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A very intimate agroforestry association

Cassava and improved homegardens: the Mukibat technique

Tropical homegardens are ideal for diversification and intensification of species. In Mulia Bakti, a village in Sumatra, diversification is illustrated by the 35 tree species that are commonly planted in homegardens. These gardens provide fruit, vegetables and tree products for household consumption and for markets. Intensification, or the vertical integration of species, affords maximum use of space in these gardens. Any technique that increases intensification also improves productivity in the homegarden.

Around the village, the main agricultural constraints are the infertile and acidic soil, which hampers permanent food crop cultivation, and wild pigs, which destroy crops. In this context, homegardens are particularly important to villagers. The complex and diverse mixture of trees and annual crops, associated with sheep and goats raised in small bamboo shelters, allows for permanent crop cultivation because manure and organic matter improve soil quality. Secondly, gardens are close to farmers' homes and families are able to keep away the wild pigs.

In these homegardens, farmers use the 'Mukibat technique' in their cultivation of cassava. This promising but little-known technique for cassava production was introduced to the area by immigrants from Java. Although it has been well documented in Indonesia (Aumeeruddy and Pinglo 1989; de Bruijn and Dharmaputra 1974), the technique has not spread to other countries.

The Mukibat technique can increase cassava production five- or even tenfold. It combines one tree species and one crop species on a single plant. This very intimate association of tree and cassava in homegarden improvement can, perhaps, be regarded as agroforestry in the most literal, even 'purest' sense.

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When a Javanese farmer experiments with American trees . . .

In 1952, a Javanese farmer named Mukibat developed a method of grafting a scion of the Ceara rubber tree (*Manihot glaziovii*) on a rootstock of cassava (*Manihot esculenta*). *M. glaziovii* is a small, fast-growing tree that reaches 8–10 m in height. It has normal roots without tubers and can thrive in light or medium shade. At the turn of the 20th century it was highly valued for its latex production and was spread from South America throughout the tropics (Burkill 1935; Hill 1978; Purseglove 1984). It was later supplanted as a latex producer by the true rubber tree (*Hevea brasiliensis*). However, it is still a common shade or ornamental tree in tropical homegardens.

The young leaves are eaten as a vegetable or given to cattle as fodder, and the seeds produce a valuable drying oil (Hill 1978). *M. glaziovii* has also been used by agronomists for developing hybrid strains of cassava with resistance to diseases such as cassava mosaic and brown streak, which are among the main problems on cassava plantations in Africa (Purseglove 1984).

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The Mukibat technique in practice

Although it is reported that any cassava varieties can be used as stock, farmers generally use only sweet varieties with low hydrogen cyanide (HCN) content. In Indonesia only sweet cassava is processed and consumed in the household; bitter varieties are processed in tapioca factories.

Planting material should be prepared during the dry season, ready for planting at the onset of the rains. Planting can be done at any time, provided there is sufficient water. However, grafting seems to be less successful during the rainy season. Stocks can be used up to a month after cutting, as long as they have been kept in shade. Scions should be used within 10 days after cutting from the mother plant.

Stock and scion should be woody, with similar diameters of 2–4 cm. Cassava rootstocks should be 20–70 cm long, Ceara scions 10–30 cm. Farmers prefer the longer stocks because they can be directly replanted after the first harvest, for a second and even a third cropping season.

A thin piece of bamboo is inserted into the pith of both scion and stock to facilitate the grafting work and to increase the mechanical resistance of the grafting. Scion and stock are then bound together. The cuttings are stored in a shady and humid place, and watered daily until sprouts start to grow (about 20 days). Sprouts from the stock are then removed to prevent competition between the aerial portions of the cassava and the Ceara tree. When the sprouts on the scion are about 2 cm long, the grafted cuttings can be planted in the field.

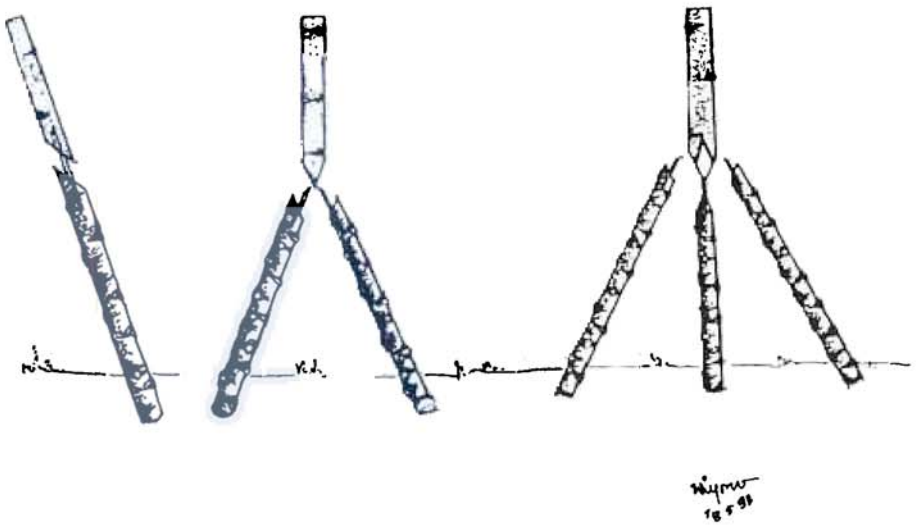
The large dimensions of the cuttings make the Mukibat technique relatively easy to use, with success rates as high as 90%. Another Javanese farmer, Satrawi, has developed a technique for grafting more than one stock (2–5) to give even higher tuber yields. But this technique is laborious, and less reliable.

Large holes, usually 1 x 1 x 0.5 m, are prepared in the homegarden before planting. From 5 to 25 kg of moist organic matter—cow dung, banana leaves, kitchen wastes—are put in each hole and mixed with the soil. The holes are then refilled with soil and gently hilled for easy harvesting. A grafted cutting is planted in each hole, in a vertical position and at a depth of 10–20 cm, depending on the length of the cutting. Usual spacing is 2 x 2 m; remaining space in the homegarden can be intercropped. In Mulia Bakti, the Mukibat plants are often separated by rows of vegetables such as mung or long beans.

Tubers can be harvested individually, but in most cases they are all harvested at once, 10 months after planting. Tuberous roots are thicker, longer and more numerous than those of normal cassava plants. They can be harvested 8–18 months after planting, depending on variety, local customs and the need for food. Farmers must find the right balance between high yield and tuber quality. If plants are too young, the tubers are still growing quickly; if they are too old, roots will be too woody to eat.

In Mulia Bakti, farmers report yields varying from 25 to 60 kg of edible tuber per grafted cutting, from plants 8–10 months old. The average is 30 kg, compared with 5–10 kg for normal cassava plants. These yields correspond with those reported by de Bruijn and Dharmaputra (1974). Assuming a 2 x 2 m spacing, annual yields from these Mukibat plants in homegardens could reach between 60 and 150 t/ha, with a mean of 75 t/ha per year. Average annual yields for normal cassava in smallholder plantations are only 3–15 t/ha, 25–50 t/ha in industrial plantations.

Grafted scion and stalk are bound together



A thin piece of bamboo is inserted into the scion and the stock to facilitate grafting

Indigenous know-how for homegarden improvement

The Mukibat technique in homegardens represents an outstanding contribution of indigenous know-how to the science of agroforestry. It is a rare example of a grafting technique that enhances underground material, which was developed and tested by individual farmers outside a research station. Extension services in Indonesia have been encouraging broader use of the technique in that country (de Bruijn and Dharmaputra 1974). It

Usual spacing of grafted cuttings is 2 x 2 m; remaining space in the homegarden can be intercropped

has been well tested and can be adapted to local conditions through on-farm experiments.

Although the Mukibat technique can be used on any field, its use in homegardens allows farmers to benefit from existing organic matter in a sheltered environment, where, in the case of Mulia Bakti, wild pigs cannot intrude and destroy crops. The usually shady environment in a homegarden is not detrimental, as Mukibat cuttings—like Ceara trees—can grow well under medium shade in conditions where normal cassava would not produce tubers.

The Mukibat technique offers farmers a rare opportunity for improving productivity of tropical homegardens. On an area of only 100 m², 25 grafted cuttings can be grown, producing 750 kg/a of edible cassava tubers.

It is often said that the secret to the success of the Mukibat technique lies in the combination of grafting and manuring. The importance of large holes with organic manure is obvious. However, in Java, farmers obtain high yields by applying the Mukibat technique on dry land outside the homegarden, without making holes and with only limited amounts of organic matter (de Bruijn and Dharmaputra 1974). Thus, the Mukibat technique need not be restricted to homegardens. Research is needed to assess the potential for sustainable open field cultivation using the technique.

The Ceara tree seems to be resistant to the major diseases affecting cassava. Where virus mosaic and brown streak are problems for farmers, in Africa for example, this intimate agroforestry technique could represent a breakthrough for cassava farmers, whether it is used in homegardens or in open fields.

Two features of the Mukibat technique make it promising for application throughout the tropics. First, the Ceara tree is widespread in tropical regions and there would be no shortage of scions from the tree. Secondly, it is a simple technique performed with robust plant material, making it practical for farmers who do not have access to specialized knowledge and tools.

Acknowledgement

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