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This article can be found in: Torquebiau E (ed.). 2024. Agroforestry at work. *Tropical Forest Issues* 62. Tropenbos International, Ede, the Netherlands (pp. 136–142).

Hillside agroforests and lowland rice fields on the east coast of Madagascar. Photo: Julien Sarron

The agroforests of the east coast of Madagascar

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“Cash crops grown in agroforests on the east coast of Madagascar generate foreign currency for the country and help to ensure food security for farmers, but is this sustainable?”

Vanilla, cloves and cinnamon are indispensable ingredients in gastronomic traditions the world over, and also have numerous industrial, medicinal and agricultural applications. These crops have made Madagascar famous, but are they the source of its wealth? Are they profitable for farmers? What is their future in a context of great economic uncertainty on the international market and in the face of climate change?

Agroforests based on cash crops

In Madagascar, vanilla, cloves, lychees, black pepper and cinnamon are all grown along the east coast by thousands of small-scale farmers in agroforestry plots featuring a high level of plant biodiversity within complex arrangements. These cash crops are a part of the country's history, which for a long time during the French colonial era focused on exports.



Clove trees in a rainfed rice plot. Photo: Pascal Danthu

The introduction of these crops profoundly altered ancestral family farming, which was based on the practice of *tavy* (slash-and-burn cultivation) on the hillsides for the production of rainfed rice and other subsistence food crops. Now, irrigated rice is cultivated in

the lowlands, and agroforestry plots for cash crops cover the slopes. These fall into three categories:

1. mono-specific plantations with a dominant crop (in particular, clove trees), although this type of plot is now in the minority;
2. parks, where a dominant tree crop is combined with one or more annual crops (for example, clove trees and rainfed rice, vanilla, maize or sugarcane), or with grazing; and
3. agroforests, which are more or less complex, and characterized by a wide diversity of associated plants (cultivated or not) forming a multistorey structure (for example, clove trees and lychees, or other fruit trees, timber trees, sugarcane, vanilla, pineapple).

Farmers who are also food processors

The markets for these products are in the hands of a few global giants of the food industry, and the structure of the commodity chains is relatively simple: collectors/buyers act as the link between farmers and exporters, who are generally based in Toamasina (also called Tamatave), the main export port. The farmers deliver a finished product to the collectors, ready for export.

Depending on the product, preparation is more or less complex and time-consuming.



Agroforest with young clove trees. Photo: Pascal Danthu

Preparing vanilla involves a series of stages requiring real expertise to give the finished product its quality and aromatic complexity. It starts with hand-pollination, followed by several post-harvest stages: scalding, steaming, drying, refining of the pods, and sorting and packaging of the black vanilla.

The clove tree is hardy and requires little maintenance, but the bud must be harvested before the flower opens, otherwise, “headless” cloves of lesser commercial value will be produced. De-clumping (separating the flower bud from the stalk) and drying in the sun take four or five days. The essential oil of cloves is obtained by distilling the leaves or cloves in stills (which are often archaic and consume a lot of firewood) for 12 to 24 hours, with a yield of around 5%.

The lychees have to be delivered very quickly for conditioning (sulphuring) and storage in the cold rooms of the refrigerated ships that transport them to Europe.

Plant products from agroforests in Madagascar’s top three exports

Today, Madagascar is the world’s leading producer of vanilla (around 70% of global production), the second largest exporter of cloves (behind Indonesia, the undisputed leader) and essential clove oil (20,000 and 2,000 tonnes respectively), and the leading exporter of lychees to the European market. In 2020, vanilla accounted for almost 22% of Madagascar’s exports, while cloves and essential oils each accounted for 3% (Danthu et al. 2020; OEC 2020; BFM 2023).

However, this snapshot should not mask very significant interannual variations, as shown in Figure 1. The share of plant products from the east coast in total Malagasy exports dropped from a range of 20% to 30% in 1990–1995 to around 5% to 10% between 2005 and 2009, stabilizing at between 30% and 40% since 2016. Vanilla is by far the most profitable crop, although this has not always been the case; in the 2010s, it was cloves.

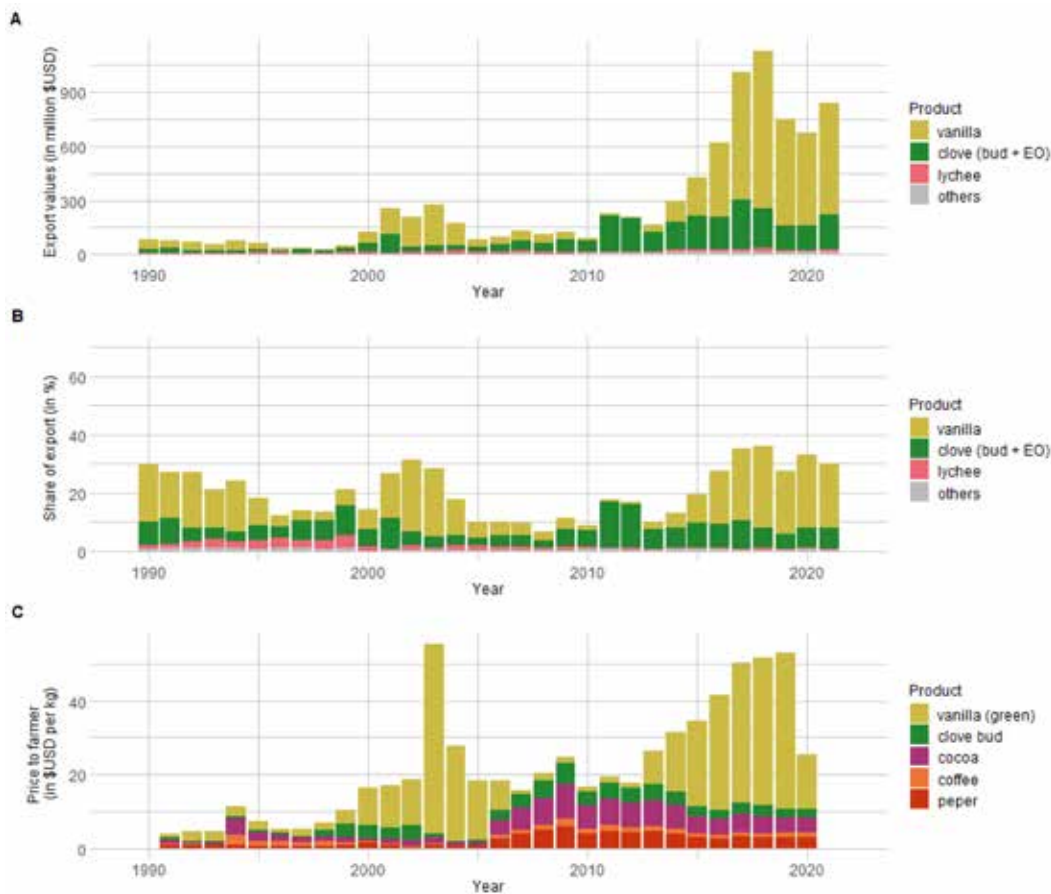


Figure 1. a) Exports (USD million); b) percentage of total exports; and c) farm gate price (USD/kg) of cash crops in Madagascar, 1990–2020. EO: essential oil. Source: BFM 2023; FAOSTAT 2023



Vanilla grower. Photo: Juliette Mariel

Vanilla has been subject to much speculation and uncertainty, and has experienced considerable price fluctuations for more than twenty years. The price of a kilogram (kg) of prepared vanilla ranged from USD 6 to USD 600 between 1999 and 2016, falling back to between USD 250 and USD 400 more recently (Veldhuyzen 2019). Some of these fluctuations are linked to the vagaries of weather, growing conditions and farmers' know-how. Added to this are local security conditions, with theft of green vanilla a real problem, as well as the speculative strategies of the main players in the industry. The setting of a minimum purchase price by the government drove buyers away when this turned out to be higher than the

world price. This has been the case since 2020. These difficulties may have prompted some manufacturers to turn to other vanilla suppliers such as Indonesia, Papua New Guinea and Uganda, or even to... synthetic vanillin.

Indonesia, Tanzania (the islands of Zanzibar and Pemba), Comoros and Brazil are significant competitors in cloves, which have three main destinations: Indonesia, to supplement the Indonesian harvest and supply the *kretek* industry (a traditional cigarette made partially from cloves); India, and the Middle East, where spice blends (curry or massala) are produced — and in addition, the niche market in northern countries. The world price of cloves is less volatile than that of vanilla, but varied from USD 2 to USD 22/kg between 2001 and 2012, stabilizing today at between USD 7 and USD 9. For essential clove oil, the average price is around USD 10/kg; it has risen almost continuously since 1998, when it was USD 3 (BFM 2023; FAOSTAT 2023).

Lychee exports from Madagascar (by refrigerated ship) supply around 80% of the European market, and total around 17,000 metric tonnes (mt) a year (Jahiel et al. 2014). The industry is organized around the *Groupement des Exportateurs de Litchi*. Every November, the export campaign mobilizes 75,000 seasonal workers to harvest and pack the fruit. Prices have stagnated at around USD 1,300/mt for 20 years, and export volumes are tending to fall (from 24,000 mt in 2008 to 14,000 mt in 2022) (BFM 2023), in line with a loss of fruit quality and less interest on the part of European consumers.

The central role of cash crops in farm income and the sustainability of family farms

In 2021, around 1.3 million households were engaged in agriculture on the country's east coast, including 780,000 in cash crops, with the largest contingents in the Sava and Analanjirifo regions (INSTAT 2020). Cash crops grown in agroforests in these regions (mainly clove essential oil and cloves, vanilla and lychee) account for between 20% and almost 100% of cash income (Fourcin et al. 2015). As a result, farm households in these regions have higher incomes than those in the more isolated southern regions (southern Atsinanana and especially Vatovavy, Fitovinany and Atsimo Atsinanana), where cash crops are more rare.

In Analanjirifo Region (the heart of clove production), at least 50% of farm income comes from clove products. Farm households with the most clove trees are those that generate the highest annual farm income. In this region,

where all the lowlands are cultivated with rice, 50% to 70% of households are unable to be self-sufficient in rice, the staple food in Madagascar. Income from cash crops is used primarily to buy additional rice, in order to achieve indirect food security.

The parks and agroforests provide income as well as self-consumed products (fruit, wood, medicinal plants), which represent a relatively significant saving — or rather, non-expenditure — for farm households. Some species, such as breadfruit, cassava and maize, are used to meet food requirements, particularly each year in April or May, when rice reserves are exhausted and the new harvest is not yet available (known as the hunger season). They also contribute to feeding livestock and poultry.

Sava Region, which produces vanilla, appears to be the richest. Vanilla is a source of high income, even if world market prices fluctuate (from USD 15 to USD 38 per kg of green vanilla between 2017 and 2020). Some boom years bring a substantial financial windfall, leading to spectacular buying sprees (mattresses, televisions, solar panels, etc.). However, the day-to-day reality remains marked by the poverty syndrome. Farmers are often forced to sell their green vanilla, sometimes below the minimum price set by the government, in order to ensure their food security.

Diversifying crops and farm income: a way of adapting to volatile world prices?

For farm households involved in cash crops, cloves and vanilla account for a significant proportion of their income. But their strategy is characterized both by diversified production for export (cloves and essential clove oil, green and prepared vanilla, as well as lychees, pepper and cinnamon), and by production that is either self-consumed or sold in local markets (bananas, avocados, cassava, lychees, breadfruit, jackfruit, *noni* (*Morinda citrifolia*), soursop, pineapple and citrus), sometimes supplemented by livestock products. This diversification of cash crops is a protection against the high volatility of products on the world market, providing income over the long term.

These diversification initiatives also take into account, although often in a very reactive way, changes in international demand for high-quality products with high added value, as is currently the case for black pepper, pepper tree (*Schinus terebinthifolius*) and above all cinnamon, for which global demand is rising sharply.

A positive situation at present, but a questionable outlook

The export commodity chains of the east coast of Madagascar for crops grown mainly in agroforests are sources of wealth for the country, significantly consolidating its trade balance. They also support food security and limit the extent of poverty, or even ensure relative financial comfort for farming households, compared with those in other regions of the country.

However, long-term observations of these agroforests and their production highlight variations in production and farmers' remuneration, which ultimately raise questions about the role of cash crops in improving the living conditions and food security of farm households. In the past, these developments have led to periods of crisis or euphoria, raising questions about the future: what dynamics, what hazards, what resilience?

In addition to production fluctuations, it is possible, and even likely, that there will be more numerous and more violent shocks linked to climate change, which is already having a significant impact on Madagascar (drought, floods, cyclones, rising temperatures) and which could cause lasting disruption to crop yields. Similarly, the production of essential clove oil in highly inefficient stills consumes large quantities of firewood, which puts considerable pressure on wood resources. As a result, a



Sale of lychees at a local market. Photo: Eric Malézieux



Cinnamon sticks. Photo: Eric Penot

major constraint has arisen in the supply of firewood to run the 5,000 to 8,000 stills of the east coast. Thought needs to be given to developing this production by, for example, promoting the inclusion of fast-growing trees in or near agroforests.

The economic outlook is no more reassuring, and some plausible developments could worsen the situation. In the short term, developments in green chemistry could offer synthetic eugenol or vanillin at such a low cost that these two compounds would replace essential clove oil or vanilla in many industrial applications. This threat is reinforced by competition from other emerging countries: Comoros, Zanzibar and Brazil for cloves, Indonesia, Mexico or Papua New Guinea for vanilla, Viet Nam and Réunion Island for lychee.

It is therefore difficult to be certain about the medium- and long-term sustainability of Madagascar's cash crop export sectors, and therefore about the resilience of the farmers who supply them.

Promoting income security through diversification

This overview of agroforests on the east coast of Madagascar, the place of the products they provide on world markets, the role they play in the resilience of farm households, and also the hazards that threaten them, raises the question of their sustainability and adaptation.

The answer may lie in one word: diversification — not only of crops but also of land management practices, and of the uses of the products (sale, self-consumption, food or feed, other uses).

Diversifying the uses in agroforests makes it possible to combine cash crops, food crops for self-consumption and crops sold locally: rice, tubers and fruit, small livestock (zebus, as standing capital or labour, pigs, poultry). It could also lead to an increase in vegetable production, in order to reduce household dependence on purchased vegetables; these are often imported from the high plateaus in the centre of the country, and are therefore expensive and not widely consumed locally.

Diversification can focus more specifically on cash crops, combining cloves and vanilla, as well as other products with high added value or high demand on international markets, such as black pepper, cinnamon, pepper tree berries, ginger and cardamom. It can also involve a better valorization of resources, particularly clove trees, by combining the cultivation of cloves and the production of essential oil from the distillation of the leaves. This diversification can (and should) also involve reintroducing trees for firewood into agroforests and rehabilitating or improving stills to improve essential oil yields at a lower environmental cost.

Studies on the physiology of interactions between species in agroforests, and on the management of

agro-biodiversity at different scales, from plots to farms and landscapes, will enable better crop diversification, improve product quality, and ensure the resilience of agroforestry systems through a better adaptation to climate hazards. But whatever the case, there are already many approaches being used by farmers, whose knowledge has enabled them to ensure the resilience of their farms and to overcome economic and ecological crises.

Conclusions

- A significant proportion of Madagascar's wealth is generated by the export of plant products from the agroforests of the east coast, mainly vanilla, cloves and lychees.
- The agroforests of the east coast, the cash crops they support and the products they produce help to reduce poverty among rural populations.
- These crops are grown by thousands of small farmers who also process the products (cloves, essential clove oil, vanilla), delivering finished products for the commodity chains.
- Farmers manage the diversity of their agroforestry plots and, more generally, of their farms, which also include rice paddies and livestock, in order to increase their financial income and food security.
- This necessary diversification of production needs to be strengthened in order to ensure the long-term resilience of farms in the face of possible future climatic and economic hazards.

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