

Cropping systems

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In DR Congo, bananas and plantains are produced in six systems, listed here in order of importance: forest cultivation, fallow cultivation, cultivation in association with perennial or food crops, backyard cultivation, monoculture cultivation and agroforestry production.

Forest cultivation

Forest cultivation generally involves plantains and dessert bananas. The planting of suckers without a clear spacing (approximately 400 plants/ha) is carried out after partial clearing, during which only the undergrowth and the smallest trees (less than 30 cm in diameter) are cut, while the largest trees (more than 40 cm in diameter) are left standing. The latter protect the soil and allow organic matter to be renewed. Some branches of the trees left standing are often cut to regulate the shade on the ground.. The land is then burned before or after the planting of plantain suckers, which are harvested from neighbouring fields. In some regions, plantains are grown without felling large trees (Figure 1). This system is generally used in combination with other crops such as maize, cassava, rice, taro, beans, yams, etc. The areas vary from less than one hectare to several hectares, depending on the capacity of each family.



Figure 1. A banana plantation in the forest in the Bolobo region, May-Ndombe

On average, three varieties of plantains (French, False Horn and Horn) and two varieties of dessert bananas are grown. The field is regularly maintained, mainly by weeding. The average weight of a bunch is 15 kg due to the continuous renewal of organic matter. At harvest, suckers are not removed unless they are taken for planting to a new field.

The longevity of the banana plantation (3 to 4 cycles) in this system depends on several combined factors, including cultivars, soil types, the level of shade, and maintenance techniques (annual leaf pruning, removal of excess suckers, clearing of ground grasses, possible removal of some small trees and certain branches of larger trees, etc.). One of the main limitations to growing plantains in the forest is the frequent invasion of predators, mainly monkeys and rats. However, predation is more significant the further away from commonly frequented areas and the deeper into the forest.

Fallow cultivation

Initially, this system involves planting bananas and plantains alongside other annual or food crops on fallow land (3 to 5 years) that has been cleared and burned. On average, three cultivars of plantains (French, False Horn and Horn types) and two dessert banana cultivars are grown. At harvest time, suckers are not removed unless they are taken for planting in a new field.

The land is farmed for 2 to 3 years, during which time the other crops gradually disappear, before being left fallow to allow the soil's fertility to recover naturally. Bananas and plantains continue to produce during the fallow period, albeit at a reduced rate.

The areas cultivated vary from less than one hectare to several hectares, depending on the capacity of each family. Planting is done with local suckers without any regular spacing between plants (approximately 400 plants per hectare).

This system ensures an average production of plantains over two to three growing cycles, with yields decreasing as forest cover increases and the land becomes overgrown. The average yield per bunch is approximately 10 kg in the first cycle. No additional nutrients are added.

Crop combinations

Banana and plantain trees are generally grown in association with other crops such as food crops, market garden crops and industrial crops in forests or on fallow land. This association system has the advantage of providing farmers with diversified production at different times of the year. These crop combinations are traditional and generally do not consider the adverse effects of certain combinations, such as competition for light, water and nutrients.

The areas cultivated can vary from one to several hectares. Plantain suckers are planted without a fixed spacing, and other associated crops are planted without a specific spacing (approximately 400 plants per hectare) with local suckers. On average, three plantain cultivars (French, False Horn and Horn types) are grown.

At harvest time, the suckers are not removed unless they are taken for planting in a new field.

At high altitudes, and more specifically in Kivu, dessert bananas, cooking bananas, beer bananas and plantains are intercropped with annual crops such as legumes (Figure 2) and taro or cocoyam, and with perennial crops such as coffee and cocoa. This system ensures an average production of 30 years. There are no nutrient inputs. The average yield per bunch is around 15-25 kg.



Figure 2. Banana-bean combinations in high-altitude regions

In forested areas, simple crop combinations with groundnuts, cocoyam or taro (Figure 3), cassava, maize, rice, yams, tomatoes, etc., alone or in various combinations exist. This system ensures average plantain production over two to three crop cycles, with yields decreasing as forest cover increases and the land becomes overgrown. No nutrients are added. Average yield is approximately 15 kg per bunch in the first cycle.

Furthermore, combining plantains with groundnuts, cocoyam or both crops has a positive effect on their growth and yield. Yields are high when the soil under the plantain crop is

covered with cocoyam or groundnuts, and the increase yield increase is even more remarkable when plantains are combined with both crops at the same time (cocoyam and groundnuts). In the latter combinations, groundnuts provide partial ground cover for three months and fix and enrich the soil with nitrogen. Cocoyam, on the other hand, continues to cover the soil for up to six months (i.e. until the plantains flower). This creates conditions that help maintain soil moisture, inhibit weed growth and reduce nutrient losses due to erosion and leaching.



Figure 3. Plantain-taro combinations in low-altitude regions

Backyard or home gardens

In this cultivation system, banana and plantain trees are planted in gardens surrounding huts or in the backyards of homes, on small plots ranging in size from a few square metres to hundreds of square metres (Figure 4).



Figure 4. Backyard

This is a permanent, highly diversified farming system with banana and plantain crops grown in association with crops such as cassava, sweet potatoes, sugar cane, aubergines, etc. Planting is carried out using local suckers from neighbouring fields or gardens, without taking spacing into account. As the suckers are not removed after harvesting, the banana and plantain trees grow in very dense clumps. Soil cultivation is not frequent.

There is a mixture of dessert banana, cooking banana and plantain cultivars. The different plantain cultivars are French, False Horn and Horn.

Yields in this cultivation system are very high, with an average bunch weight of 15-35 kg. The high fertility of the soil is linked to household waste, livestock manure and all kinds of ash accumulated around the clumps. The decomposition of this mixture enriches the soil with nutrients. The soils of backyards are therefore not only rich in calcium, magnesium and potassium, but also have high levels of organic matter and phosphorus, and a good structure. These characteristics facilitate the exploration of the soil beyond 25 cm by the roots of the plants, resulting in better plant development, early fruiting and significant suckering. Without a doubt, banana and plantain benefit from the favourable physical and

chemical conditions of the soil, which allows them to thrive for many years (more than ten years).

The system is of considerable interest to farmers in that their production is spread throughout the year. Bananas and plantains grown in home gardens are primarily intended for personal consumption. However, production in home gardens alone cannot ensure food self-sufficiency in bananas for the population. To achieve this, the establishment of large, high-yielding plantations incorporating sustainable production techniques over varying periods of time should therefore be considered.

Monoculture

The pure cultivation of bananas and plantains is more common near urban areas, where large-scale producers mainly grow crops for commercial purposes. These fields cover several hectares.

It consists of planting them with local suckers in an open field, generally on burnt land in primary or secondary forest, or on old fallow land. In most cases, planting is done without regard to regular spacing (\pm 1000 plants/ha) and does not receive fertilisers or organic matter, but benefits from regular weeding. Yields are high during the first cycle only (average weight per bunch 12-15 kg) and the plantation has a lifespan of 2-3 years. Shoots are not removed after harvesting.

The choice of cultivars depends mainly on consumer market demand. False Horn and Horn types of plantains are mostly grown in low-altitude areas, while high-altitude cooking banana cultivars are grown in high-altitude areas.

Agroforestry system

The agroforestry system is a cultivation system in which banana and plantain trees are grown in association with perennial crops (trees, shrubs, palms, etc.) (Figure 5).

After clearing the forest by cutting down undergrowth, some precious wood species are preserved due to their domestic or industrial uses, the lack of suitable felling equipment, or socio-cultural reasons. The seedlings are planted at intervals of 4 m x 4 m. When they reach the age of two, Limba (*Terminalia superba*) seedlings are planted at intervals of 8 m x 12 m. Dessert bananas (Gros Michel, Yangambi km 5) and plantains (French, False Horn and Horn) can be harvested in this system with an average weight of between 7-17 kg for around 60 years. The trees are never pruned, and the banana and plantain trees are barely maintained. At harvest time, the suckers are not removed. The areas can cover several hundred hectares.

Another agroforestry system involves growing plantains (French, False Horn and Horn) in combination with exotic legume trees such as *Leucaena leucocephala* (Figure 5), *Albizia chinensis*, *Acacia sp.*, etc.



Figure 5. Plantain in an agroforestry system with *Leucaena leucocephala*

With exotic tree legumes, banana and plantain trees are planted in rows 3 m x 3 m apart. The prunings from these legumes are regularly cut and placed as mulch around the plantain stumps. This system ensures good yields and plantain production for +/-15 years. The banana and plantain trees are barely maintained. At harvest time, the suckers are not removed. The fields cover a few hectares.

Trials have been conducted involving the direct planting of banana and plantain trees (French, False Horn and Horn) in forests or old fallow land dominated by local legumes such as *Pterocarpus soyauxii*, *Piptadeniastrum africanum*, *Albizia adianthifolia*, *Prioria balsamifera*, etc. In this case, when clearing the land, the legume trees found on site are not cut down but left. Plantain suckers are planted under these trees. The prunings from these legumes are also regularly cut and applied as mulch around the plantain stumps. In terms of biomass produced, all four of these legumes produce sufficient amounts. The values observed on the older stems were 3.8%, 4.17%, 3.18% and 4.26% dry matter, respectively, for the nitrogen content of the leaves of *Albizia adiantifolia*, *Piptadeniastrum africanum*, *Prioria balsamifera* and *Pterocarpus soyauxii*. The proportion of other nutrients such as phosphorus and potassium is relatively low.

This cultivation system, which uses prunings from local legume trees, increases plantain production in the second crop cycle.