Reducing ecological damages while preserving livelihoods: Helping oil palm farmers to protect their environment

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Oil palm cultivation: An economic success at a high price

Two narratives dominate the debate on the expansion of the oil palm cultivation. The first narrative focuses on the destruction of forest or agroforestry systems and their transformation into oil palm monoculture plantations. It identifies the massive threat that this development deals to the environment's capacity to preserve and provide biological processes and components of an ecosystem.[1] The second narrative shows how oil palm cultivation improves the livelihoods of rural households by increasing their income and nutrition.[2] Both narratives are supported by scientific evidence, and they need to be thought together when aiming to improve the ecological and economical sustainability in the production areas.

Oil palm *(Elaeis guineensis)* is a perennial oilseed crop originating from West Africa. Globally it is the most important and productive oil crop. It is grown on more than 13.5 million hectares of tropical land, usually in monoculture systems that can exceed 20,000 hectares in industrial plantations.[3] Palm oil represents 57 percent of global vegetable oil consumption and is the most widely cultivated crop for the production of biodiesel.[4,5] The rapid population and income growth in many countries and the associated demand for food and non-food products, particularly biofuels, have driven oil palm expansion. Biofuels consumption in developed countries has increased as a source of renewable energy to reduce dependence on fossil fuels (e.g. oil, coal or gas).[5] Renewable energy represented 17 percent of the total energy consumed by the European Union in 2016, from which 7.1 percent was used in the transport sector.[6] This share is projected to increase by 20 percent and 10 percent respectively in 2020. On the supply side, the cultivation of oil palm has many attractive characteristics for the large producing countries. An oil palm plantation can start bearing fruits as early as four years of planting and it has a lifespan of 25 years on average.[5] The most important economic advantage is the return-to-land which is comparably higher than for other oilseed crops. For example, one hectare of oil palm produces 6 tonnes of oil (palm and palm kernel), compared to the yields of 1.8 tonnes/ha for rapeseed or 0.6 tonnes/ha soybeans.[5] Likewise, the return-to-labor is higher than for other cash crops, e.g. rubber. On average, a hectare of oil palm requires 205 hours of labor a year compared with 929 hours in a rubber plantation. This provides farmers with free time to engage in other economic activities.[7] Altogether, oil palm cultivation translates into high economic profitability for producers.[8]

Figure 1 Harvesting oil palm. a) a fresh fruit bunch after harvest; b) Farmers weighting the fruits

Oil palm grows best in humid tropical areas, where tropical forest and biodiversity hotspots are located.[9] Thus, the expansion of oil palm production areas is largely associated with deforestation and the loss of rich ecosystems. Oil palm monoculture systems decreases biodiversity and affect the function of natural processes.[1,10] This damage is amplified by the common establishment of a new plantations on peat soils. Through this process soil structures are fragmented by the use of heavy machinery and slash-and-burn practices that eventually leads to decomposition, compaction and sedimentation. On a global scale, the destruction of the peat soils leads to carbon losses that contribute towards climate change.[1] On the local level, this soil transformation alters water cycles and affects water sources, which is associated to a higher incidence of floods during the rainy season and water scarcity during the dry season.[11,12] Compared to more complex land use systems, such as primary forest or rubber agroforestry, the homogenous structure of a monoculture oil palm plantation supports fewer forest species, thereby further deteriorating biodiversity in species richness and abundance.[13] The combination of these environmental externalities affects water availability, pollination, soil fertility, carbon storage, and pest control, thus jeopardizing human well-being.

Figure 2 Land just cleared for a new plantation. September 2015, Jambi Province

Indonesia concentrates 53 percent of the global palm oil production and is the world's largest producing country since 2008.[14,15] First introduced under Dutch colonial rule, the oil palm production has increased from 935,000 tonnes to 160 million tonnes between 1961 and 2016.[16] In the same period, the harvested area increased from 70,000 hectares to 9 million hectares.[14] Oil palm cultivation plays a key role in the national economy: in 2007 it created an estimated 3 million jobs, it increased more than $12 thousand million export revenues, and contributed to poverty reduction by 70 percent in the districts with the largest oil palm area.[5,17,18] The oil palm boom was boosted by the Transmigration program in the late 1980s which was a central moment in the governments' support of the oil palm expansion.[19,20] After initial involvement of the central government, the expansion of the oil palm area was driven by private companies, however, later independent small-holder farmers gained in importance.[21] Currently, they account for 41 percent of oil palm cultivated area and 36 percent of palm oil production. This highlights the important role that smallholder farmers could have on restoring biodiversity. Indonesia plays a crucial role in the mitigation of global warming and the conservation of the world's biodiversity. At the same time, the large economic opportunities of oil palm production is likely to cause a further expansion of oil palm production. In this situation, a strong case can be made for policies that reduce the environmental cost of this process while not harming farmers' livelihoods. Programs that proactively support smallholder farmers to enhance biodiversity in their plantations, while minimizing their economic losses, are one promising option on this path.[22]

Figure 3 Trucks transport the fresh oil palm fruit bunches to the mill. October 2015, Jambi Province

The road to resilience in oil palm

To minimize the biodiversity loss caused by the conversion of forests to oil palm plantations two non-exclusive strategies have been proposed: The first requires environmentally-sound management practices that combine agricultural production with conservation areas inside the production area (land sharing), the second proposes to separate land for conservation, while maximizing production on agricultural land instead of expanding the area (land sparing).[4,23,24]

Conserving forest fragments, buffer zones of natural vegetation or mixing trees in oil palm, increases the potential to restore and sustain biodiversity. [25–27] This is because, these areas of high conservation value house forest-dependent species, and could bridge, as “stepping stones”, biodiversity to other impoverished areas.[26] When oil palm is mixed with other trees, species richness increases substantially, as they create a habitat for forest-dwelling species, such as birds and create corridors to the nearest forest patches.[28] Tree planting could also enhance local economies by providing timber and fruits, while improving ecological conditions such as soil fertility.[29] Trees can be planted in remaining gaps inside the plantation (similar to an island) or along the borders. In this way, tree planting creates nuclei of biodiversity.[30] Still, given that oil palm is a water and light demanding crop, there is a concern that yields might be affected, as oil palm can draw nutrients from a distance of 15 meters.[9,31] This factor may give a disincentive to smallholder farmers or even companies from taking-up such practices. Thus, there is a need for further research to establish the long term effect of these practices and create trust into their economic viability.[32] At the larger scale, studies favoring land sparing further advocate for heterogeneous landscapes conservation, to avoid the limitation of ecologically valuable land of unconnected small agroforestry zones.[33,34]

The sustainable intensification of oil palm production could further reduce environmental damage. In spite of being a highly productive crop, the yields of smallholder farmers remain under optimum level. A smallholder plantation grown under appropriate conditions produce 11-15 tonnes of Fresh Fruit Bunches (FFB) per hectare/per year, while on a large industrial plantation yields can be in the area of 30-40 tonnes per hectare/ per year.[35,36] Likewise, there exist a yield gap between smallholder farmers associated with the transmigration program and those farmers who independently adopt oil palm in traditional villages. Plantations from traditional farmers on average produce 10 tonnes FFB per hectare/per year while production from transmigrant farmers averages at 21.3 tonnes FFB per hectare/ per year.[19,37] Some contributing factors are the age of the plantation, nutrient deficiencies, the frequency of harvests, input management, and planting material.[5,35] Closing yield gaps requires addressing all these factors sustainably. Some sustainable practices largely focused on soil conservation. For example, soil organic carbon can be improved by leaving empty fruit bunches at the plantation. Applying these crop residues benefits soil fertility and soil biological activity.[38] Similarly, by combining ground vegetation, planting of nitrogen fixing legumes, building terraces or digging silt pits favor water flows, while reducing soil erosion.[12,28] Improving fertilizer application techniques can increase yields while reducing costs. Often, farmers tend to apply nitrogen and phosphorous in large quantities, while the provided potassium is insufficient.[35] Among other good agricultural practices to increase yields are the use of good quality seeds, harvesting the plantation every ten days, mechanically weeding at least three times per year, and pruning at least twice per year.[39] Still, while some actors might argue that land sparing will prevent further conversion of land, it is possible that smallholder farmers are still attracted to expand into new areas.[40,41] Investments into yield increases cannot completely prevent this, but they make policies that protect natural forests more acceptable. They constitute an alternative way to support the economy and the increased production reduces the price of palm oil, thereby making area expansion less attractive. It will still be necessary to strengthen the government's capacity to enforce existing laws and support local institutions that aim to protect local resources. Proper mechanisms and incentives to offset the impacts of oil palm on biodiversity can be fitted into this process to further reduce the environmental damage of the plantations.

How to engage smallholder farmers to adopt environmentally-friendly management?

Given the role that smallholder farmers play on oil palm expansion, it is important to understand their underlying motivations to adopt sustainable management practices. In Indonesia, agricultural training programs were delivered in combination with environmental education, however, this approach failed to promote widespread adoption of environmentally-friendly practices among farmers.[42] The information in these programs tends to be complex and is not properly conveyed through informal farmer-to-farmer communication, limiting the scaling of these apporaches.[39,43] This indicates that environmental programs need to be better tailored to farmers situation, interests, and concerns, particularly, since the perceived economic gains from oil palm cultivation might outweigh farmers concern for its environmental costs.[8,40,44] The available empirical evidence shows that interventions designed to overcome knowledge gaps and structural constrains foster pro-environmental behaviors.[45] Social-psychology theories, explain that the decision to adopt an innovation or behavior is determined by the knowledge and contextual factors an individual is exposed to. It is an ongoing process where perceptions and beliefs can largely influence the final choices.[45] Therefore, perceptions hold valuable information that can help to predict behavior. Investigating intrinsic motivations, such as those reflected in farmers' moral values, environmental concern, beliefs, attitudes and social norms, can guide policies to encourage pro-environmental behavior or create incentives that aim at environmental protection while being of relevance for farmers.[46–49]

Box 1: Evaluation of outreach mechanisms to adopt biodiversity-friendly management in oil palm plantations

To explore which mechanisms are likely to influence adoption of pro-environmental behavior among oil palm smallholder famers, a Randomized Controlled Trial (RCT) was conducted in Jambi Province, on the Island of Sumatra, Indonesia and implemented with 800 farmers. The aim of the study was to evaluate the effect of two environmental policies that promote tree planting in oil palm plantations. The first policy consists of an environmental information campaign that delivered information about the establishment and maintenance of trees in oil pam. This campaign involved the design of an illustrative manual and a video-clip to access the emotions and cognitions of farmers, thereby increasing the likelihood of adoption. The second policy combines the information campaign with free delivery of seedlings to overcome missing markets for seed material. The statistical analysis shows that both policies have a positive and significant effect on tree planting adoption. Through altering perceptions and intentions, information provision increases the likelihood of tree planting. Over and above this mechanism, the provision of seedlings has a large influence on farmers' planting decision, suggesting that overcoming structural barriers is key to sustainable plantation management. This hints to the conclusion that interventions aiming at influencing adoption decisions need to be designed according to the context. If it is only negative perceptions and lacking intentions, information provision by itself may be effective to change behavior. However, if farmers face structural constraints, interventions need to overcome those barriers.

Source: Romero, M., Rudolf, K., Asnawi, R., Irawan,B., Wollni, M.: "Tree planting adoption among oil palm farmers: the role of perceptions and intentions" Unpublished manuscript.

Another important aspect in the adoption process is knowledge sharing, especially since training and extension programs may have larger effects on those farmers who directly receive them compared to famers that do not participate. Meaningful productivity and conservation gains can only be driven by a large-scale uptake of sustainable practices.[39] In the context of oil palm in Indonesia, farmers learned about plantation management through extension services provided by companies or by working in others' plantations.[40] Yet, often this technical training did not encourage conservation practices. Information is also shared through informal discussion between family members, peers and farmers groups.[39] While these are important channels of knowledge diffusion, they are unlikely to drive large conservation efforts.

To upscale environmental programs at a regional level, it is essential to connect the private and public sector with smallholder farmers and NGO's; for example, through certifications schemes.[50,51] This could strongly encourage landscape heterogeneity.[52] The most known and adopted certification is the Roundtable for Sustainable Palm Oil (RSPO). This private initiative stresses the importance of preserving high conservation areas, but the impact of its current activities on biodiversity has been questioned.[37] Therefore, it is important to evaluate and modify existing systems or design new models oriented to integrate landscape approaches.[4,52] Another alternative is the introduction of market-based instruments such as Payment for Ecosystem Services (PES). This financial incentive can directly enhance ecosystem functions. However, while this approach could offset the opportunity cost of private benefits on environmental externalities, the set-up needs careful design, taking social norms and land rights into account.[53] It could also be more effective to (partially) replace financial incentives with direct service provision to villagers, e.g. through access to electricity or secured land rights.[54]

A growing global population combined with an increase in living standards and changes in dietary patterns will further drive the demand for food and related agricultural products, including vegetable oils.[3,41] To cover this demand, it is estimated that food production will have to increase approximately by 70 – 100 percent.[3,55,56] Driven by these trends, large-scale oil palm plantations are rapidly expanding into further biodiversity-rich regions, across the Amazon, Equatorial Africa, and Southeast Asia.[52] This trend urges for action where private companies, farmers, state institutions and civil society organizations support conservation-friendly agriculture.[50] This is not an easy answer to the problems caused by oil palm cultivation, but taking into account the complexity of the issue is a necessary step to overcome the future challenges of oil palm expansion.

Figure 4 Extension session in the village Mekar Sari in Jambi Province, February 2016.

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