crop to be raised and the degree of soil fertility. Ordinarily three to four years are required before the farmer can change the site. During the occupancy the farmer is required to look after the forest plantation.

The demand for land has been gradually but continually increasing. Most of the area taken up is along the Lira-Soroti road. A survey of tenants according to sex and age shows that a greater part-60 percent-of the tenants come from outside the forest area and are middle-aged women. The workers from within the forest area are, however, mostly young males.

### [A FISH POND COMBINED WITH FORESTRY ACTIVITY where communal farming traditions favour the growth of taungya](#)

To assess the effects of inter-cropping on the main tree crop, which is *Pinus caribaea* in Kachung, measurements and observations were taken in areas having almost the same age but have been under agri-silviculture for varying lengths of time. Because of the size of the available plots, 100 percent of the full area of each type was included in the study.

The agri-forestry practice has a beneficial effect on the condition of the forestry crop mainly through the elimination of the rank growth of weeds, which offer a very strong root and shoot competition to a sapling raised in an area where there is no agri-forestry or it has been practiced for only one year. Weeds in such cases are ineffectively removed and readily reappear. The most abundant weeds of the area are: *Imperata cylindrica* (sword grass). *Acacia hockii*; *Hyperrhenia rufa*; *Acacia mellifera*; *Grewia trichocarpa*; *Vangueria opiculata*; *Asparagus flagellaris*; *Combretum spp.*

*Imperata cylindrica* is a suppressant which tends to grow in pure forms excluding almost all other vegetation. It is very difficult to control during the first year of cultivation because of its sturdy rhizomes.

As for the effects of agri-silviculture on agricultural crops, information obtained from the farmers working in agri-forestry has been compared with answers from farmers working on other lands in adjoining areas.

All the agricultural crops tried so far under the system have proved promising and their yield is better than the outside land. The cultivation of agri-crops has to stop when the tree canopy above closes. There is a declining trend in production on both types of land due to the effect of soil leaching and exhaustion of fertility.

### **Taungya's effect on the local ecosystem**

Because the farmers clear the site of weeds through hard work, they would like the area to be available for cultivation for a longer period. This at times provokes feelings of hostility in the farmers toward the tree crop. Some of them would even physically uproot the tree while digging the adjoining land. Some instances of heaping weeds on top of saplings have been recorded. In other cases fires were initiated to kill weeds which had reappeared after the first year. But all such instances are exceptions rather than the rule and such tendencies are very much controllable.

There has so far 'been no serious attack of pests or diseases on either the trees or the agricultural crops growing together. In April 1977 there was however a grasshopper attack on millet. That appeared to be a region-wide attack, which was not restricted to the forest area, although some of the farmers alleged that the attack was more severe in the forest area. There is also no evidence of attack by monkeys and browsers present in the forest reserve on the agricultural crops.

Though soil working had improved the aeration and water-holding capacity of the soil a small

incidence of erosion was observed on slopes, especially on sites where the agricultural crop was still young. Nevertheless, local farmers and forest workers are of the view that replacing of the rank growth of weeds with agri-forestry crops had greatly improved the aesthetics of the area. The enhanced production of agri-crops and improved rate of growth of trees are an important socio-economic contribution to the area.

Generally, the people involved in the practice (the farmers and the Forest Department) are satisfied with the yield of crops from the land, the present land allocation system and the present way of working. The practice has evolved a sort of block farming. The Forest Department employees continually check their tree-crop though some of the farmers discourage them from passing over the cultivations. Because of the general economic condition of the farmers, mechanized farming seems to be a remote possibility unless some other agency takes the initiative.

## Effect on labour costs

If agri-forestry had not been adopted, the Forest Department would be employing labour to carry out the entire tree-planting operations. For example, the planting coup of 1977 only, as calculated from past records, would have required 8120 additional man-days to establish the plantation of *Pinus caribaea* over 116.5 ha over the first three years.

And in spite of so much investment the achievement would be only forest trees, which anyway are favourably affected under agri-silviculture.

Agri-silviculture -or taungya-- is a method seeking in various ways to create harmony between crop farming and tree farming. It is a compromise between two apparently conflicting demands. It is not easy and may not always work as planned. But in the tropics, where the pressure of population is ever-increasing, such compromises are the only answer. Shifting cultivation and savanna land utilization have to be integrated to get timber, food, fuel and other allied products to ameliorate the economic condition of the developing tropical countries. It is believed that in the world today an estimated 3.6 thousand million hectares are under shifting cultivation and some 250 million people live by it. In Uganda alone about 10 percent of the total land area (its savanna) is ravaged by the fires caused by shifting cultivators or graziers each year. This calls for a change: change in land utilization, change in attitudes and change in the ultimate fate of millions of people. And agri-silviculture brings in a series of changes.

## Ecological factors

No doubt there is quite some amount of change caused by the planting of trees alone, without involving the taungya system (Johnson, 1976). And the change is much greater if the tree rows are interplanted by agricultural crops. The rate and extent of change appear to depend upon the number of years of cultivation and the type of crop cultivated. In the Kachung area, after one year of cultivation there is a sudden vigorous re-growth of grasses, herbs and shrubs. *Imperata cylindrica* tends to come back in a big way, and after it has been weeded out again there is a quick invasion by lesser competitive species. That is why the areas that are cultivated only once may not ultimately be very different from those that are not cultivated at all. The vegetation changes become more and more conspicuous and permanent as the number of cultivations increase. The constant and repeated cultivation has the effect of making the vegetation simpler, as the farmer makes incessant efforts to keep his crops weed free. And as the pines grow and close up, a new type of vegetational cover develops which is quite different from that in the neighbouring unplanted areas. The trees influence the environment through casting shade, keeping the temperature low, minimizing evaporation from the soil surface and affecting the microflora and microfauna of the soil. A new micro-environmental set-up comes into being. *Imperata cylindrica* cannot re-invade the area under

pine shade as the grass is not shade tolerant.

As can be seen from the foregoing, the taungya practice has its beneficial effects on the growth of pines. The faster rate of growth is due to reduction in competition from grasses and other weeds. Most agricultural crops tend to be less competitive than the natural vegetation. Tropical soils are extremely susceptible to nutrient leaching, particularly when the ground is made bare of its vegetational cover by exposure either through cultivation or through other means. The soluble substances are continually washed down into deeper layers of soil. Some of these nutrients are drained down while the rest are taken back by the deep-rooted plant communities. Since it is only the pines that are a deep-rooted vegetation within the agri-silviculture area, they take back those nutrients. This in part may also account for the increased vigour in growth of the pines.

The agricultural crops, in their own way and at a given depth, also compete for nutrients with young pine seedlings. Millet, when looked after properly on a fertile soil and allowed to establish, forms a thick network of adventitious roots and a dense growth of parts above ground. It is therefore essential that the pines be given an initial advantage over millet, perhaps by delaying the sowing of millet or not sowing millet in the first year. Pines can comfortably cope with millet in the second year and onward. *Cajanus cajan* (pigeon peas) also need the same precautions. They grow to form a sort of shrub attaining a height of over 1.5 metres within three to four months and tend to overtop the pines in addition to making nutrient demands on the soil. However, an obvious result of the taungya practice is an increased yield per unit area of the agricultural crops during the first year. This is due to the still unleached fertility of the soil-the state of being uncultivated is a form of fallow and it is known that fallow is the best way to maintain tropical soils in the absence of fertilizers. The longer the fallow period, the better. The effect of allowing land to remain fallow results in striking increases in yield, regardless of fertilizer treatment. During the second year the yield of agricultural crop falls and from the third year onward it almost becomes constant. Obviously this decline in yield is due to a decline in the availability of nutrients. The yield can be raised if somehow the tillage can be taken deeper than the layer which is used during the first year. The cultivation can continue to about four years when the pines almost close up the canopy.

## Effects on socio-economic aspects

Although communal farming has been in existence in the Lango area of Uganda for a long time, the system has got better organized thanks to the taungya practice. In traditional communal farming the shambas (gardens) are scattered, but the taungya system has brought them closer. Equity in site, working conditions and walking distance have gone a long way to remove unnecessary grudges and have helped the people to get better organized. This is reflected by the fact that at occasional parties - like at Christmas, Easter and other occurrences-usually organized within the forest reserve by workers, outsiders are welcome. Conversely the people living next to the forest invite the forest and taungya workers to their parties as a group. Block farming has decidedly contributed to the social development of the community.

Millet and pigeon peas are the main staple foods of Uganda's north and they can be grown as agri-silvicultural crops.

The taungya system has a tangible effect on saving the operational cost of afforestation. Another benefit is the faster rate of growth of the trees resulting in more yield in shorter rotations. Not only the Forest Department gains directly, but it is the farmer who gains more from an increased yield of his agricultural crops. And this benefits is available on a sustained basis as every year new areas keep coming under agri-silviculture. That is why there has been a constant increase, every year, in the number of people engaged in the practice.

It should, however, be noted that the practice of agri-silviculture in Uganda has passed its infancy but is still young. Through careful planning and wise manipulation vast lands and human resources can be put in a progressive and productive combination. The communal farming habit of the people can be used very advantageously by educating them in agri-silviculture. Terms and facilities can be improved and the timing of planting the forestry and agricultural crops can be suitably adjusted. Research is required on suitable crop rotations and possibilities of introduction of perennial crops like cassava and dessert bananas. There are opportunities for helping the farmers by making tractor-hire services available, by arranging convenient sales of agricultural crops and by procuring basic agricultural tools and insecticides, at reasonable costs. Agri-silviculture needs to be carried out as a matter of policy and not only as a localized means to get free labour for forest areas.

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