Improving smallholder inclusivity through integration of oil palm with crops

Maja Slingerland
Ni'matul Khasanah
Meine van Noordwijk
Ari Susanti
Mayang Meilantina

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> "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 was in the past the exclusive domain of large companies. This was 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 such companies.

To so-called plasma smallholders, this policy measure supported access to technical and financial assistance for planting and tending, provided by companies on a loan basis, and guaranteed purchase of fresh fruit bunches delivered to their mills. More recently, independent smallholders throughout Indonesia and Malaysia have started planting oil palm by themselves, and are free to choose the mills they want to deliver to. But this freedom is accompanied by a lack of access to technical and financial assistance, including superior planting stock, 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.

Palm oil cultivation

Oil palm is the most 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 that have limited land availability and labour resources, and it lifted large numbers out of poverty.

Yet, like all crops, oil palm cultivation does need land. There are multiple cases where oil palm plantations replaced forests on mineral and peat soils, causing biodiversity loss, fires and haze amongst other impacts. These negative effects have been exacerbated by the fact that oil palm has been largely promoted as a monoculture crop, which in many cases 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 incorporation in the oil palm supply chain.

One way the oil palm sector is dealing with negative impacts from palm oil production and expansion is through government regulation and public and private certification schemes that aim amongst others to prevent biodiversity losses by prohibiting deforestation of high conservation value areas and prevent conflict through processes of free prior informed consent. Yet neither of these addresses farmers livelihoods concerns as they focus on oil palm monocultures.

Monoculture productivity

Oil palm is at its most productive on a per hectare basis when trees are planted as a monoculture, based on an equilateral triangular planting pattern at a 9x9x9m spacing. The first few years after planting, other crops can be planted in the spaces and many smallholders do so, including banana and cassava on mineral soils as in Central Kalimantan, Indonesia and pineapple on peat soils as in Johor, Malaysia. This provides smallholders with income before the oil palm starts bearing fruit, but after

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

3-5 years, 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 use of certified seeds, adequate weeding, pruning, use of fertilizers and harvesting. With optimized management, potential annual oil yields can be as high as 12 tonnes per hectare. Many smallholders in Indonesia and Malaysia reach only up to 3 t/ha, however, due to poor planting material, inadequate or in appropriate use of fertilizers and pesticides, no access to credit, and poor logistics during harvesting and delivery to mills (Woittiez et al. 2017).

Farmer practices in Indonesia

Two independent surveys in 2018 in central Kalimantan identified several smallholders including other tree crops in their oil palm fields, including rubber, fruit trees such as durian and mango, or timber species such as sengon (*Paraserianthes falcataria*) motivated by a sudden demand for timber in the market. A further survey in Jambi, Sumatra, revealed that farmers included *Shorea leprosula* in their oil palm fields stimulated by the scarcity of construction timber. Unfortunately, as planting density and configuration of oil palm trees has not been modified in these cases, this led to strong competition for light, water and nutrients and resulted in reduced yields of 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 oil palm yield.

The surveys show that despite reductions in palm oil yields, smallholders still preferred mixed systems 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 that came to Sumatra or Kalimantan as part of a government supported transmigration programme were given monoculture oil palm plantations of 2 hectares to cultivate and half a hectare to build a house and have a home garden. They were very dependent on oil palm for their income. The wish for diversification was additionally motivated because of 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, that was preparing for replanting in three years' time. At that time, they only had 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 et al. 2009). The same number of trees per hectare (138) as in the conventional planting configuration are planted closer together (9x9x6m), with 9 m between the two rows and 6 m between trees in the rows, leaving 15 m wide avenues 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 (Raja Zulkifli et al. 2016), the state of Sarawak, Malaysia has started a subsidy programme for smallholders that want to start intercropping with black pepper, 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).

Using models to increasing the learning on intercropping

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

Box 1. The example of intercropping with black pepper

Black pepper starts producing 1-2 t/year during the first 3-5 years and 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 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$2000/t in 2006 to US$14,000/t in 2015, dropping to US$2700/t in October 2018 (www.agriwatch.com). During the same time, palm oil prices fluctuated between US$350/t (2009) and US$500/t (2003-2016) and peaks of US$886 (2008, 2011, 2013) traded at the Malaysian stock market (https://tradingeconomics.com/commodity/palm-oil). In the worst case scenario, with the palm oil peak price of US$886/t and lowest black pepper price of US$2000/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.

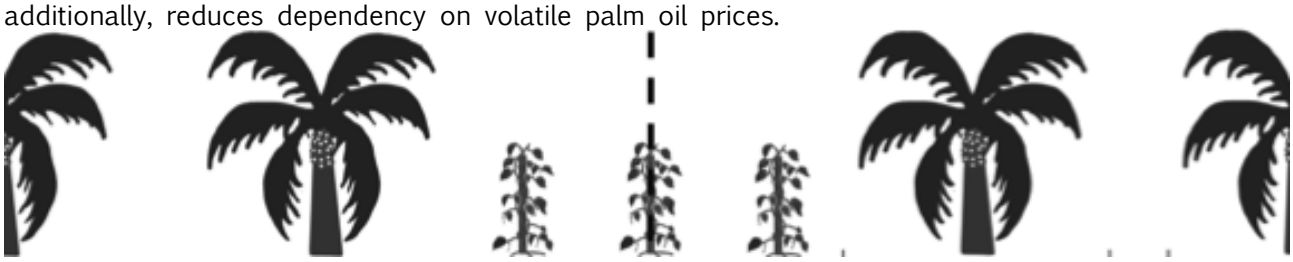

Figure 1. Oil palm integration with black pepper as used in WaNuLCas model. Illustration: Adrien-Francois Migeon

Oil palm and Shorea leprosula in Jambi. Photo by: Budiadi

In 2016, testing different crop combinations using this WaNulCAS model identified multiple synergies and trade-offs. For example, interplanting oil palm with velvet bean, groundnut and cassava showed similar returns to labour as for oil palm monoculture, of IDR80,000 (US$5.50) per man day, which is almost twice the average daily wage of IDR43,000 (US$3). Compared to oil palm monoculture, all these combinations improved erosion control by about 40%, but 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 had a positive cash flow for the first 12 years, compared to 22-23 year for the annual crops analysed. Advantages of interplanting oil palm with rubber are the environmental benefits compared to oil palm monoculture, from increasing carbon stock by 37%, decreasing nitrogen leaching by 66%, and improving erosion control by 57%. In times where climate change matters, high carbon stock is 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 10 years after planting, after which production from pepper rows closest to oil palm trees declined rapidly. This is important information for smallholders as it tells them that initial success will not continue for the full 25 years and that more shade tolerant crops are needed when oil palm trees grow larger.

These results derived from the WaNulCas model show that perfect solutions do not exist, but they provide smallholders with an increased basket of options to choose from, depending on their wishes. We see that there are possibilities to generate substantial income by intercropping systems as well as to achieve environmental benefits. The spreading of income over two or more crops is expected to decrease dependency on oil palm alone and therefore provide more income resilience. Impact of intercropping on other ecosystem services such as biodiversity, pollination and integrated pest management are still to be investigated in field experiments and may likely 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 compared to oil palm monocultures.

Oil palm pine apple on peat soils at first years of oil palm cultivation (replanting). Photo by: Maja slingerland

When to propose intercropping options?

In new planting areas or in oil palm frontiers such as in West Kalimantan, companies promote oil palm monoculture and try acquiring 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 a farmer (de Vos 2018). 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 all together.

Intercropping within a double row avenue system may prevent such conflicts, being potentially able to satisfy both farmers and companies. Smallholders would benefit from additional income from oil palm trees compared to their conventional cropping patterns, and they can continue cultivating 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 potential monoculture yields. However, so far average actual yields of smallholder plantings have been up to 3 ton of oil/ha only and such yields can certainly be achieved in intercropping systems. There could even be the opportunity to go beyond these, depending on crop choice, the level of competition, and on 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. In Indonesia many of them need to replant the coming years. Using the double row avenue system may be attractive to them, to satisfy their livelihood options beyond oil palm income alone. Results suggest that those funding replanting should include such options in their portfolio.

Conclusions

Based on field experiments and farmer surveys in Indonesia and Malaysia reported here, it is argued that oil palm 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 to contribute to more stable incomes and access to food and building material based on a diversity of crops.

Smallholders have been found to experiment with diversification of existing oil palm monocultures to better meet their livelihood needs, with observed negative results on yields of both oil palm and 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. As intercropping needs a new planting configuration, it can only be proposed at replanting or when establishing new plantations. Intercropping as an option, 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. Proposing oil palm intercropping systems increase the chances of smallholders being included in oil palm 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 interesting as this may convince smallholders to enter oil palm value chain instead of resisting it.

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

Many actors, scientists and development workers define smallholder inclusion as engagement of smallholders in oil palm supply chains, thereby gaining 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 not only evaluated on yields and associated income, however, but also on inclusion regarding 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 the dependency on volatile palm oil prices.

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This paper was submitted for inclusion in the forthcoming edition of **ETFRN News 59 - Exploring inclusive oil palm production**, due for release in early 2019. This will contain 20 papers plus interviews, presenting examples of innovative and inclusive palm oil production systems. It will assess what has not worked, but importantly, it will analyse what positive practices and policies have worked for more inclusive palm oil production and why, as we strive towards more collective and sustainable solutions to this apparently intractable problem.

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Author: Maja Slingerland, *Wageningen University and Research, the Netherlands (maja.slingerland@wur.nl)*

Ni'matul Khasanah and Meine van *Noordwijk, Wageningen University and Research, and ICRAF, Bogor, Indonesia (n.khasanah@cgiar.org and M.vannoordwijk@CGIAR.org)*

Ari Susanti, *Universitas Gadjah Mada, Yogyakarta, Indonesia (arisusanti@ugm.ac.id)*

Mayang Meilantina, *Palankaraya University, Kalimantan, Indonesia (mayangparay@gmail.com)*

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Cover photo: *Oil palm pine apple on peat soils at first years of oil palm cultivation. Photo by: Maja slingerland*

ETFRN
c/o Tropenbos International
P .O. Box 232,
6700 AE Wageningen,
the Netherlands
tel. +31 317 702020
etfrn@etfrn.org
www.etfrn.org