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FOOD SYSTEMS AT RISK

NEW TRENDS AND CHALLENGES

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CHAPTER 2.3

DEFORESTATION FOR FOOD PRODUCTION

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SUMMARY

Deforestation contributes to carbon emissions and therefore to climate change. Within food systems, agricultural production is the stage which plays the largest role in deforestation and forest degradation, and it is therefore the focus of this chapter. There is a critical link between food systems and deforestation. Arable lands most often have a forested past. It might be ancestral, with deforestation having happened in the early occupation of land by humans or be very recent on current forest frontiers. Over the past two decades, commercial agriculture has overtaken subsistence agriculture as the main driver of deforestation in LI and LMI countries, especially in tropical areas.

There is a critical link between food systems and deforestation. Because of their climate and soil characteristics, potential arable lands are usually covered with forests under natural conditions. In LI and LMI countries, commercial agriculture is the most important driver of deforestation, followed by subsistence agriculture (FAO, 2016). Hosonuma *et al.* (2012) estimated that commercial agriculture contributed to 68 percent of deforestation in Latin America between 2000 and 2010, and to about 35 percent in Africa and Asia, while subsistence agriculture contributed to 27 percent and 40 percent of deforestation in each continent. Agriculture is also involved in forest degradation, though timber extraction and logging drive most forest degradation, followed by fuelwood collection and charcoal production, uncontrolled fires and livestock grazing (Hosonuma *et al.*, 2012; Carter *et al.*, 2018).

Deforestation, forest degradation and loss of ecosystem services

Forests provide multiple ecosystem services, such as carbon sequestration, biodiversity preservation, soil protection and regulation of water resources. More specifically, tropical forest evapotranspiration cools the local climate through feedbacks with clouds and precipitation. Deforestation (complete destruction of forest cover) and forest degradation (modifications of forests due to the accumulation of disturbances over time) threaten the provision of forest ecosystem services. Massive deforestation would lead to a decrease in carbon storage and an increase in GHG emissions. It also leads to the reduction of convective clouds involving a significant reduction in precipitation and an increase in average temperatures (Bonan, 2008).

Currently, one-third of the planet's forests are considered as primary or intact while the other two-thirds are subject to human activities and degradation. In tropical areas, carbon gains from forest growth are cancelled out and exceeded by carbon losses from deforestation and degradation, leading to a net emission of 425.2 ± 92.0 Tg C year^{-1}. Forest degradation affects about 60 percent of the world's tropical forests and accounts for 68.9 percent of the current overall tropical forest carbon loss (Baccini *et al.*, 2017). The evolution of tropical forests will play a key role in the possible mitigation of climate change.

Song *et al.* (2018) have reported that the global tree cover area (including all agroforestry systems, much degraded forests and plantations) increased by 2.24 million km² from 1982 to 2016, an increase of 7.1 percent. The overall gain is mainly due to an increase in forest cover in the subtropical, temperate and boreal climate zones (green pixels, *cf.* Figure 14) balancing the net loss of tree cover in the tropics (pink pixels, *cf.* Figure 14). These

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estimates do not consider imported deforestation, caused by the production of imported agricultural and forestry products. FAO (2015) agrees on the estimate of tree canopy loss. However, it reported a net forest loss between 1990 and 2015.

In rural landscapes, forests provide ecosystem services essential to agriculture, such as habitat for pollinating species and beneficial insects, maintaining soil stability and fertility, facilitating water infiltration into the soil for better renewal of groundwater reserves, acting as a buffer zone transforming heavy rainfalls into networks of small rivers with limited erosive impact, protection against strong winds and regulation of the micro-climate. Forests, when appropriately planned and managed, can withstand and protect against natural disasters of varying degrees and types (FAO and RECOFTC, 2013; Carter *et al.*, 2018). Forest spatial organisation is recognised as a key factor in providing these ecosystem services. Small-scale farming allows for discontinuity in production areas. Plots usually range from less than one to a few hectares in size. Corridors of forests and buffer zones around hydrologic networks might be easier to protect in landscapes dominated by this production system.

The role of agriculture in deforestation

Recently, high resolution imagery and fast image processing have been used to address the question of which type of agricultural systems have the largest influence on deforestation, looking at the size of clearing as a proxy of the type of production. Austin *et al.* (2017) have provided an analysis of deforestation evidence from 2000 to 2012, examining the trends in forest clearances of different sizes by country, region and development level. Their findings suggest that, in general, tropical deforestation increased between 2000-2006 and 2007-2012. More than 50 percent of this increase related to the expansion of medium, large and industrial-scale clearings (10-100 ha, 100-1,000 ha and >1,000 ha respectively), with a more pronounced trend in South East Asia (especially in Indonesia, Malaysia and Cambodia) and South America (especially in Bolivia and Paraguay). The opposite trend was observed in Brazil, where deforestation decreased, with more than 90 percent of this from a reduction in medium and large-scale clearings. Austin *et al.* (2017) also provide evidence that the deforestation profiles in most Central American and African LI and LMI countries continue to be dominated by small clearings (more than 80 percent of the country's deforestation). In South East Asia, Philippines and Thailand show the same trend with 90 to 92 percent of the increased deforestation related to small clearings.

Small-scale agriculture includes family farming for subsistence and sales of surpluses, as well as managerial farming mixing family labour with permanent hired labour for commercial production. These farms might be included in informal value chains and their importance on the market at the national and global scale is therefore often underestimated, even though they are key players for certain crops. For example, smallholders of less than 2 ha produce 70 percent of all rice but only 10 percent of maize at the world level (Samberg *et al.*, 2016). Taken together, they represent a huge population and are a priority target for SDGs tackling poverty alleviation, food security and access to health services and education.

Where there is a growing population, small-scale farmers consume forest land to expand the productive agricultural area, use timber for housing construction and wood for fuel. Agricultural conversion of forests might also be a means to land appropriation and transmission. In LI countries, small-scale agriculture is mainly organic and labour-intensive by default[4], mostly because of the lack of cash or access to inputs and materials. Farmers benefiting from technical advances in agriculture sometimes expand to sell more agricultural products rather than spare land. This means agricultural intensification does not systematically lead to less pressure on forests (Rudel *et al.*, 2009; Byerlee, Stevenson and Villoria, 2014). Besides, De Fries *et al.* (2010) have shown that tropical deforestation is more closely correlated with urban population growth and the development of export-oriented agriculture rather than growth in the rural population.

Austin *et al.* (2017) have demonstrated that industrial-scale agriculture played an increasing role in deforestation during the 2007-2012 period in Paraguay, Bolivia and Peru in South America, and in Indonesia, Malaysia, Cambodia and Vietnam in South East Asia. Agriculture in these countries is increasingly directed towards the export of commodities. When the price of the commodity is high enough, it becomes profitable to stretch the agronomic limits of the ecosystem by huge installation investments. When replacing forests, these costs might be partially covered by the sale of timber and wood.

Large-scale land-based investments in agriculture are also an answer to political strategies seeking to diversify national economic resources, populate national border areas, boost the national economy and balance imports and exports of food, fibre or energy. While they might be a great economic

4. However, this might not always be the case in main cash crop agricultural systems nor in peri-urban agriculture (see Chapter 3.3).

opportunity for host countries, they may also be a threat to natural forests and possibly to access to land by local populations. They create new living areas, with a local increase in the human population which increases pressure on natural resources and creates high local demand for food crops and animal proteins, for fuelwood and for timber for housing. Adjacent forests might suffer from higher pressure from hunting and gathering, slash and burn for agriculture and small-scale logging (Feintrenie, 2014).

They are a frequent target for activist NGOs. However, industrial companies must meet requirements from the governments of host countries of their production sites as well as in the countries of origin where the companies are registered. A consequence of these pressures is the definition of strategies and commitments by many agri-business companies towards responsible production schemes such as certifications or zero-deforestation pledges (Tonneau *et al.*, 2017).

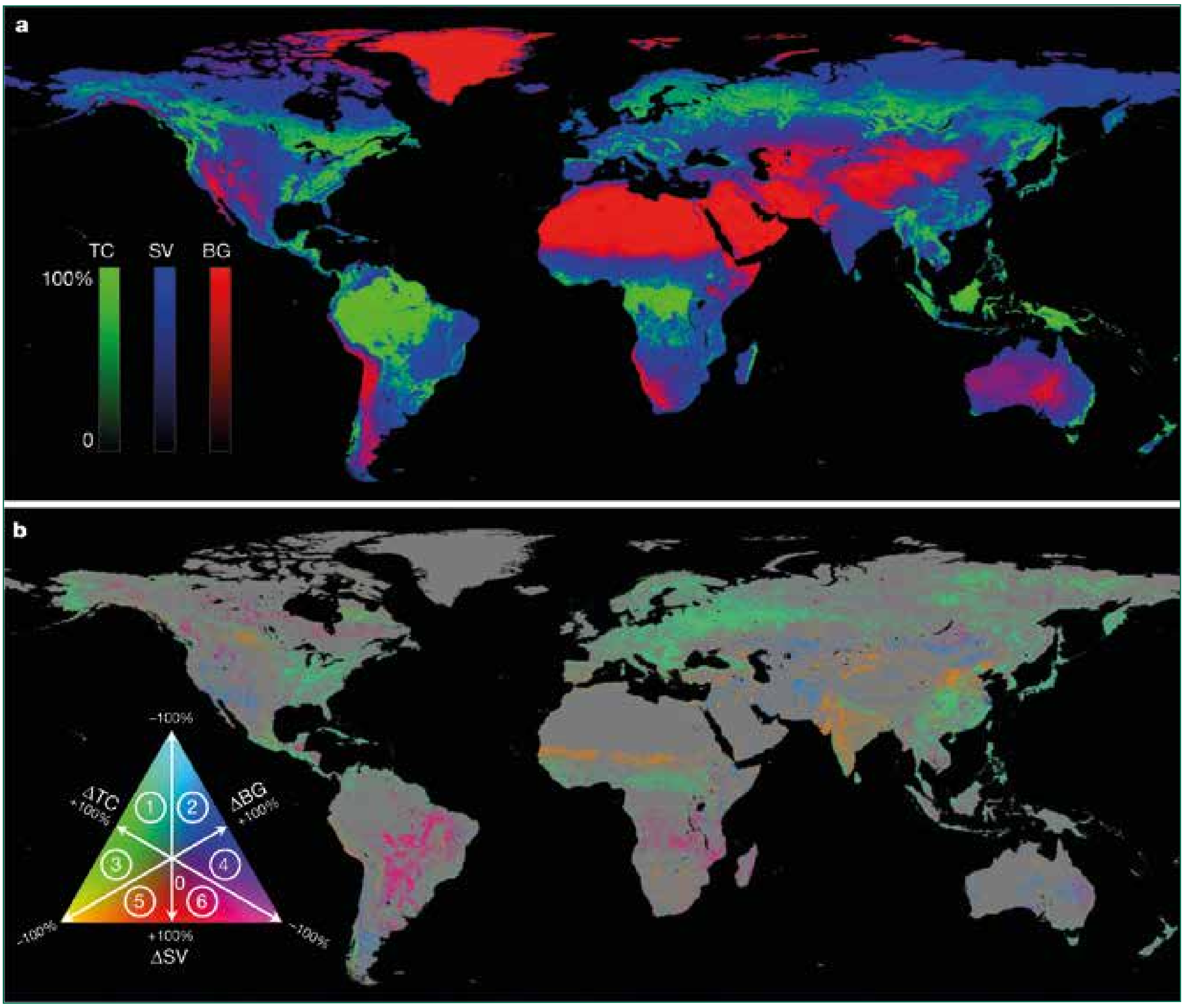

Figure 14: *Satellite-based record of global tree canopy (TC) cover, short vegetation (SV) cover and bare ground (BG) cover from 1982 to 2016.*
Source: Songe et al. *2018.*

A satellite-based record of global TC, SV and BG cover from 1982 to 2016. a, Mean annual estimates. b, Long-term change estimates. Both mean and change estimates are expressed as per cent of pixel area at 0.05° x 0.05° spatial resolution. Pixels showing a statistically significant trend (n = 35, two-sided Mann - Kendall test, P<0.05) in either TC, SV or BG are depicted on the change map. Circled numbers in the colour legend denote dominant change directions: 1, TC gain with SV loss; 2, BG gain with SV loss; 3, TC gain with BG loss; 4, BG gain with TC loss; 5, SV gain with BG loss; and 6, SV gain with TC loss.

BOX 3

NON-INDUSTRIALISED FAMILY FARMING MIGHT NOT ALWAYS BE FOREST FRIENDLY: THE EXAMPLE OF AGROFORESTRY IN INDONESIA

Sourisseau et al. (2015) have described the diversity of family farming systems and their interactions with the environment. Many examples of non-industrialised family farming are given to argue that where forests are available for agricultural conversion and where labour is not a limiting factor, expansion is the main strategy to increase family agricultural income.

Indonesia is well known for its complex agroforestry systems, also called agroforests, and when dominated by rubber, 'jungle rubber'. These agroforests preserve most forest ecological functions (FAO, 2016). They protect soils, regulate hydrological resources and micro-climates and preserve a high level of biodiversity. Farmers who develop and manage them are sensitive to the complexity of plant, insect and animal interactions and recognise their aesthetic quality. Behind this pleasant picture hides the deforestation of natural forests in response to commercial opportunities. Coffee, cocoa and rubber were first planted in medium and large-scale plantations according to industrialised agricultural practices. Local farmers, often working in these plantations, began intercropping these cash crops in their upland rice and food crops. They have added commercial agriculture to their subsistence farming. The complexity of the botanic composition in these agroforests is mostly spontaneous: after three years of rice and food crop cultivation, the plot is abandoned until trees become productive. In the case of coffee or cocoa this is only a matter of a few years, while in the case of rubber, it might be up to 15 years. Then the farmer returns to the plot, cleans it, preserving useful trees (valuable timber trees and fruit trees) and opens a path to the cash crop trees. Useful trees might be planted to enrich agroforests where space allows it (Feintrenie, Schwarze and Levang, 2010).

The environmentally friendly practices in agroforests do not compensate for the forest and wildlife habitat losses necessary for their establishment. Other features of these agroforests translate into lower agricultural yields and income generation compared with mono-specific plantations. Because of this, agroforests are increasingly being converted into more productive mono-specific plantations. Feintrenie, Schwarze and Levang (2010) analysed this common trajectory in three sites: Sulawesi (cocoa), Lampung (coffee and damar) and Eastern Sumatra (natural rubber). They found that the main drivers of conversion of forests to agroforests or agroforests to mono-specific plantations are identical: economic opportunities.

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