Legume Trees for Integrated Crop/Livestock Farming in Southern Nigeria

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With an annual rainfall of over 1300 mm, and a growing season of over 8 months, farmers in Southern Nigeria harvest 2 crops per year. Two ha of land are cultivated by hand, and a further 6-8 ha may be held under bush fallow. The major crops are yams, cassava and maize; 90% of the farmers own livestock (goats, sheep and poultry). Small ruminants receive very little attention and rely on scavenging from household wastes to supplement natural grass and browse in the diet. Because of the rise in pressure of human population on the land, confinement and tethering of animals, particularly in the crop growing season, is increasingly important, requiring farmers to cut and carry forage for these animals. Free roaming animals, able to select the most nutritious parts of plants are 25% more productive than confined animals, which rely on the food the farmer can provide. The primary objective of the farmer is to obtain food for home consumption, selling any surplus to pay for household necessities, school fees etc. Fertilizers and pesticides are expensive and not widely available. It is not economic to turn crop land into pasture to feed the animals, and smallholder farmers show no interest in pasture.

Mulch of legume trees as fertilizer

In the late 1970's the International Institute of Tropical Agriculture showed in on-station trials that mulch from the legume tree *Leucaena leucocephala* could act as a fertilizer improving both soil fertility and crop yields. In the beginning of the 1980's, the International Livestock Centre for Africa (ILCA) extended this work to crop/livestock systems, allowing farmers to meet their main priority by increasing food crop production, while simultaneously obtaining high quality supplementary feed for their animals. To avoid over-reliance on a single tree species, ILCA included *Gliricidia sepium*, a legume tree originating from Central America that had been introduced into West Africa as shade for cocoa, and they are currently investigating the potential of indigenous browse species.

The original design, tested on-station and on-farm, involved alternate rows of *Leucaena* and *Gliricidia* planted 25 cm apart within a row, and with 4 m between rows where food crops can be grown. Trees were planted by direct sowing just after the farmer had planted the food crop so that weeding operations for the food crop would also benefit the emerging tree seedlings. Towards the end of the growing season in the establishment year, young trees may need pruning to a height of 60 cm to prevent them from shading the second season companion food crop. In the second and subsequent years, before crop planting, the Leucaena and Gliricidia are pruned at 60 cm above ground for mulch and re-pruned every 6-8 weeks to prevent them from shading the food crop. The application of mulch increases the maize yield by 50% in case inorganic fertilizer is absent. Subsequent prunings have a smaller effect on crop yield, but the fact that the tree clippings can be used as animal feed makes pruning still worthwile. As a supplement to the normal diet of either free roaming or confined animals, *Leucaena* and *Gliricidia* forage reduces pre-weaning mortality, improves growth rates, and shortens parturition intervals, so that more and larger marketable animals are produced each year.

Under traditional cropping practices soil fertility slowly declines, so that after a few years the land is left fallow During the fallow period natural vegetation regenerates and, through decomposition of the leaf litter, organic matter and nutrient content of the soil slowly improves Fallow periods of 3-4 times the length of the cropping period are needed to restore soil fertility. Grasses, bushes and trees on the fallow land are used by farmers as a source of animal feed.

Leaves of legume trees as fodder

Mulching of deep rooted legume trees is a method of incorporating fallow practices into the cropping period, but it may be necessary to leave farms uncropped for perhaps 2 years after 4 years of cultivation to achieve full sustainability (compare this with 2 years of cropping and a fallow period of 6-8 years under traditional systems). Soil fertility will benefit from leaf drop from both natural vegetation and the planted legume trees during the fallow period. In addition the production of animal feed can be maximized by pruning *Leucaena* and *Gliricidia* in the middle of the dry season (January), and again at the end of the wet season (October). This system of tree management is not possible during cropping periods because the tree growth would shade growing food crops and thereby reducing their yield. Any foliage surplus of animal feed can be sun-dried, the edible portion shaken from the dried branches, and stored for use later in the dry season. A useful by-product are the stakes, which can be used in yam production, or as firewood.

A 0 2 ha alley farm can provide sufficient forage for 25% of the daily requirements of 4 small ruminants during the cropping years or 16 small ruminants during the fallow period (if

Feed gardens: 50 % of all new planting activites was carried out by women farmers. (Photo: ILCA).

all tree foliage is used for animal feed).

Feed gardens

A related practice involves a small plot (20 x 10 m) of trees alone, or of trees and grass, called a **feed garden**. Alternate rows of *Leucaena* and *Gliricidia*, planted 1 m apart for "tree only" plots, or 4 m apart when interplanted with 4 rows of *Pennisetum purpureum* or *Panicum maximum*, can provide supplementary feed for 4 small ruminants. Farmers will only accept this intervention when they start to take livestock production seriously, and when they can see that the economic benefits of producing forage from a feed garden can outweigh those of using the same land for food crops. ILCA originally believed that the feed garden would be most appropriate in areas of high population density, and small farm size. However this belief has not been borne out in practice, and feed gardens are now being planted in areas where the availability of land is less of a constraint

On-farm trials started in 1984 with 68 farmers. By the end of 1988 around 250 farmers had adopted alley farming, some independently of ILCA. The initial group of farmers were approached as a community, the benefits of alley farming were explained, they were taken to demonstration plots established 2 years earlier with individual farmers, given seed and planting demonstrations were organised. An ILCA technician and an extension worker supported by the state government were based in the village to provide on-going advice, and to assist in monitoring the progress of the trial. Neither credit nor fertilizers were provided. All small ruminants were vaccinated against the disease Pest des Petits Ruminants (PPR), which, in epidemics every 3-5 years, causes high mortality rates, particularly with stock under one year of age.

Farmers were allowed a high degree of autonomy in the management of their alley farms, so that institutional, intrahousehold and management constraints could be assessed. This could not have occurred under more researcher controlled conditions. The full importance of such factors as land tenure, the competing demands on labour within the context of the farming system, and the appropriateness of new techniques of land and livestock management in farmers' decision making could be determined (Francis and Atta-Krah, 1988).

Involving women

In the first year of the on-farm trials, women formed only 17% of the co-operating farmers although a large amount of small ruminants belong to women, and much of the supplementary feeding of animals uses by-products from food processing, for which women are responsible. At that stage of the project, the extension message was being brought to the village by a male ILCA technician and a male extension worker. It was decided to employ a female research associate, based in the village, with combined extension and research responsibilities. Subsequently 50% of all new planting activities was carried out by women farmers.

Only 29% of the women said their primary occupation was farming, but a much higher percentage of women were engaged in farming, often for subsistence purposes. The majority of women managed their own farms independently, on land allocated to them by their husbands, while the men usually inherited their land. Although women did not have the right to alienate the land allocated to them by their husbands, they were free to decide on the crops, their way of management and disposal of products grown. Most women, however, sought permission of their husbands before planting alley trees, and this was never, to our knowledge, refused.

In Southeast Nigeria all participant farmers in the first year of an alley farming project were male, but after the addition of a female technician to the area, the percentage of women alley farmers reflected more closely that of women in the farming community as a whole. However, unlike the Southwest Nigeria site, all the women farmers at the Southeast site were widows, able to proceed without the need to consult a husband. Nevertheless wives often played important roles in managing alley farm feed gardens for their husbands.

Other advantages

Under traditional **land tenure** systems cultivated trees (oil palm, cocoa) remain the property of the person who plants them, irrespective of ownership or tenure of the land on which they stand. It was believed that tenants might therefore be prevented by land owners from planting *Leucaena* and *Gliricidia*, but this does not appear to be the case.

Alley farming reduces the need for fallow periods, and when an alley farm is brought back into cultivation after a fallow period, **less labour is needed for clearing and land preparation** than would be the case on a similar, conventional farm. However, clearing labour is generally provided by the men of the household, supplemented by hired labour, so the benefits here may not accrue directly to the women.

Farmers have observed that **land preparation is easier in alley farms**, that **weeds are less problematical**, particularly *Imperata cylindrica*, which usually is a serious problem in the derived savannah. On the whole, time needed for clearing, ridging, planting the food crop, pruning and mulching on alley farms in the derived savannah, was slightly less than the management operations required on an adjacent convential farm.

Farmers are beginning to take livestock production more serious

During the early stages of the project, ILCA observed various modifications to the recommended design and management, made by the farmers to suit their own objectives and circumstances. These included the burning to clear dried material (crop residues, weeds) from the alleys before the start of the rains; leaving some trees unpruned to produce yam stakes (used either in situ or after cutting) and increasing alley width to around 5 m where tractor ploughing was anticipated. More recently some farmers at the Southwest Nigeria site were confining their animals at night, and offering *Leucaena* and *Gliricidia* forage in the pens. Previously supplementary feed was hung in a bundle outside the house, and animals from several households were attracted. Confinement indicates that farmers in this area are beginning to take livestock production more seriously. Further evidence of a change in attitude forms the interest shown by these farmers in feed gardens, to provide additional browse.

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