Farmer Zé Paixão in his oil palm agroforest, Tomé Açu, Pará State.

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CHAPTER 27

Oil palm in Brazil: lessons from policies and agroforestry innovation

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Highlights:

- Brazil may well have the worlds' largest potential area for oil palm expansion, but only a very small part of expansion plans has been realized
- The Amazonian oil palm, *Elaeis oleifera*, has a number of agronomically desirable traits and is used in hybridization and breeding programs with the African oil palm (*E. guineensis*)
- National policies aimed at including family farmers in contract farming of monocrop oil palm plantations have had mixed results on farmer livelihoods and negative environmental impacts
- Early results from demonstration sites in the Brazilian Amazon suggest that oil palm cultivated in agroforestry in this context can be feasible socially, financially and environmentally
- A key to successful oil palm agroforestry is the flexibility of systems and practices and farmer engagement in designing solutions, as oil palm arrangements in different combinations with agroforestry crops can produce attractive financial results and meet other farmer goals.

1. Introduction

Geological similarity of Latin America and Africa is based on a common history before the mid-Atlantic rift caused the two continents to drift apart. The Amazon basin climate is comparable to that of the W and C African coastal zone, with similarities in vegetation types, potential for tropical commodity production and agroforestry systems. These favourable conditions on both sides of the Atlantic gave rise to parallel commodity development processes despite marked disparities between the two regions with regard to governance, policies and land use dynamics. While some regions of Brazil have reached high development indices, others such

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as the Amazon basin still face similar social and environmental challenges as found in tropical African countries, including high rates of deforestation, prevalence of slash-and-burn farming among smallholders, illegal logging, mining and the rapid expansion of large-scale monocrop commodity production (Duguma et al 2021). These similarities and differences allow for rich learning on developing pathways for more inclusive value chains and environmentally friendly production systems including commodities.

In the Brazilian Amazon, while only a small fraction of the original inhabitants survived (currently less than 1% of the Brazilian population is officially considered indigenous), indigenous peoples, who speak 170 languages in 250 ethnic groups, still occupy vast swaths of land protected under Brazilian law (totalling roughly 12% of the territory). Besides their key role in conserving remaining forests, particularly in the Amazon basin, the influence of these indigenous peoples can be seen to this day in traditional farming methods and harvesting of wild fruits and nuts ("extractivism"), practices widely adopted by riverine and other forest-dwelling communities throughout the Amazon. So despite clear differences in levels of governance, access to public services, and land use policies, the two regions face similar challenges and threats with regard to social exclusion, rural livelihoods and conservation goals. They also share similar opportunities for turning the tide on degradation and inclusion of small-scale farmers in commodity production.

The expansion of oil palm in Brazil provides valuable lessons for African contexts in terms of policies, production systems and approaches to innovation. This learning seems particularly relevant in contexts where: oil palm companies are establishing outgrower agreements with small-scale farmers; there is an appetite and markets for agroforestry products (such as cocoa, food crops and native fruits and timber species), and/or; ecosystems services or conservation are important components of land use goals. This chapter draws out learning from policies that drove the expansion of oil palm in the Brazilian Amazon, examining social and environmental impacts, then zooms in on a case study of diversified oil palm production through agroforestry systems.

2. Recent expansion of oil palm in Brazil

While Brazil is a minor producer and major importer of palm oil, its area of deforested land with soil and climate suitable for oil palm cultivation (mostly in the Brazilian Amazon) is twice that of current oil palm production throughout the world (Villela et al 2014). Global models of biophysical suitability for oil palm consistently rank Brazil as having the greatest potential for expansion of the crop, with estimates as high as 238 Mha of suitable lands (Benami et al 2018). In 2010, Brazil launched the Sustainable Palm Oil Production Program (SPOPP) to incentivize oil palm development without deforestation on as much as 30 Mha (Benami et al 2018). Although only a fraction of this target has been reached (harvested area 0.18 Mha in 2019 according to FAOstat data (FAO 2022), which is comparable to the 0.17 Mha of natural rubber), the area on which oil palm production could expand spurred by global market prices is substantial.

The first oil palm stands in Brazil date back to the 16th century, when enslaved peoples from West African were taken to the Atlantic coast state of Bahia, where palm oil is still a key element of local cuisine and Afro-Brazilian culture. Diversified oil palm agroforestry for small-scale local processing of oil persists to this day in Bahıa homegardens, despite efforts to replace it by monocrop plantations and industrial processing (Watkins 2018). The first industrial-scale oil palm production started with seeds collected from these Bahia oil palms and planted in the Eastern Amazon State of Pará. In 1995, the Pará State government held an official visit to Malaysia to learn about palm oil contract farming between agroindustry and peasant communities, and afterwards the state government and palm oil industry devised a contract farming pilot model for small producers (Córdoba et al 2022a). In the same region where oil palm has expanded in recent decades (Tomé Açu, Pará State), farmers with Japanese roots pioneered semi-intensified agroforestry practices that proved to be compatible with oil palm production.

Historically, one of the main constraints for companies expanding operations in NE Pará has been the grave risks associated with bud rot ("fatal yellowing"), which can have catastrophic effects on plantations. A potential solution for this threat can be found in an indigenous American oil palm *Elaeis oleifera* or 'caiauê', a sibling species of the African oil palm (*E. guineensis*), which occurs naturally along the Amazon river network. Although its cultivation is not economically viable due to its lower yields, it has some agronomic traits of great interest for breeding with its African cousin, such as slower growth in height (allowing more years of harvesting before palms are too tall), a preferred, mostly unsaturated oil quality and resistance to bud rot (Moretzsohn et al 2002). The two species hybridize easily, although manual pollination is often required, and interspecific hybrids can be obtained with yields around 90% of the commercial oil palm yields. In Brazil, hybrids of the African and native Amazonian oil palm may also play an important role in mandatory land restoration efforts.

Environmental policies requiring restoration of environmentally sensitive areas allow farmers to use agroforestry systems, which can include oil palm and other exotic species, provided they are intercropped with at least 50% native tree species. The Brazilian Law for the Protection of Native Vegetation (2012) obliges farmers to restore degraded lands on rural properties, which can be done through agroforestry systems or other methods, as long as they maintain ecological functions in addition to social functions, targeting family farmers, whose farm size can vary legally from 20 to 440 ha (depending on municipal economic indicators) (Miccolis et al 2019). While the use of these hybrids as natives has yet to be regulated, these obligations afford opportunities for oil palm to help offset the high costs of land restoration efforts, particularly among family farmers (Permanent Preservation Areas and Legal Reserves), but also on medium to large-scale farms (Legal Reserves only).

3. Oil palm governance and impacts among family farming in Brazil

Launched in 2010, the national Sustainable Palm Oil Production Program (SPOPP) (Córdoba et al 2018) provides important lessons on governance models and the attempt to include large numbers of family farmers in the oil palm value chain (Box 27.1). A recent study assessing the program's impacts argues that although its goal of avoiding forest conversion from new plantations was largely achieved, its main objective of including smallholders ("family farmers", in Brazil) in the oil palm supply chain did not live up to expectations (Brandão et al 2021). Moreover, the study finds that over half the surveyed farmers who managed to meet eligibility criteria required by companies to establish contracts performed poorly in terms of oil palm yields or farmer well-being. In practice, the SPOPP, touted as an avenue for including small-scale farmers, reinforced large-scale production and excluded more vulnerable farmers, while also promoting the concentration of land ownership and failing to improve the terms for including marginalized actors in the oil palm chain (Córdoba et al 2018), with some notable exceptions, as discussed below (Box 27.1). While government incentives for sourcing palm oil through family farmers spurred considerable investments in expansion of monocrop plantations, more investments are needed in the enabling environment for diversified systems: building farmer capacity to establish and manage oil palm agroforestry, increasing access to lines of credit for mixed systems, and more evidence on their multiple benefits to farmers.

Box 27.1

Mixed press on Brazil's Sustainable Palm Oil Production Program (SPOPP)

As discussed by Córdoba et al (2022a), the Sustainable Oil Palm Production Program (SPOPP) launched under the Lula da Silva administration in 2010 was an attempt to break decades of 'developmentalist' federal policies dating back to the 1970s that had dire social and environmental consequences for the Brazilian Amazon. Born out of the national biodiesel program, the SPOPP sought to articulate social, environmental and sustainability concerns by including smallholders ("family farmers", in Brazil) in the biodiesel feedstock supply chain (Andrade and Miccolis 2011), and boost industry competitiveness. Oil palm took centre stage as the mainstay of this program for the Amazon biome, due to its agroecological suitability, high yields and manual labour-intensive management practices (Brandão et al 2021). In order to avoid the negative environmental impacts that gave oil palm a bad reputation in Southeast Asia, SPOPP guidelines restricted new plantations to degraded lands. Social inclusion goals would be attained by integrating family farmers into the oil palm value chain, increasing access to credit, knowledge and technical assistance, as well as investments in research and capacity-building (Córdoba et al 2022b).

Despite its laudable goals, however, the SPOPP program faced various hurdles in its implementation, struggling to reconcile the reality of family farmers on the ground with industry interests and business models. A recent study on family farmer inclusion under SPOPP shows that although some farmers clearly benefitted financially, more vulnerable farmers tended to be excluded in selection processes due to eligibility criteria that favoured more resource-endowed farmers (Brandão et al 2021). What's more, the majority of family farmers (54%) in this study performed poorly in terms of productivity and adoption of management practices, mainly due to labour constraints or low farmer capacity to adopt the technical recommendations required by companies. While federal agencies at the time, most notably the Ministry for Agrarian Development, made considerable efforts to address farmer groups' concerns, in practice contracts ended up being geared towards conventional monocrop technological packages, prohibiting farmers from intercropping food or fruit crops within oil palm plantations (Córdoba 2022b), and requiring minimum plantation sizes (6-10 ha/farm). On the other hand, SPOPP's main environmental goal of avoiding conversion of primary forest to oil plantations was largely met, as described below. Despite the daunting challenges of balancing trade-offs between company interests, farmer livelihood strategies and environmental goals, at least part of SPOPP's shortcomings could have been avoided had it put in place lasting participatory governance and monitoring mechanisms to enable adaptive management and tailor company requirements to different family farmer contexts (Brandão et al 2021).

4. Environmental impacts of recent oil palm expansion in Brazil

Incentivized largely by the SPOPP, large-scale oil palm plantations quickly dominated the landscape in the Tomé Açu region of Northeast Pará, a state encompassing a large portion of the Eastern Amazon basin and major oil palm producing state in Brazil. Considered a priority landscape for corporations to promote deforestation-free supply chains (Brandão et al 2021), NE Pará has been the epicentre of oil expansion, mushrooming from roughly 70 thousand hectares in 2010 to over 218 thousand hectares in 2014 (Benami et al 2018). Despite this rapid rise in planted area, analyses of satellite imagery showed that 91% of oil palm in this region had been converted from pasturelands while ~8% replaced natural vegetation, including intact and secondary forests (Benami et al 2018). Although >80% of all oil palm plantations in this region are located within 0.5 km of intact forests, direct conversion of intact forests decreased from ~4% pre-SPOPP (2006−2010) to <1% post-SPOPP (2010−2014). A recent study (Almeida et al 2020) collaborates these findings by demonstrating that approximately only 1% of the area planted with oil palm involved primary forest conversion.

While the wider environmental aim of avoiding primary forest conversion has been largely achieved, other serious concerns have been raised about the negative impacts of large-scale oil palm plantations on water resources and human health (Mendes 2021). High amounts of chemical fertilizer and herbicides used in plantations, in addition to wastewater from processing plants, have been associated with contamination of waterways, leading to human health hazards among traditional riverine communities (Mendes 2021).

Farmer perceptions on two study sites in Pará State regarding potential changes in ecosystem services due to oil palm plantations raised similar concerns (Córdoba et al 2019). Based on qualitative interviews, this study indicated that the main impacts of expanding plantations from farmers' perspectives would be: water availability, air and water quality, due to the excessive use of agrochemicals; reduced food production, declining soil productivity, and lower drought resistance. While farmers in this case study were aware of the negative impacts of future palm plantations on ecosystem services, the majority of respondents still expressed support for further expansion given their perceived economic benefits and job creation potential, regardless of demographic characteristics and time of exposure to the crop (Cordoba et al 2019). Despite potential economic benefits, this set of potentially negative social and environmental impacts of oil palm expansion gleaned from the Brazilian experience underscores the need for innovative solutions in outgrower agreements and production systems that balance trade-offs between economic returns, farmer goals (e.g. food production) and key ecosystem services.

5. Inclusive oil palm development pathways

Brazil has been described as a trailblazer in inclusive oil palm development pathways (Miccolis et al 2019b). Three specific factors underlying more inclusive and oil palm production have been identified in that context:

1. The inclusion of other food crops to optimize labour use, which reduces the break-even time for the high initial investment costs and bolsters food security.
2. Equitable value chain development for other products: processing and marketing of cacao, black pepper, açai, cassava and passionfruit, among others, implying investments in processing and strengthening smallholder organizations.
3. Development of independent, collectively owned, small-scale processing to a) strengthen smallholder livelihoods through capturing a greater share of value addition and b) enable autonomy from the prevailing business model by which they depend on large industry to extract oil from fresh fruit bunches.

As an overarching lesson form the Brazilian experience, inclusive approaches should seek to construct options that tailor technological and business model elements to smallholder circumstances. This requires investment by government agencies in producer and consumer countries to adapt business models to shifting smallholder contexts so that they can benefit from inclusive business arrangements while also meeting company interests. While industry-led certification schemes such as the RSPO have played a major role in attesting to the social and environmental sustainability of oil palm production in the Southeast Asia, recent experience in Brazil has shown that meeting national labour and environmental requirements, particularly in the context of family farmers in the Amazon, is fraught with challenges (Box 27.2).

Box 27.2

Smallholders and Roundtable on Sustainable Palm Oil (RSPO) certification

Agropalma became the first palm oil export company in Brazil certified under the Roundtable on Sustainable Palm Oil (RSPO). Certification, however, had unforeseen consequences for the family farms that had delivery contracts with Agropalma due to the challenges posed in meeting and enforcing certification requirements (Córdoba et al 2022b). These authors show how RSPO's requirements of compliance with domestic labour and environmental regularization laws became a point of tension with farmers. Despite Agropalma's active efforts in facilitating formal land titles for the family farmers involved, certification ultimately hinged on existing property titles. Moreover, compliance with Brazilian labour regulations meant breaking traditional patterns of involving all family members, including youth and women, in crop management, thus obliging farmers to hire external laborers and reducing their returns. Compliance with the nominally strict Brazilian environmental regulations for restoring degraded lands in environmentally sensitive areas (Permanent Protection Areas) and areas set aside for sustainable farming practices (Legal Reserves) was also considered out of reach for many farmers. So while certification schemes such as the RSPO can afford companies and associated contract farmers promising opportunities for increasing access to global markets and a higher value for their production, the need for complying with stringent – yet often difficult to enforce – national laws, as seen in Brazil, can be out of reach given the reality of many family farmers (Córdoba et al 2022b).

As oil palm became a major new component of the NE Pará landscape, social movements, farmer groups and academics questioned the potential negative impacts on family farmer livelihoods of adopting monocrop oil palm plantations (REF). Their concerns were grounded on perceived risks associated with investing a large portion of their available land and labour on a single crop, as well as market and disease-related risks, and lower production of staple crops such as cassava, a mainstay of local livelihoods. One strategy to mitigate these risks in production systems, while also enhancing ecosystem services, is to intercrop oil palm with food and fruit crops and trees in diversified agroforestry systems (Miccolis et al 2019). An innovative experiment to test the social and environmental sustainability of oil palm agroforestry was spearheaded in 2007 by the cosmetics giant Natura in partnership with CAMTA, a cooperative comprised mostly of Japanese settlers, and Embrapa (the national agricultural research agency), in the municipality of Tomé Açu.

6. A special case: Tomé Açu oil palm diversification experience

The municipality of Tomé-Açu along the Acará river in the mesoregion of NE Pará has a population density of 10 km^{-2} and an area of roughly 5000 km^2 (van Noordwijk et al 2020). It is currently dominated by oil palm, pastures and perennial crops, particularly cocoa, cupuaçu (*Theobroma grandiflorum*), black pepper, and açaí (*Euterpe oleracea*), a native palm, as well as slash and burn agriculture for cassava production, a mainstay of local livelihoods. Tomé Açu has seen 56% of its original forest cleared, mostly dating back to the 1970s and 1980s, whereas some neighbouring municipalities face high deforestation rates to this day. Since 2010, the municipality has been a hotspot of oil palm expansion against a backdrop of extensive grazing juxtaposed with clusters of agroforestry innovation. Plummeting prices and fusarium disease that ravaged monocrop black pepper plantations in the 1960s and 1970s led Japanese settlers (Smith et al 1996) to diversify their production systems to reduce such risks, developing Tomé Açu Agroforestry Systems (SAFTAS), a term coined by a fruit-processing cooperative (CAMTA) [Saes et al 2014]. These commercially- oriented systems have become a key example widely followed by family farmers in Tomé Açu and far beyond in the Brazilian Amazon.

An ongoing study aims to assess the potential for - and factors underlying - scaling and adoption of oil palm agroforestry, a technology that is novel vis-à-vis the dominant monospecific production paradigm, focusing on the constraints and levers for scaling agroforestry with oil palm. Based on the agronomic success of these earlier experimental sites, in 2017 the project (*Oil palm diversification: reconciling conservation with livelihoods)*, involving ICRAF and support from USAID, set up new demonstration sites among a wider group, most of whom family farmers but with varying levels of access to key resources (labour, knowledge and markets). Technicians and farmers joined efforts to co-design 15 oil palm agroforestry demonstration sites (on a total of 42ha) in 2017 and 2018, which were then managed by farmers, who had technical assistance but ultimately made their own management decisions.

Among the 10 sites established in 2017, seven were led by family farmers and three involved CAMTA (medium-scale) farmers with hired laborers, averaging roughly 2ha overall per site. A baseline diagnosis was performed through a rapid appraisal tool called PLANTSAFS aimed at assessing contextual factors and farmer constraints, as well as social, systems, and environmental indicators, that may prove critical to adoption and success of oil palm agroforests. Additionally, cash flow analysis was performed on 7 of these 10 sites 4-5 years after planting. Managed predominantly through agroecological practices, these systems are comprised of different arrangements of oil palm (double, triple, quadruple rows, total planting) intercropped with other commercial crops typically grown in agroforests locally: cacao, açai, and black pepper, in addition to several fruit, fertilizer and native forest species (Figure 27.1).

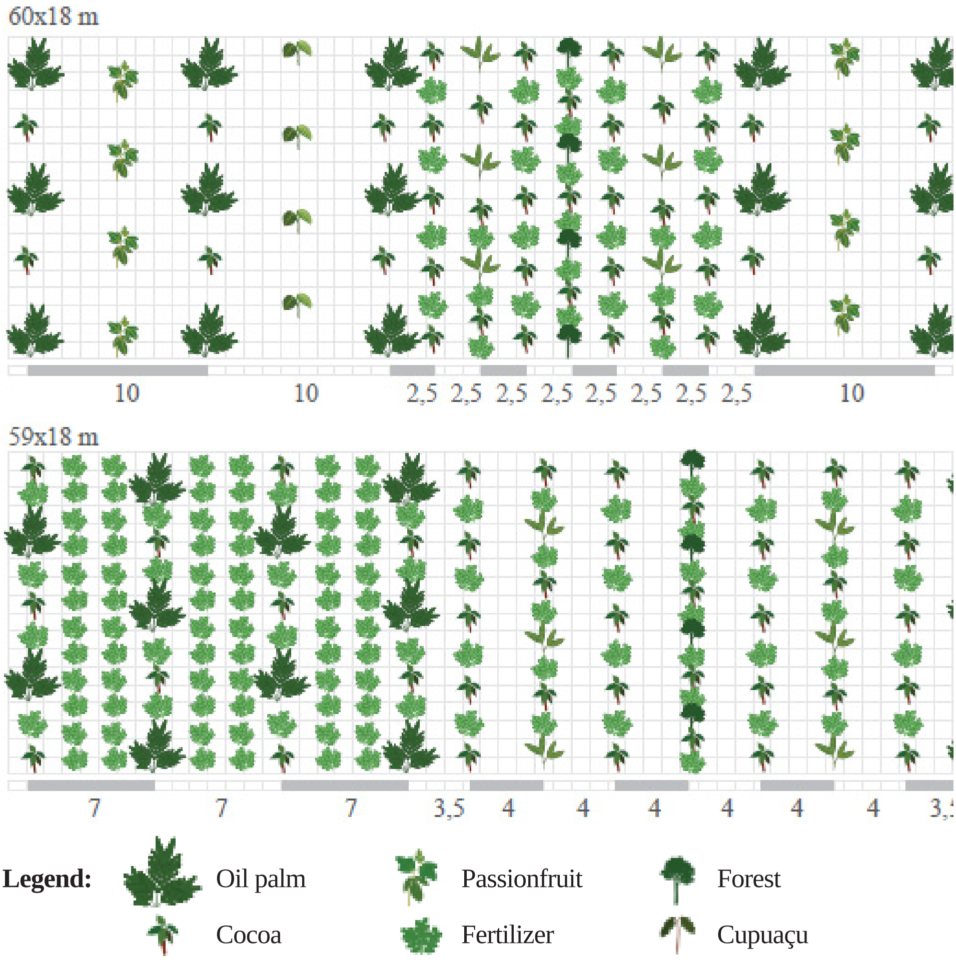

Figure 27.1: *Example of layout of co-designed oil palm agroforestry demonstration site, farmer Zé Paixão, Tomé Açu, Pará State, Brazilian Amazon*

Initial learning from these sites suggests that farmer decisions towards diversification and innovation tend to hinge on a set of factors, including: access to high quality technical assistance, particularly on agroecological management practices for complex systems; access to high quality germplasm (seeds, seedling and cuttings) to establish biodiverse agroforests;

marketing routes for non-commodity agroforestry fruit crops and oilseeds; and systems/ practices suited to the family's labour availability, livelihoods characteristics and multiple objectives. A key feature of these multi-strata successional systems that seems to render them amenable to different farmer contexts is their adaptability, since farmers can plan and manage the agroforests over time differently depending on market and climate factors as well as family preferences and capacities.

Moreover, these demonstration sites suggest that oil palm intercropped with annual and perennial crops can balance trade-offs between social, economic and environmental goals. By including other cash crops, such as cocoa (*Theobroma cacao*), açai (*Euterpe oleracea*), and black pepper (*Piper nigrum*), in addition to native trees such as ipe (*Handroanthus* spp.), mahogany (*Swietenia macrophylla*), and *andiroba* (*Carapa guianensis*), such systems can provide farmers with several other revenue streams throughout the 25- year production cycle. Financial analyses using the AMAZONSAFS tool (Arco-Verde et al 2014) show that high value crops such as cassava, pineapple, and black pepper can provide quick returns to offset the high initial establishment costs, and that fruit trees such as Yellow mombin (*Spondias mombin*) and *cupuaçu* (*Theobroma grandiflorum*) can play a major role in overall income streams on a medium to long-term basis.

Figure 27.2: *Oil palm agroforestry demonstration site at year 5, farmer Zé Paixão, Tomé Açu, Pará State, Brazilian Amazon*

Results from this social-environmental appraisal 1.5 and 3 years after establishment point to substantial improvements in 19 of the 27 plot-level indicators, particularly food production and presence of species with different lifecycles, and increased soil cover throughout the 10 sites established in 2017. These two ecological indicators suggest improved soil quality given the increase in mulch thickness, quality and percentage of area occupied across the systems, as well as enhanced biodiversity and ecological succession in light of the high number of native species (19 out of 36 overall) spread out in different lifecycles. Financial indicators analysed on 7 of these 10 sites, based on data collected during the four years after planting and modelled for 25 years, were also considered attractive to family farmers as returns were analogous to - or above - other predominant land uses in the region. According to these projections, all seven farmers are expected to achieve a positive benefit-cost ratio and return to labour above the average daily wage in the region.

On the other hand, constraints to adoption identified in the first five years include a low level of labour available among family farmers to carry out the various management operations required in the more complex systems and in light of other on-farm activities. Indeed, initial findings suggest that labour shortages, particularly in the establishment phase, led some farmers to plant a lower diversity and density of short-cycle cash and food crops than originally designed, leading to lower income streams than might be possible.

The process of engaging with farmers from diagnosis to co-design, establishment and monitoring after five years has also generated a series of lessons that might be useful to initiatives in Africa wishing to develop oil palm agroforestry among smallholder farmers. The initial diagnosis and systems co-design process showed how farmers in seemingly similar biophysical and social contexts can have quite different levels of access to resources and capacities considered key for agroforestry adoption, as well as varying objectives and aspirations. Hence, given their innovative nature and company requirements underpinning technological packages required of contract farmers (minimum plantation size, intercropping, management practices), technical solutions for oil palm agroforestry should be flexible and adaptable to farmers' existing livelihoods strategies, capacities and goals. Ultimately, this experience has shown that designing solutions *with* farmers and not *for* them can be pivotal to farmers effectively adopting and maintaining biodiverse agroforests with oil palm over time.

Even after facing almost two years of very little or no outside support (due to end of project funding followed by the Covid pandemic), and low labour availability given various other on-farm activities, the majority of these farmers continued to actively manage their sites five years after planting. This level of adoption and maintenance despite adverse conditions indicates high farmer interest in - and ownership of - the new systems. On the other hand, some of the key challenges reported by farmers include: high labour requirements of complex systems due to high species diversity and densities, especially labour-intensive fertilizer species, and rapid growth of secondary vegetation, leading to over-shading of oil palm in some cases (where management was delayed). These difficulties were also compounded by external factors such as prolonged drought, flooding, and low availability of fertilizer after project funds expired.

Despite these constraints, some farmers have been innovating spontaneously, applying aspects of these systems on other fields (fertilizer species in high densities, intense pruning, mulching), and developing new systems designs based on learning from the demonstration sites. This high degree of farmer ownership can be attributed partially to the tailored systems resulting from the co-design process, coupled with frequent and high-quality technical assistance throughout the first few years, but also to the adaptability of these successional agroforests to farmer conditions and shifting management strategies. Since most rural development agencies and projects cannot afford to adopt this level of support at a wider scale given the high associated costs, other methods such as farmer-to-farmer training, field visits, exchanges and co-learning workshops can be employed to complement learning on demonstration sites. Overall, this case study suggests that bottom-up approaches such as co-designed solutions based on active farmer engagement are key to smallholder adoption of innovative oil palm agroforestry solutions. On the other hand, top-down policies, closed technological packages and business models that don't take into account farmer aspirations and constraints might fail to include many farmers, especially the most vulnerable, in palm oil value chains.

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