Improving smallholder inclusivity through integrating oil palm with crops

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Oil palm and pineapple intercropping in the first years of oil palm cultivation (replanting). Photo by: Maja Slingerland

"Despite reductions in palm oil yields, smallholders prefer mixed systems to diversify sources of household income."

Introduction

Oil palm cultivation in Indonesia and Malaysia is valuable for the trade balance of these countries and in the past was the exclusive domain of large companies. This was the case until national policies facilitating the Federal Land Development Authority (FELDA) system in Malaysia and the Nucleus Estate Plasma system in different forms in Indonesia made the oil palm sector more inclusive by encouraging links between smallholders and large companies.

To so-called plasma smallholders, these policy measures supported access to technical and financial assistance for planting and tending, provided by companies on a loan basis. It also guaranteed purchase of fresh fruit bunches delivered to the mills. More recently, independent smallholders throughout Indonesia and

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Malaysia have started planting oil palm themselves, and are free to choose the mills they want to deliver to. This freedom, however, is accompanied by a lack of access to technical and financial assistance, including superior planting stock; this could lead to with lower prices or even rejection by mills, especially in times of oversupply. Over time, some plasma smallholders have also established additional independent fields that are excluded from their existing agreement with mills.

Oil palm cultivation

Oil palm is the most financially productive of all vegetable oil crops, providing regular income from frequent harvests throughout the year. It generates relatively high income per hectare and per labour hour. Therefore, it is a crop that fits well with many smallholders in Indonesia and Malaysia who have limited land availability and labour resources, and it has lifted large numbers of people out of poverty.

Yet, like all crops, oil palm does need land. There are multiple cases where oil palm plantations have replaced forests on mineral and peat soils, causing biodiversity loss, fires and haze, among other impacts. These negative effects have been exacerbated by the fact that oil palm has been largely promoted as a monoculture crop. In many cases this has led to loss of ecosystem services, replaced food production in farms and over entire landscapes, and caused dependency on world market prices, leading to high income fluctuations for smallholders. In Indonesia and Malaysia, promotion of oil palm cultivation by companies has also caused conflict with smallholders about land, their livelihood strategies, and the terms of their involvement in the oil palm supply chain.

One way the oil palm sector is dealing with the negative impacts of palm oil production and expansion is through government regulation and public and private certification schemes. These schemes aim to prevent biodiversity losses by prohibiting deforestation of high conservation value areas and prevent conflict through processes of free prior informed consent, among other goals. Neither regulation nor certification schemes address farmers' livelihoods concerns, however, since they focus on oil palm monocultures.

Monoculture productivity

Oil palm is most productive on a per-hectare basis when trees are planted as a monoculture, based on an equilateral triangular planting pattern at 9x9x9-metre spacing. The first few years after planting, other crops can be planted in the spaces between trees and many smallholders do so. These crops include banana and cassava on mineral soils as in Central Kalimantan, Indonesia, and pineapple on peat soils as in Johor, Malaysia. This intercropping provides smallholders with income before the oil palm starts bearing fruit. After three to five years, however, depending on the level of management, the canopy closes, leaving too little light for other crops to grow. To increase oil palm yields, best management practices are often promoted, starting with the use of certified seeds, adequate weeding, pruning, use of fertilizers and improved harvesting. With optimized management, potential annual oil yields can be as high as 12 tonnes per hectare. Many smallholders in Indonesia and Malaysia achieve only up to 3 t/ha, however, due to poor planting material, inadequate or inappropriate use of fertilizers and pesticides, lack of access to credit, and poor logistics during harvesting and delivery to mills (Woittiez et al. 2017).

Oil palm and banana intercropping in Johor, Malaysia. Photo: Maja Slingerland.

Farmer practices in Indonesia

Two independent surveys in 2018 in central Kalimantan identified several smallholders who included other tree crops in their oil palm fields, including rubber, fruit trees such as durian and mango, and timber species such as sengon (*Paraserianthes falcataria)*; the planting timber species was motivated by a sudden demand for timber in the market. Another survey in Jambi, Sumatra, revealed that farmers included meranti (*Shorea leprosula)* in their oil palm fields, stimulated by the scarcity of construction timber. Unfortunately, as the planting density and configuration of oil palm trees had not been modified in these cases, this led to strong competition for light, water and nutrients and resulted in reduced yields for both oil palm and the other species. The outcomes of these farmer experiments and associated observations seem to confirm that oil palm needs to be cultivated in monoculture in order to optimize yield.

The surveys show that despite reductions in palm oil yields, smallholders still preferred mixed systems in order to diversify sources of household income and to stabilize income over time. Local smallholders often had diversified systems before converting to monoculture oil palm and over time missed their former livelihood options. Javanese workers who came to Sumatra or Kalimantan as part of a government-supported transmigration programme were given monoculture oil palm plantations of two hectares to cultivate and half a hectare to build a house and have a home garden. These people were very dependent on oil palm for their income. The wish for diversification was also motivated by the very volatile prices of agricultural commodities. In July 2018 this was confirmed during discussions with a cooperative of Javanese oil palm farmers in central Kalimantan who were preparing for replanting in three years' time. At that time, they had only oil palm monocultures, but were exploring options to integrate oil palm with cacao, without losing too much of the expected oil palm benefits.

Learning from experimental research in Malaysia

In Malaysia, research by the Malaysian Palm Oil Board has led to the development of a new planting scheme called the double-row avenue system (Suboh Ismail, Norkaspi and Zulfkifli 2009). Under the system, the same number of trees per hectare (138) are planted as in the conventional planting configuration, but are planted closer together (9x9x6 m), with 9 m between the two rows and 6 m between trees in the rows, leaving avenues 15 metres wide for growing other crops between the double rows. Experiments have included rice, pigeon pea, cassava, black pepper, groundnut, rubber, cacao and some fodder crops. After promising initial results (Zulkifli et al. 2016), the state of Sarawak, Malaysia has started a subsidy programme for smallholders who want to start intercropping with black pepper, which is already an important export crop with existing supply chains. Combining oil palm with black pepper provides diversity in income and lower dependency on the fluctuating world market price for oil palm (Box 1).

Box 1. Intercropping with black pepper

Black pepper starts producing 1–2 t/year during the first three to five years, before oil palm comes into production. At peak production, black pepper yields about 3 t/ha. Black pepper is a high-value crop that has a much higher price per tonne than oil palm; therefore, some decreases in oil palm yield in an integrated system (compared to monoculture) will be compensated by the additional income from black pepper. The exact compensation depends on the evolution of yields of oil palm and black pepper over time and market prices each year. Black pepper prices FOB Indonesia went steadily up from US$2,000/t in 2006 to US$14,000/t in 2015, dropping to US$2,700/t in October 2018 (www.agriwatch.com). During the same time, palm oil prices fluctuated between US$350/t (2009) and US$500/t (2003–16) and peaks of US$886 (2008, 2011, 2013) traded at the Malaysian stock market (Trading Economics 2019). Even in the worst case scenario, with the palm oil peak price of US$886/t and lowest black pepper price of US$2,000/t, one tonne of black pepper can still compensate for a 2.5 t decrease in palm oil production, equal to 12 t of fresh fruit bunches, whereas yield decreases of fresh fruit bunches at maturity never exceeded 5 tonnes (compared to monoculture) and black pepper yields at maturity are 3 t/ha. So, black pepper always more than compensates for the modest reductions in palm oil yields, and additionally, reduces dependency on volatile palm oil prices.

Figure 1. Oil palm integration with black pepper as used in WaNuLCas model

Illustration: Adrien-Francois Migeon

Oil palm and meranti *(Shorea leprosula)* in Jambi. Photo: Budiadi

Using models to increasing the learning on intercropping

To provide smallholders with adequate advice on intercropping, various crop combinations should be tested, preferably for the entire 25-year rotation of oil palm. As an alternative or a complement to costly long-term trials, models such as WaNulCAS, which have been developed specifically for this purpose (van Noordwijk et al. 2011), can be used. The model focuses on competition for water, nutrients and light, leading to predictions on yields of each crop over 25 years. It uses labour requirements and costs of labour and inputs to calculate farm income, both per hectare and per unit of labour. In addition, effects are estimated for environmental indicators such as erosion control, runoff, nitrogen leaching and carbon stocks.

In 2016, testing of various crop combinations using the WaNulCAS model identified multiple synergies and trade-offs. For example, interplanting oil palm with velvet bean, groundnut and cassava showed similar returns for labour as for oil palm monoculture: US$5.50 per day, which is almost twice the average daily wage of US$3. Compared to oil palm monoculture, all the crop combinations improved erosion control by about 40%, but also slightly increased nitrogen leaching. Interplanting oil palm with rubber provided farmers with a daily average income of US$3, equal to the daily average wage and provided a positive cash flow for the first 12 years, compared to the 22–23 years required for the annual crops analyzed. Other advantages of interplanting oil palm compared to oil palm monoculture with rubber are environmental benefits: increasing carbon stock by 37%, decreasing nitrogen leaching by 66%, and improving erosion control by 57%. In terms of climate change, high carbon stocks are a desirable feature of systems, and decreasing nitrogen leaching may save fertilizer costs. Further testing of the model in 2017 with black pepper intercropping found very positive effects until ten years after planting, after which production from pepper rows closest to oil palm trees declined rapidly. This is important information for smallholders; it tells them that their initial success will not continue for the full 25 years and that more shade-tolerant crops are needed when oil palm trees grow larger.

The results derived from the WaNulCas model show that perfect solutions do not exist, but that intercropping provides smallholders with an increased number of options to choose from, depending on their wishes. Intercropping systems provide the possibilities of generating substantial income as well as environmental benefits. Spreading income over two or more crops is expected to decrease dependency on oil palm and therefore provide more income resilience. The impacts of intercropping on other ecosystem services — such as biodiversity, pollination and integrated pest management — are still to be investigated in field experiments and likely will differ per crop combination. Research on biodiversity in smallholder alley cropping oil palm systems in Malaysia (Ashraf et al. 2018) adds to optimism in this regard, as it showed that the number of arthropod orders, families and abundance were significantly greater in alley-cropping systems than for oil palm monocultures.

When to use intercropping options

In new planting areas or in oil palm frontiers such as in West Kalimantan, companies promote oil palm monoculture and try to acquire farmland for nucleus plantations. Local land users strongly reject oil palm because of their preference for diversified livelihoods and a desire to be self-sufficient in their main food crop: rice. Furthermore, smallholders did not want to become "coolies" (paid labourers) on their own land and lose their independence as farmers (de Vos 2016). Many conflicts arise around these opposing wishes, offering smallholders only two choices: either fully converting to oil palm monoculture, or being excluded from oil palm cultivation altogether.

Intercropping within a double-row avenue system may prevent such conflicts, since it is potentially able to satisfy both farmers and companies. Smallholders would benefit from the additional income provided by oil palm trees, compared to their conventional cropping patterns, and they can continue to cultivate a variety of their usual crops in the avenues of the proposed integrated system. It is to be expected that potential oil palm yields in intercropping systems will be lower than those from monoculture. However, so far the actual yields of smallholder plantings have averaged only 3 tonnes of oil/ha and such yields can certainly be achieved in intercropping systems. Yields could even increase, depending on crop choice, level of competition, and the extent to which farmers follow management recommendations by government and companies for each of the crops.

In Sumatra, where there is a long history of oil palm cultivation, smallholders have been enriching their existing oil palm monocultures with other species. However, throughout Indonsia, many smallholders will need to replant in the coming years. Using the double-row avenue system may be attractive to them to satisfy their livelihood needs beyond oil palm income alone. Results suggest that those who fund replanting should include such options in their portfolios.

Conclusions

Based on the field experiments and farmer surveys in Indonesia and Malaysia reported here, it is argued that palm oil production can be much more inclusive for smallholders when it addresses their diverse livelihood needs and resilience. This means going beyond just providing high incomes from palm oil monocultures, and contributing to more stable incomes and access to food and building materials based on a diversity of crops.

Smallholders have been found to experiment the with diversification of existing oil palm monocultures to better meet their livelihood needs, with observed negative results on the yields of both oil palm and the interplanted crops. Based on experiences and research results, as discussed in this article, the double-row avenue system is a promising alternative to monoculture. It provides opportunities to include more smallholders in oil palm cultivation while safeguarding their diversified livelihoods.

Since intercropping needs a different planting configuration, it can be proposed only at the replanting stage or when establishing new plantations. Intercropping, rather than either full conversion to oil palm or being fully excluded from oil palm benefits, can increase smallholder inclusion in oil palm supply chains and potentially contribute to conflict avoidance. This could be especially valuable in frontier areas during free, prior and informed consent (FPIC) processes linked to certification schemes. Oil palm intercropping systems increase the chances of smallholders being included in palm oil production value chains by accepting oil palm trees on their land while pursuing additional, otherwise conflicting, livelihood goals such as food production. For companies, intercropping may be desirable since it may convince smallholders to enter the oil palm value chain instead of resisting it.

Intercropping approaches — including the double-row avenue system — still need to be further investigated for additional crop combinations, using field measurements and modelling. This is necessary to provide companies and smallholders with realistic expectations of what to expect in terms of yield, and amount and stability of income, and what to invest in. This preferably considers the 25-year oil palm cycle, something that can be achieved using models. Also, the potential to include more ecosystem services in oil palm cultivation, such as biodiversity for pollination and integrated pest management, merits additional research. In terms of biodiversity, intercropping may be a stepping stone between high conservation value areas and currently proposed landscape approaches.

Many actors, scientists and development workers define smallholder inclusion as engaging smallholders in oil palm supply chains, thereby providing them with access to national and international markets and to technologies to increase yields and income per hectare and per unit of labour. This inclusion needs to be evaluated not only on yields and associated income, however, but also on the potential for investments through access to planting materials, labour and agrochemicals, and access to credit to acquire these. But to really enhance smallholder inclusiveness, palm oil production systems need to address smallholder livelihoods in terms of crop choices that fit their direct household needs for food or timber, or for income by connecting to existing or emerging local marketing options and longer value chains. This would contribute to improved livelihood resilience from a diversity of income sources and lower dependency on volatile palm oil prices.

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