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Aerial view of the oil palm agroforestry Expansion Pilot site. Photo: Natura Cosméticos

Criteria for scaling up oil palm agroforestry in northeastern Pará, Brazil

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"Ensuring regeneration performance and environmental benefits while promoting inclusive economic benefits for different farmer profiles is the goal."

Introduction

The global scenario of oil palm monoculture produces several social and environmental conflicts, mainly regarding conversion of logged tropical forests, loss of biodiversity and insecure land rights (Goh et al. 2017). In Brazil, science-based evidence has emerged in recent years on the positive impacts of oil palm agroforestry (Ramos et al. 2018; Castellani et al. 2011), showing that the conservation of biodiversity allied to the oil palm chain is possible. When well realized, this approach includes oil palm — a pioneer forest species that before being domesticated existed naturally in a forest environment — as part of a diversified production system. The system promotes farmers' livelihoods, guarantees future income from timber production and supports food security, as well as soil improvement and carbon capture and storage.

The municipality of Tomé-Açu, in the northeast of the state of Pará, encompasses more than 200 agroforestry systems (with different arrangements of plants) tested by the Mixed Agricultural Cooperative of Tomé-Açu (CAMTA), which has achieved international recognition for agroforestry practices (Piekielek 2010). Founded by Japanese immigrants more than 90 years ago (1931), the cooperative was once the world's largest producer of black pepper, but disease in the 1960s in the monoculture areas decimated the pepper plantations. After a period with monoculture and many lessons learned, the cooperative realized that the backyard agroforestry gardens of riverside dwellers did not face significant agronomic difficulties. The cooperative saw the opportunity to work from the perspective of diversification. Today, with the support of agro-industry, it is one of the largest examples of agroforestry production and commercialization in the Amazon, acting as an important disseminator of agroecological practices and an essential partner for agroforestry research and the pilot scale-up of the SAF Dendê oil palm agroforestry system.

This article reports on part of the activities carried out in Tomé-Açu by Natura, a cosmetics company, and CAMTA, which build on former research activities that also included the Brazilian Agricultural Research Corporation (Embrapa) and the World Agroforestry Centre (ICRAF). These pilot activities, called the Expansion Pilot, aim to mobilize developing low-risk business models for farmers.

Challenges to the expansion of oil palm agroforestry

There are four main challenges in scaling up oil palm agroforestry in the Brazilian Amazon:

1. environmental and land tenure regularization, both in time frame and costs of legalization;
2. effective implementation of financing systems with disbursements that align with the agricultural calendar, as well as financial mechanisms for various types of farmers;
3. labour demand — including mechanized alternatives and involvement of a diversity of farmers (family farmers, small and medium farmers); and
4. market connections and agreements for various agroforestry products — internal purchasing agreements with the cooperative, with the subsequent involvement of other companies.

It is important to emphasize that socio-environmental benefits must be linked to farmers' needs. This requires access to qualified technical assistance for guidance on agroecological system management and productivity, on the agroecological inputs available, and on guarantees of complex relationships such as land-use rights. One essential aspect is that no planting should take place in areas with illegal deforestation after 2008.

As for market certification related to sustainable oil palm practices, the requirements of the Roundtable on Sustainable Palm Oil (RSPO) have been used. And, since oil palm agroforestry includes other crops, it is important to consider all components. In this context, the Union for Ethical Biotrade (UEBT), which certifies the ethical sourcing system of natural ingredients and is guided by the principles of fair trade, biodiversity conservation and a trusting relationship with supplier communities, can guide practices.

As mentioned above, a specific challenge is land tenure regularization. Although the legalization process generates management benefits and greater visibility for local restoration and recovery initiatives, the necessary documentation, the applications for authorizations for site preparation and the planting licences all need to be taken into account into the budget and schedule, as they can be complex and time consuming.

Brandão et al. (2018) observed with small integrated producers in northeastern Pará that the ability to hire labour has been a more important determinant of labour allocation in plantation management than the availability of family labour. Labour is very important in the initial phase of the system, and its scarcity has been worsened by the fact that farmers are also involved in cocoa harvesting and maintaining good practices for the production of cocoa beans.

There is a need to release funds on a schedule that is adjusted to the agricultural calendar, as there was no specific credit line for the implementation of agroforestry systems.

Importantly, carbon was also considered as a product of the system. And along with the market created for it, a question arose: can carbon generate financing for a transition from oil palm monoculture to more ecological production systems?

Oil palm agroforestry research site in Pará, Brazil. Photo: Natura Cosméticos

Unprecedented solutions for a revolutionary production system

In 2007 Natura, CAMTA and Embrapa started what would become the largest research project in duration and investment ever carried out by the companies, with the third-highest number of scientific publications. The first demonstration plots were planted 15 years ago. Thanks to the choice of inputs in the production process, and to agroecological management and arrangements that are well-adapted to the ecological functions of the species, the project has shown excellent results in terms of productivity per hectare and environmental benefits, such as increased carbon storage (Ramos et al. 2018), soil fertility, nutrient cycling and biodiversity.

All the knowledge and learning by the cooperative was incorporated in the structuring of the Expansion Pilot. This learning, combined with the natural demands of the scaling process, brought with it the understanding of the need to develop parameters that would meet the interests of the various farmers without losing the guidance and essence of the work already done. It is in this context that the SAF Dendê guiding principles for oil palm agroforestry emerged, seeking to quantify the new productive areas through three key performance indicators (KPIs): plant diversity, functionality, and economic diversity. The guiding principles also provide inputs for the monetization of positive impacts in the scaling phase.

Guiding principles

It was necessary for the guiding principles to address five factors:

a. reliability, by proposing technical-scientific robustness combined with transparency and simplicity in obtaining data;
b. eligibility, from the use of more than one criterion per KPI, and where criteria can be used simultaneously or prioritized as appropriate;
c. scalability, by considering agility and ability to adjust to different areas and contexts through the use of remote sensing tools for field measurements;
d. replicability, by adapting the criteria to different landforms, climate and agricultural activities; and
e. impact, by correlating each key performance indicator to an ecosystem service, considering the scope of the impacts and extrapolating the results in a context beyond the borders of the analyzed property.

It is important to reaffirm the basic requirements of effective oil palm agroforestry: comply with RSPO and UEBT specifications; have a range of tree species in the system; address ecological succession among species and the presence of at least two strata at the end of the cycle; carry out more than one regenerative practice, in addition to the non-use of fire and the use of service species; have at least 50% native species in the system

throughout its existence; and achieve a minimum of 5 of the 12 criteria of the KPIs.

There are three KPIs. Each of the three indicators has four criteria, and each criteria receives a score of either 0 (absence) or 1 (presence). Therefore, there is a possible score of up to 4 points per KPI and a total possible score of 12 points.

KPI Plant diversity assesses the abundance and number of species in the production system and is directly interconnected with other ecosystem services and the presence of micro, meso and macrofauna. It confers nutritional and phytosanitary health and resilience to the system. These are the four criteria:

- at least two of the three main functional niches: forest species (long cycle), intermediate species (medium cycle), and agricultural crops (short cycle);
- at least three forest species native to the biome throughout the system cycle, at least two of which are perennial;
- support soil health, increased use of organic inputs throughout the cycle, replacing chemical fertilizers;
- support native biodiversity in the system by eliminating pesticide use throughout the cycle.

KPI Functionality assesses the harmonious functioning of the system; i.e., how well the production system ecologically and architecturally mimics natural forest processes. Functionality supports intensification of ecosystem services and greater climate resilience of the system. These are the four criteria:

- active ground cover in and between the rows throughout the entire system in the early and middle stages;
- at least 50% of the area has some canopy cover by the middle stage of the system;
- at least two species (annual, perennial, semi-perennial) in the system have provide an environmental service; e.g., nitrogen fixation and provision of organic matter;
- in terms of land cover density the number of individuals of perennial species per hectare is greater than 600 in the most advanced period of succession.

KPI Economic diversity assesses the economic and market resilience of the system, as well as food security, product diversity and management effectiveness. Reducing risks through diversification confers possibilities for various products and price premiums as well as robustness in production. These are the four criteria:

- at least one species in the system provides non-timber forest products (NTFPs) as its main product at any time in the cycle;
- at least one species in the system is a fruit tree;
- at least one long-cycle timber species is present (no less than 20 individuals per hectare);

Left: Field workshop at an oil palm agroforestry scaling site. Right: Planting. Photos: Natura Cosméticos

- diverse agricultural species are present, with no less than two being annual or semi-perennial.

The minimum value of compliance should be five of the 12 KPIs criteria met (42%). The requirement for farmers is that the system should show continuous improvement with constant monitoring that reflects a higher and better score over the years. Farmers are now able to achieve 100% compliance from the middle stage of the system, between eight and nine years after the start (given that 50% canopy cover cannot be achieved before the middle stage). Five farms planted in 2022 and 2023 have areas ranging from 5 to 48 hectares.

The guiding principles were established for the micro scale of the production system, with the flexibility to be used at the macro scale of the landscape (depending on the local partners available), and with potential for use at a global scale, in terms of expansion of the intended impact. The involvement of a range of actors (farmers, associations, cooperatives, partner companies) emphasizes the importance of valuing all those who contribute significantly to the generation of positive impacts through proven ecosystem services. It also opens up the possibility of the principles themselves being adjusted in the future if necessary.

It is also important to reinforce the importance of considering the 12 criteria in the selection of production areas, so that ecosystem services are maximized. As shown in Figure 1, this includes areas' potential for contributing to six themes (T): conservation of genetic resources (T1), livelihood systems (T2), forest management and restoration (T3), investments, value chain and overall sustainability (T4), landscape dynamics (T5) and climate change and forest changes (T6). These six factors are intrinsically related to land use; i.e., in areas with annual crops or grasses, the contribution to climate change mitigation, conservation of genetic resources and forest management and restoration are practically nil. Therefore, such areas should be a priority for oil palm agroforestry.

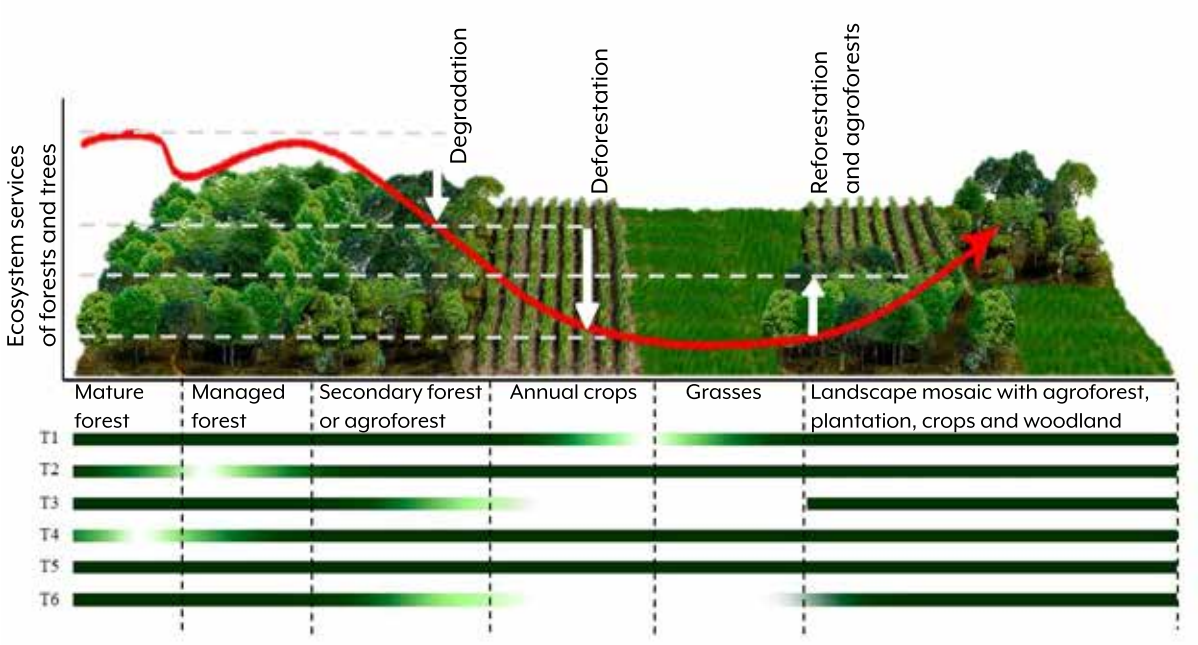

Figure 1. Forest and land use transition curve (red arrow), human intervention (white arrows) and the themes for each area of the landscape (the darker the green bar, the more pertinent the theme)

T1: conservation of genetic resources; T2: livelihood systems; T3: forest management and restoration; T4: investments, value chain and overall sustainability; T5: landscape dynamics; T6: climate change and forest change. Source: Costa (2018), adapted from CIFOR (2011).

Financing implementation

Assessing the research data for the oldest demonstration plots of oil palm agroforestry, the costs and management practices of the cooperative's technicians and farmers, and the bank's assessment of the species indicated for modelling, allowed Natura, along with a financial institution, to develop the first spreadsheets in Brazil for financing oil palm agroforestry. Previously, for the first three years, in which farmers have the greatest need for investments, there was no way for them to obtain financial resources through banks. Now, however, the financial institution has an investment line for setting up agroforestry systems with oil palm.

Two spreadsheets were created for analysis. They differ in fertilizer inputs during implementation; the organic model includes 100% organic fertilizer and the mixed model includes a combination of organic (40%) and chemical (60%) fertilizer. Farmers who opt for the mixed model frequently increase the use of organic inputs throughout the cycle.

Due to the high cost of chemical inputs in recent years, the two spreadsheets showed similar profitability. There were large areas implemented in 2022 (approximately 40 to 50 ha each), where farmers chose to finance implementation with their own resources. Table 1 presents the more conservative spreadsheet, with mixed fertilizers. The main crops considered were oil palm, cocoa, black pepper and *andiroba* (*Carapa guianensis*, a timber tree also grown for the oil content of its seeds), with guaranteed purchase of cocoa and black pepper by the cooperative and of palm and *andiroba* oil by Natura.

Oil palm seedling. Photo: Natura Cosméticos

Table 1. Costs (Brazilian real, or BRL) for soil preparation, demarcation and seedlings, year zero

Use of the product / service	Description of the product	Unit	Quantity	Unit price	Total
Planting	Oil palm seedlings	unit	109.00	15.00	1,635.00
Planting	Cocoa seedlings	unit	571.00	1.75	999.25
Planting	Agroforestry seedlings (propagules)	unit	300.00	1.00	300.00
Planting	Agroforestry seedlings (seeds)	unit	40.00	20.00	800.00
Planting	Pepper seedlings	unit	326.00	3.00	978.00
Planting	Forest species seedlings	unit	26.00	2.50	65.00
Liming	Dolomitic clay	kg	1,000.00	0.50	500.00
Phosphate	Natural phosphate	kg	439.60	2.03	892.39
Soil survey and analysis	Soil analysis	unit	1.00	220.00	220.00
Soil preparation for planting	Tractor	hourly rental	10.07	300.00	3,021.00
Removal of wood stakes (marking for planting)	Agricultural day labourer	daily wage	5.48	75.72	414.95
Demarcation and picketing	Agricultural day labourer	daily wage	1.00	75.72	75.72
Land surveyor	Surveyor's daily allowance	daily wage	0.10	1,000.00	100.00
Total					**10,001.31**

Given these costs, and the challenge of finding financing mechanisms that meet the various profiles of farmers, there is an opportunity to consider carbon as another element in the financing of a transition from oil palm monoculture to more ecological production systems such as oil palm agroforestry, once good management practices are adopted to incorporate carbon and promote soil health.

In addition, insurance specific to agroforestry is being developed with a global insurance company, so that farmers are covered, especially in the face of the growing impacts linked to climate change.

Ways forward

The learning accumulated over the years working with oil palm agroforestry brings confidence, but does not eliminate the possibility of new challenges.

Expediting land and environmental regularization requires a concerted effort with government agencies to ensure that investments meet broader business and government demands, and do not leave out interested smallholder farmers who can benefit from inclusive agreements.

For the mechanization cost challenge, given the diversity of farmers, it is appropriate to consider viable alternatives that meet the needs of small and medium farmers who are already involved, based on local partnerships. New technologies are emerging all the time and CAMTA's technical team, Natura and new partners are aware of them.

Although there are decades of research and agronomic experience in oil palm monoculture, compared to only one full decade of oil palm agroforestry, it is certain that increasing ecosystem services is the only possible path to improve the world's most important vegetable oil chain, still so tied to and associated with environmental and social harm.

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