Oil palm has a rigid development pattern, with potentially every leaf carrying an inflorescence that (if female) can become a fruit bunch, if light, nutrient and water availability are high

Photo credit: Meine van Noordwijk/World Agroforestry

CHAPTER 18

Negative environmental externalities within cocoa, coffee and oil palm value chains in Africa

Priscilla Wainaina, Peter A. Minang, Judith Nzyoka

Key highlights

- While tree commodities, including cocoa, coffee and oil palm, are important for Africa's economic and social development, negative environmental externalities from these commodities are a growing concern.
- Major tree commodities have expanded at the expense of forests, with negative impacts on biodiversity and greenhouse gas emissions.
- Other negative externalities from tree commodity value chains include water and soil pollution and accompanying human health impacts from agrochemicals, and emissions from deforestation, transport, and waste.
- Several practices, regulations, and policies are increasingly being deployed to address these externalities in Africa, with certification in coffee in the lead, while zero-deforestation commitments, and living wage initiative in cocoa also growing. However, monitoring and traceability are still very weak.
- Integrated portfolios of instruments and good practice designs would be needed to address externalities because environmental, economic and social externalities are often connected, and single instruments, however good, are often insufficient.

1. Introduction

Tree commodities play a significant role in most African countries both at the country and household level. Cocoa and oil palm are highly substantial in West African countries, and coffee in East African countries. At the household level, cocoa, coffee and oil palm contribute significantly to livelihoods. Cocoa directly employs more than 1,000,000 farmers in Cote d' Ivoire and about 800,000 farmers in Ghana; a large proportion of their income is from cocoa

Wainaina P, Minang PA, Nzyoka J. 2021. Negative environmental externalities within cocoa, coffee and oil palm value chains in Africa. In: Minang PA, Duguma LA, van Noordwijk M, eds. 2021. Tree commodities and resilient green economies in Africa. Nairobi, Kenya: World Agroforestry (ICRAF)

production in Cote d' Ivoire (about 90%) and Ghana (about 80%) (Waarts et al 2019). Similarly, coffee provides livelihoods for about 15 million farmers in Ethiopia ECTA (2018), and nearly 2 million farmers in Kenya. Also, these tree commodities (TCs) contribute to the livelihoods indirectly through employment in processing, transportation and distribution.

Approximately 75% of the world's cocoa is produced in West Africa, mainly in Cote d' Ivoire and Ghana. Similarly, for coffee, Ethiopia and Uganda are among the top ten global coffee producers and exporters. Although Africa's coffee contribution to the world is not as massive as cocoa, it is still substantial. According to FAOSTAT, in 2017, Ethiopia contributed 5%, Uganda 2.3% of the total world coffee. However, for oil palm, the world's production and trade is dominated by Indonesia and Malaysia, which accounts for 90% of total global output; West Africa accounts for 3.5% of the total global output, with Nigeria accounting for 1.5 - 3% of global output.

Like other food commodities, there are externalities - both positive and negative - in how TCs are produced, processed, distributed, and even consumed. Externalities refer to benefits and costs that are not financially internalized by the responsible actors. Considering these externalities can help decision-makers, including policymakers, take corrective measures for environmental problems (Atela et al 2017). The flow of these externalities directly depends on how agricultural ecosystems are managed and upon the diversity, composition, and functioning of remaining natural ecosystems in the landscape (Zhang et al 2007). Existing literature on environmental externalities within TCs value chain is scanty, with most of the literature leaning towards the production stage. For this chapter, we identify the environmental externalities within cocoa, coffee and oil palm value chains in Africa, as well as existing and potential policies, regulations and standards set to correct them.

Production of cocoa, coffee, and oil palm in Africa is mainly for export. Increasing global demand for these products has resulted in increased land under tree commodities, a significant driver of deforestation in Africa. The loss of forests and shadow trees amplifies the impact of climate change, especially in West Africa, where natural forest cover in Ghana, Cote d' Ivoire, and Burkina Faso has declined by more than 70% in the past three decades (Cocoa Barometer 2018). Land expansion to produce TCs has also resulted in social issues such as community dispossession, power relations and large-scale land grabs, which are a major concern in Africa. *(link to Chapter 14 – How much do cocoa and coffee contribute to livelihoods in Africa?*). In addition to the land expansion, the production of these crops involves high use of agrochemicals, which has adverse effects on the soils, water, and human health. Beyond production, the processing of these commodities yields waste, which is a significant pollutant. In addition, emissions in the form of greenhouse gases (GHGs) are also released along the various value chain stages of these commodities.

However, various global, regional, and country-specific measures and regulations have been put in place to minimize these negative externalities. For example, the zero-deforestation agreements by cocoa-producing countries to reduce further deforestation, or certifications such as the Rainforest Alliance among cocoa and coffee producers, and the Roundtable of Sustainable Oil Palm (RSPO) for oil palm producers. Additionally, there are practices adopted by the TCs producing countries aimed at increasing production of these TCs to meet growing demand without expanding the area under cultivation, such as sustainable intensification. In the following sections, we will discuss these externalities, as well as the practices, policies and measures put in place and those that can be adopted to reduce the negative externalities.

2. Environmental externalities within the cocoa, coffee and oil palm value chains

Based on comprehensive literature reviews, we identified environmental externalities across four distinct stages of the cocoa, coffee and oil palm value chains (production, processing, distribution & marketing and consumption) as presented in Table 18.1. Negative externalities within these value chains may result from either; 1) deforestation owing to land expansion for the production of these tree commodities, 2) environmental impact from the use of agrochemicals, 3) waste produced during processing, and 4) greenhouse gases (GHGs) emissions generated during production, processing, distribution and consumption of these tree commodities. We discuss these externalities in detail in the following sub-sections.

Table 18.1: *Negative externalities within cocoa, coffee and oil palm value chains*

Value chain stage	Production	Processing	Distribution & marketing	Consumption
Cocoa	• Deforestation • Pesticides effect on human health, soils and water bodies • GHGs from fertilizer production and use	• Waste from cocoa processing in the form of pod husks as well as pulp • GHGs	• GHGs from transportation, packaging	• GHGs
Coffee	• Deforestation • GHGs from fertilizer production and use	• Water pollution Wastewater from wet coffee processing which affects human health and aquatic life • GHGs from wastewater fermentation	• GHGs from transport and packaging	• GHGs

Value chain stage	Production	Processing	Distribution & marketing	Consumption
Oil palm	• Deforestation results in biodiversity loss, particularly the loss of primates • Pesticides use affecting soils, water quality, and aquatic life • Invasive aspects of oil palm cultivation • GHGs	• Waste from processing from Palm Oil Mill Effluents (POME) affects aquatic life and water quality for domestic use • GHGs from POME	• GHGs from transportation and packaging	• GHGs

2.1. Deforestation

Rising global demand for cocoa, coffee, and oil palm has led to the need to increase production over time. Over the decades, increases in cocoa and coffee production in Africa have been achieved through increasing the land under cultivation and has been a significant driver of deforestation. Generally, from 2001 to 2018, Cote d' Ivoire, the largest global cocoa producer, lost 2.78 Million ha of tree cover, equivalent to a 19% decrease in tree cover since 2000, resulting in 730 million tonnes (Mt) of CO_2 emissions. Ghana lost 1.09 Million ha of tree cover, equal to a 16% decrease in tree cover since 2000, resulting in 291Mt of CO_2 emissions[2]. Ethiopia, the leading coffee producer in Africa, lost 384,000ha of tree cover from 2001 to 2018, equivalent to a 3.2% decrease in tree cover since 2000, resulting in 120Mt of CO_2 emissions[2].

Oil palm production in Africa has also been on the rise over the last decade and is expected to continue rising. In Asia, oil palm production has been a significant contributor to deforestation, which may also be true in Africa. Most African countries that produce oil palm are in West Africa, where the bulk of cocoa consumed in the world is produced, and significant deforestation has already occurred. The destruction of forests may also mean the loss of vital habitat areas for highly threatened species like orangutans, elephants, and rhinos. It is estimated that 273M ha of land could be planted with oil palm in Africa: 84M ha with low yields, 139M ha with average yields, and just 50M ha with high yields (Strona et al 2018). Combining these figures with the data on primate vulnerability, oil palm could only be grown with little impact on primates on 3.3M ha, which corresponds to just 6.2% of the demand for additional land by 2050 (Strona et al 2018). However, compared to other oil-producing crops such as soya, rapeseed, and sunflower, oil palm requires ten times less land (Thomas et al 2015). Thus, substituting another oil source in place of oil palm will not solve the problem of expansion. It will only lead to more land use; hence the solution is to produce palm oil sustainably. Deforestation also leads to several other adverse effects, including loss of livelihood, weakened forest governance, e.g., community forest management is cripled through private sector investments. (*link to chapter 19 – Tree commodities and Climate change: Impacts and Opportunities*).

2.2. Effect of agrochemical use on soil, water and human health

Furthermore, as a result of the rising global demand for cocoa, coffee, and palm oil, intensification practices such as the high-tech plantation systems have been increasing. Intensification through high input use is viewed as an avenue to increase production through sparing land as opposed to extensive cocoa cultivation. This has led to increased use of agrochemicals which, left unchecked, also have negative effects on the environment. Additionally, intensification of tree commodities, especially oil palm, may also result in reduction of food crops. This is a huge threat for the poor who depend on locally available food. (*link to chapter 14 – How much do cocoa and coffee contribute to livelihoods in Africa?*).

The use of fertilizers and pesticides is majorly higher within cocoa and oil palm production than coffee production in Africa. It is particularly highest in high-tech (highly intensified) plantation systems relative to other production systems. Many pesticides, including organochlorines, are usually applied on cocoa and oil palm farms in sub-Saharan Africa (SSA) to reduce the incidence of insect pests and diseases. The regular application and indiscriminate use of chemicals have been associated with unintended environmental (soil and water contamination) and human health consequences. The pathways through which pesticides applied to cocoa farms may affect human health include; 1) through pesticide residues contaminating drinking water sources, 2) through traces of pesticides left in cocoa beans, and 3) through physical contact during pesticide application (Okoffo 2015). Of these pathways, pesticide application without protective gear is the most linked to adverse health effects among the farmers. Poor handling and storage of pesticides are also linked to adverse human health effects (Okoffo 2015).

Pesticides residues are also highly linked to adverse environmental and health consequences. A life cycle assessment of cocoa beans conducted in Ghana (Ntiamoah and Afrane 2008) found that for every tonne of cocoa beans produced, approximately 3.7kg and 0.95kg of pesticides residues are released to freshwater and soils, respectively. Similarly, about 0.042kg of heavy metals get released to the agricultural soils in the production of one tonne of cocoa beans in Ghana. Along Ghana's cocoa value chain, cocoa production makes the most substantial contribution (<96% compared to other value chain levels) to the environmental impacts of eutrophication, ozone layer depletion, freshwater aquatic eco-toxicity, human toxicity, and terrestrial eco-toxicity (Ntiamoah and Afrane 2008). This has mostly been attributed to pesticide and fertilizer use.

Several studies have also assessed the levels of pesticide residues in soils and drinking water sources from cocoa farms in Ghana (Okoffo 2015, Fosu-Mensah et al 2016). From these studies, although most of the pesticide residues recorded in water were below the World Health Organization Minimum Residue Levels (WHO MRLs) for drinking water, some pesticides exceeded the WHO MRLs at some sampled sites. Hence pesticide residue concentrations in drinking water sources pose a health hazard to farmers' households and their entire community who utilize water from these same sources. The pesticide residues in the soil also pose a danger to soil organisms and contaminate surrounding water bodies through runoff and leaching. Also, there is the likelihood of translocation of these residues from the soil into the cocoa beans and other crops (like vegetables that are commonly intercropped with cocoa) through the root system, thereby posing health risks to consumers (Fosu-Mensah et al 2016).

2.3. Waste produced during processing

Waste generation during the processing of coffee, cocoa, and oil palm is one of the significant environmental externalities within these crops' value chains. Solid and liquid waste, and gaseous emissions are generated in the processing of oil palm. The solid wastes include empty fruit bunch, palm press fibre, chaff, and palm kernel shell (Izah et al 2016). These solid wastes are mostly used as boilers fuel for the palm oil mills in most developing countries in Africa. During oil palm processing, a lot of water is required; specifically, one tonne of fresh fruit bunch (FFB) of oil palm requires 5 – 7.5 tonnes of water to produce 10-30% of palm oil. About 50 – 79% of the water used ends up as POME. Discharged POME (which is usually acidic) changes the soil appearance and some properties, including vegetation, colour, odour, and constitution, and sometimes results in biodiversity loss. It also leads to acidification/eutrophication in the aquatic ecosystem (Izah et al 2016). Cocoa production and on-farm processing also generate a large amount of solid waste in the form of pod husks and as well as hydrolyzed pulp during on-farm processing (Ntiamoah and Afrane 2008). The pod husk constitutes about 67% of the fresh pod weight and presents a serious disposal problem, and approximately 50 litres of the pulp is obtained from one tonne of wet beans (Ntiamoah and Afrane 2008, Campos-Vega et al 2018). The pulp is mostly drained off as liquid waste in the farms.

Within the coffee value chain, wastewater generated through wet coffee processing yields high environmental costs in the form of water pollution. On average, coffee processing results in effluent wastewater to the extent of about 3,000 litres per tonne of coffee processed. In Ethiopia, the leading coffee producing country in Africa, there are more than 400 wet coffee processing installations located in the vicinity of rivers (Woldesenbet et al 2014, Olani 2018). This is because a lot of water is needed for washing the beans, removing the pulp and the mucilage, but also to use the water bodies for direct disposal of the wastewater released from the wet coffee processing plants. These industries do not re-use the water, which is used once for de-pulping and fermentation. All the generated wastewater is directly released to downstream water bodies and sometimes in disposal pits (Woldesenbet et al 2014).

Wastewater is a significant pollutant. Figure 18.1 shows a comparison between observed chemical characteristics of discharge wastewater from Ethiopia's processing industries against the World Health Organization (WHO) and Ethiopia's permissible levels. We considered the following parameters*: i) Biological oxygen demand (BoD)* which indicates the amount of oxygen needed to biologically breakdown organic wastes in the water, ii) *Chemical oxygen demand (CoD)* which indicates the amount of dissolved oxygen required to combine with chemicals in the wastewater, iii) *Total suspended solids (TSS*) which is a measure of water turbidity, i.e., the concentration of suspended solids in water bodies. We also considered the pH as well as the nitrates and phosphate levels. The average levels of effluent concentration reported at the discharge points of the Ethiopian coffee processing plants as assessed by various studies (Woldesenbet et al 2014, Olani 2018, Beyene et al 2012, Ejeta and Haddis 2016, Tekle et al 2015) were substantially higher than the acceptable limit indicating high pollution strength of the wastewater from the processing industries.

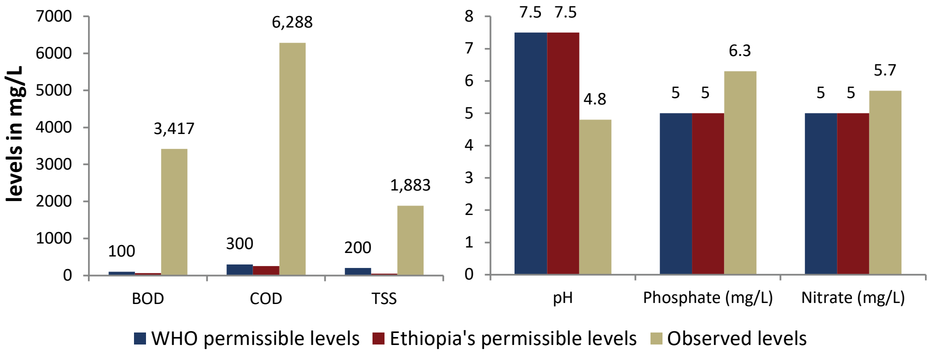

Figure 18.1: *Comparison of water discharge with the WHO and Ethiopia's recommended levels*

Wastewater directly discharged to the surrounding water bodies from wet processing industries causes many severe health problems among residents within the vicinity of these processing industries, including; spinning sensation, eye, ear and skin irritation, stomach pain, nausea, and breathing difficulty (Woldesenbet et al 2014, Haddis and Devi 2008). Also, the wastewater has a significant adverse environmental impact on aquatic systems in coffee-producing countries (Beyene et al 2012).

2.4. Greenhouse gases emitted throughout the value chains

Greenhouse gases (GHGs) are emitted throughout the cocoa, oil palm, and coffee value chains. At the production level, GHGs are attributable to the production and use of fertilizers. These emissions are particularly high for cocoa and oil palm, for which fertilizer use is high in Africa. Table 18.2 shows the estimates for different GHGs emissions for cocoa, coffee, and palm oil at various stages of the value chains. These estimates were sourced from multiple studies and are not necessarily consistent with each other.

Table 18.2: *GHGs within cocoa, coffee, and palm oil value chains*

Value chain stage	Production	Processing	Distribution& marketing	Consumption	Entire value chain
Cocoa	0.323 tCO_2e per tonne of cocoa beans [a]	0.28-1.91 tCO_2e per of tonne chocolate [b]	Transportation 0.22-0.39 tCO_2e per tonne of chocolate[c]	Packaging 0.3 tCO_2e per tonne of chocolate[b]	3.36-3.6 tCO_2e per tonne of chocolate [a]
Coffee	-0.37-1.2 tCO_2e per tonne of coffee beans [d]	2.51 tCO_2e per tonne of coffee beans [d]	Transportation 0.208 tCO_2e per tonne of coffee beans [e]		3.05 tCO_2e per tonne of coffee beans [f]
Oil palm	-0.87-0.37 tCO_2e per tonne fresh fruit bunch [g]	0.16-0.24 tCO_2e per ton of palm oil [h]			2.8-19.8 tCO_2e per tonne of crude palm oil [h]

a (Ntiamoah and Afrane 2008) b (Perez Neira 2016) c (Recanati et al 2018) d (Maina et al 2016) e (Hassard et al 2014) f (Killian et al 2013) g (Bessou et al 2014) h (Reijnders and Huijbregts 2008)

The bulk of the GHG emissions in the chocolate/cocoa value chain is at the production stage, estimated at 0.323 tCO_2e per tonne of cocoa beans produced (Ntiamoah and Afrane 2008). Post-production, the manufacturing stage emits the highest amount of GHGs estimated at 0.28-1.91 kg CO_2e per kg of chocolate Perez Neira (2016), followed by packaging (0.34 tCO_2e per tonne of chocolate) Recanati et al (2018) and transportation (0.22-0.39) tCO_2e per tonne of chocolate Perez Neira (2016). The total GHG emissions for the cocoa value chain are estimated at 3.48 tCO_2e per tonne of chocolate.

For coffee, the emissions estimate at the production and processing stage (wet processing) were sourced from a study conducted in Kenya (Maina et al 2016). The GHGs emission at production stages varies with the production system; hence the estimates range between -0.37-1.29 tCO_2e per tonne of coffee beans. The negative values are due to carbon sequestration within sustainably produced coffee, while the positive values accrue from other coffee production systems. Of the total GHG emissions at the processing stage, the highest proportion

(98%) was due to the generation of wastewater from pulping, fermentation and washing of coffee cherries associated with wet coffee processing. The rest arises from transport (1.4%) and energy use (0.7%) during processing. The estimated transport emissions included both domestic and international coffee transport from Ethiopia to Europe and were sourced from this study (Hassard et al 2014). The total domestic transport emissions were estimated at 0.0975tCO_2e per tonne of green coffee beans based on an estimated distance of 650 km. In comparison, international transport emissions were estimated at 0.1107tCO_2e per tonne based on a distance of 12,200 km.

The carbon footprint related to consumption was attributed to the (post-export) processes in Europe and were sourced from Killian et al (2013), estimated at 3.05 tCO_2e per tonne of green coffee. Of these post-export processes, the emissions by consumption are the greatest (71%), which comes from the high demand for energy required for the preparation of coffee with an automatic coffee machine. Others include; roasting process (6%), packaging (4%), distribution (5%), grinding and purchasing (9%), and from the end of the phase (disposal) (5%).

Within the palm oil value chain, the main hotspots of emissions include; land clearing, peat oxidation, fertilizer-related emissions (embodied emissions in fertilizer production and field emissions), and methane from palm oil mills effluent (POME) (Bessou et al 2014). At the mill level, two main sources of GHG emissions are present, fossil fuel consumption and methane emission from POME, but only the latter is significant at the supply chain level. The GHGs were mainly from emissions of methane linked to the anaerobic conversion of POME (Reijnders and Huijbregts 2008).

3. Practices and policies for reducing negative externalities within cocoa, coffee, and palm oil value chains

Table 18.3 presents a summary of different practices, policy instruments, incentives, and regulations that can be employed to minimize the negative externalities and promote positive externalities within the value chain of cocoa, coffee, and oil palm. (*link to chapter 22 – Policy instruments for enhancing tree commodities*)

Table 18.3: Practices and policy instruments for reducing negative externalities within cocoa, coffee, and palm oil value chains

Value chain stage	Production	Processing	Distribution & marketing	Consumption
Cocoa	• Sustainable intensification practices such as agroforestry • Zero-deforestation commitments (ZDCs) • Certification for sustainably produced cocoa • Regulations on pesticides use • Minimize postharvest losses	• Regulations on waste treatment	• Rethinking packaging materials	• Minimize food waste
Coffee	• Sustainable intensification practices such as agroforestry • Certification for sustainably produced coffee • ZDCs • Minimize postharvest losses	• Regulations on wastewater treatment from wet coffee processing • Innovations on value addition of waste	• Packaging	• Minimize food waste • Energy-efficient coffee-making procedures
Oil palm	• ZDCs • Certification such as the Roundtable of Sustainable Oil Palm (RSPO) • Sustainable production • Minimize postharvest losses	• Value addition of waste • Regulations on wastewater treatment		• Minimize food waste

3.1. Sustainable intensification practices

Production of these commodities does not necessarily have to yield negative externalities; depending on the production systems employed, positive externalities can be realized in the production of TCs. Globally, climate-smart agricultural (CSA) practices are promoted to; raise agricultural productivity and farm incomes, enhance adaptation and resilience to climate change, and reduce greenhouse gas emissions from agriculture. The commonly practised and promoted CSA within cocoa and coffee farms in Africa is agroforestry. In addition to achieving the three objectives of CSA, agroforestry can also directly benefit forest conservation. Agroforestry systems lead to increased output per unit of land since the farmer has multiple income streams on the same piece of land resulting in an increase in income and a reduction in the demand for land, thereby reducing deforestation. Similarly, they prevent deforestation by reducing harvest from natural forests of timber, fuelwood, charcoal, fodder, and other products that agroforestry trees provide (Minang et al 2014, Rapidel et al 2015). Agroforestry systems within tree commodities also provide several ecosystem services, including; provision of carbon storage, increases biodiversity, biological pest and disease control, pollination, cleaner water, soil formation, nutrient cycling, and less erosion (Duguma 2013, Mbow et al 2014, Namirembe et al 2015, Chiputwa et al 2020).

Most importantly, agroforestry systems have received increased attention as potentially cost-effective options for climate change mitigation due to their importance in carbon storage and sequestration while also maintaining livelihoods (De Beenhouwer et al 2016). Due to the carbon retained in trees, shrubs, and soils, agroforestry has the potential to offset greenhouse gas emissions from conversion to more intensive forms of land use, particularly in the case of traditional coffee farming, which typically retains a high degree of canopy cover and associated carbon. Due to the role of agroforestry in carbon sequestration, there is potential for REDD+ (Reducing Emissions from deforestation and forest degradation) as a policy measure (Minang et al 2014)[28]. Specific countries have also incorporated action plans in their National Plans aimed at sustainably producing TCs. For example, the Policy for Forest Preservation, and Rehabilitation in Cote d' Ivoire and the Ghana Cocoa Forest REDD+ program.

3.2. Zero deforestation commitments and Certification premiums

A relatively small number of large companies handle most transportation, processing, and distribution of these forest-risk commodities. Since early 2000s, many of these companies have experienced increased scrutiny regarding their sourcing practices. In response, many large companies have made public pledges to exclude commodities produced by suppliers that have recently cleared or are actively clearing land. These pledges are known as "zero-deforestation commitments" (ZDCs) and are aimed at reducing deforestation in the production of cocoa, coffee and oil palm. There are also zero-deforestation commitments in specific countries, such as the road map to deforestation-free cocoa in Cameroon.

Closely related, there are certification standards such as the rain forest alliance that recognize ecological benefits accruing from sustainably produced products by paying these farmers a premium over the market price. These premiums are essential in making sustainably produced TCs economically attractive to the farmers (Leimona et al 2017). For example, in Ethiopia, agroforestry coffee farmers certified under the Rainforest Alliance certification schemes earn higher coffee returns compared to garden coffee production systems despite the lower coffee yields in agroforestry coffee (Mitiku et al 2018). They receive a premium of about 21% of the price of regular coffee in the market. However, certified agroforestry cocoa farmers are only paid a premium of approximately USD15 per tonne (Gockowski et al 2013). There are arguments that the amount of certification premium paid to these farmers is not enough to make the cocoa agroforestry systems as profitable as the full-sun cocoa systems. Even when such premiums are tripled, the profitability of Rainforest Alliance certified cocoa agroforestry systems will still be less than that of an intensive monoculture (Gockowski et al 2013). Thus, there is a need to revisit the certification premium agenda and sensitize consumers within the cocoa value chain on the environmental and ecological benefits of sustainably produced cocoa to increase their willingness to pay for these benefits. Similarly, the issue of monitoring and traceability remains a key challenge in implementing the certification programs (Bowe et al 2014). Figure 18.2 shows the conceptualization of zero-deforestation commitments and eco-certification for sustainable production

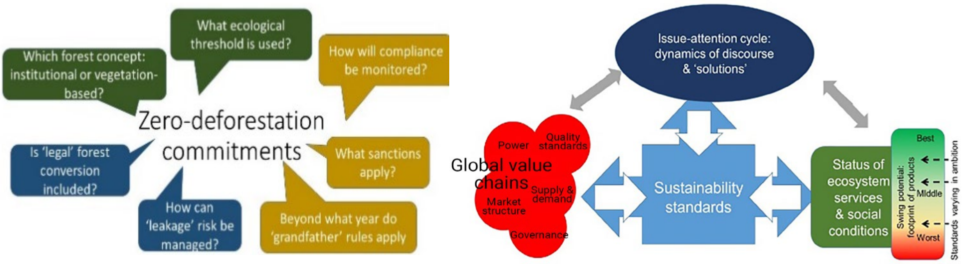

Figure 18.2: *Conceptualization of Zero-deforestation commitments and Eco certification*

3.3. Innovation on value addition of processing waste for bio use

Through value addition, waste from coffee and palm oil processing can be converted into useful products. Oil palm and palm oil processing wastes can replace the input of fossil fuel in palm oil processing and biodiesel production (Bessou et al 2014). Also, the solid wastes from palm oil can be converted to a wide range of value-added products that can be clustered into bio-based value-added products and various bioenergy products (Bessou et al 2014). The potential energy applications include direct power generation bioelectricity, bioethanol, bio-briquettes, biobutanol, bio-methanol, bio-oil, biochar, syngas using multiple technologies. Other bio-valued products include application in the bioplastic industry and as fillers in thermoplastics, composites, boosting soil fertility and preventing soil erosion (Bessou et al 2014). The pulp and wastes from cocoa pod husks have also found uses, and more studies are being undertaken in producing countries to determine their viability as commercial products (Campos-Vega et al 2018). Similarly, coffee wastes from dry processing (mostly coffee husks) in Kenya and Ethiopia are converted into branded briquettes for domestic energy supply and pulp into fortified organic fertilizer for increased land productivity (Woldesenbet et al 2014). The waste generated from wet coffee processing can also be used in bio-ethanol production.

Box 18.1

Churning value from waste: Turning negative externalities for good

With the growing demand for wet-processed coffee, wastewater discharge is increasing in coffee-producing countries in Africa. While evidence points to the fact that wastewater from coffee processing yields massive environmental and health costs, there are no regulations in most coffee producing countries that require these industries to treat the wastewater before discharging it to the water bodies. There is potential to produce bioethanol from wastewater, although it has not been explored in most of the African coffee-producing countries (Janissen and Huynh 2018). Recent feasibility studies, e.g. Woldesenbet et al (2016) conducted in Ethiopia, show that bio-ethanol production from coffee wastewater is financially and technically feasible (the benefit-cost ratio >1.05). Such an enterprise would present a win-win scenario since bioethanol can be utilized as an alternative energy production, which reduces environmental pollution and dependence on oil and petroleum in Ethiopia. It can also provide alternative energy solutions for small-scale holders as well as a source of income and jobs among the residents.

3.4. Regulations and Environmental impact assessments

There is a need for regulations and guidelines to be followed in the production and processing of TCs to minimize negative externalities. For example, for palm oil, the Roundtable of Sustainable Oil Palm (RSPO) formulates criteria for certified oil palm producers to reduce negative impacts on the environment and people. The RSPO principles and criteria cover the most significant environmental and social impacts of palm oil production and the direct inputs to production, such as seed, chemicals and water, and social effects related to on-farm labour and community relations (RSPO 2018). Similarly, some African countries such as Ghana, Kenya, and Nigeria have regulations that ban the use of some of the harmful pesticides, such as organophosphates, due to the negative effect they have on the environment and human health. Nonetheless, most African countries' enforcement of these regulations is still weak and remains a key challenge. However, within the coffee value chain, despite the high environmental costs from coffee processing, there are no country-level regulations that require processing industries to treat the wastewater before discharging it to the water bodies. Formulation and implementation of such regulations and policies would be useful.

4. Towards Integrated Portfolio instruments and practices for addressing externalities

Reflecting on the experiences in Africa hereinabove, the evidence is pointing to the fact that single instruments and/or practices are good, but in most cases, largely insufficient in dealing with the many interconnected externalities. For instance, zero-deforestation commitments without meaningful support for sustainable intensification could enable displacement of production to neighbouring areas (not covered by the commitments). Therefore, ZDCs without supportive planning frameworks that cater for potential leakage across scales may not deliver the desired benefits. Certification costs are often covered by farmers and or cooperatives, often aggravating poverty as farmers do not earn a 'living income" from commodity production. Appropriate context-based integrated portfolio designs would thus be necessary for addressing externalities.

5. Conclusion

This chapter discusses the negative environmental impacts within the cocoa, coffee, and oil palm value chains, including; deforestation, agrochemicals on soils, water, and human health, processing waste, and GHGs emissions. We also highlight the existing practices, policies, regulations, and guidelines which are being and can be implemented to minimize these negative externalities within these African countries. Sustainable intensification practices, particularly agroforestry, are widely promoted and adopted in most African countries producing TCs to reduce deforestation and other negative externalities. Policies, programs and standards that provide incentives for the uptake of such practices should be encouraged. For example, certification programs that offer agroforestry farmers a premium in recognition of ecological benefits and payment for ecosystem services programs such as REDD+ that provide compensation for carbon sequestered. Other policies that would help in reducing these negative externalities are regulations on the use of pesticides and the treatment of wastewater from processing. Also, African countries should take opportunities to produce useful products from waste generated during processing; for example, the production of bioethanol from coffee processing waste or production of biodiesel and other useful products from palm oil processing waste.

Finally, in order to comprehensively address multiple connected environmental, economic and social externalities, integrated portfolio designs including a complementary set of instruments and practices might be needed in different contexts and for different commodities. A place-based portfolio design for externalities would also be essential in instances where several commodities exist in certain landscapes or jurisdictions.

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Endnotes

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