



# Application of the TEEB for Agriculture and Food (TEEBAgriFood) Framework; Case of cocoa and coffee agroforestry value chains in Ghana and Ethiopia

## Executive Summary

Priscilla Wainaina, Peter Minang, Lalisa Duguma  
World Agroforestry Centre (ICRAF)



Photo credit: U.S. Department of Agriculture, available from <https://flic.kr/p/CqpaFm>, and

## Executive Summary

This study quantifies and qualifies the biophysical impacts and dependencies along the agroforestry cocoa and coffee value chains in Ghana and Ethiopia respectively. It also describes and, when possible estimates the value of negative and positive impacts to ecosystems and human health of the processes associated with the value chains of the two commodity crops. This was achieved by applying “The Economics for Ecosystem and Biodiversity for Agriculture and Food (TEEBAgriFood)” framework due to Obst and Sharma (2018). The Framework highlights the social, economic, and environmental elements as well inputs and outputs throughout the value chain.

For this study we did not collect primary data, instead we used secondary data sourced from different publications within and outside of the study areas for some ecosystem services. Data was sourced from grey and peer-reviewed literature including Google Scholar, Web of Science and ResearchGate by searching for different key words. We applied a systematic review process. For most of the economic and/or ecosystem services, we used data collected in the respective countries and valued them using the prevailing market and/or social prices. However, for some where no data exists in the respective countries, we sourced data from other similar places and applied the benefit transfer method. In this study, data sourced from the respective study countries accounted for approximately 86% and 80% for the case of cocoa in Ghana and coffee in Ethiopia, respectively<sup>1</sup>. The rest of the data was sourced from other similar places and conditions and we applied the benefit transfer method to value the services.

Table A presents a summary of the agroforestry cocoa and coffee value chain in Ghana and Ethiopia. For the case of cocoa, most of the value chain activities (post-production) occur outside Ghana since the country exports approximately 80% of its cocoa in the form of raw beans, and the rest is sold to the domestic processors. The cocoa beans sold to the domestic processors are processed into semi-finished products such as liquor, butter and powder, of which 95% is exported. Similarly, Ethiopia exports about 50-60% of the coffee produced. Europe is the largest importer of both cocoa from Ghana and coffee from Ethiopia, hence, some of data on processing, distribution, packaging and consumption was sourced from studies conducted in Europe.

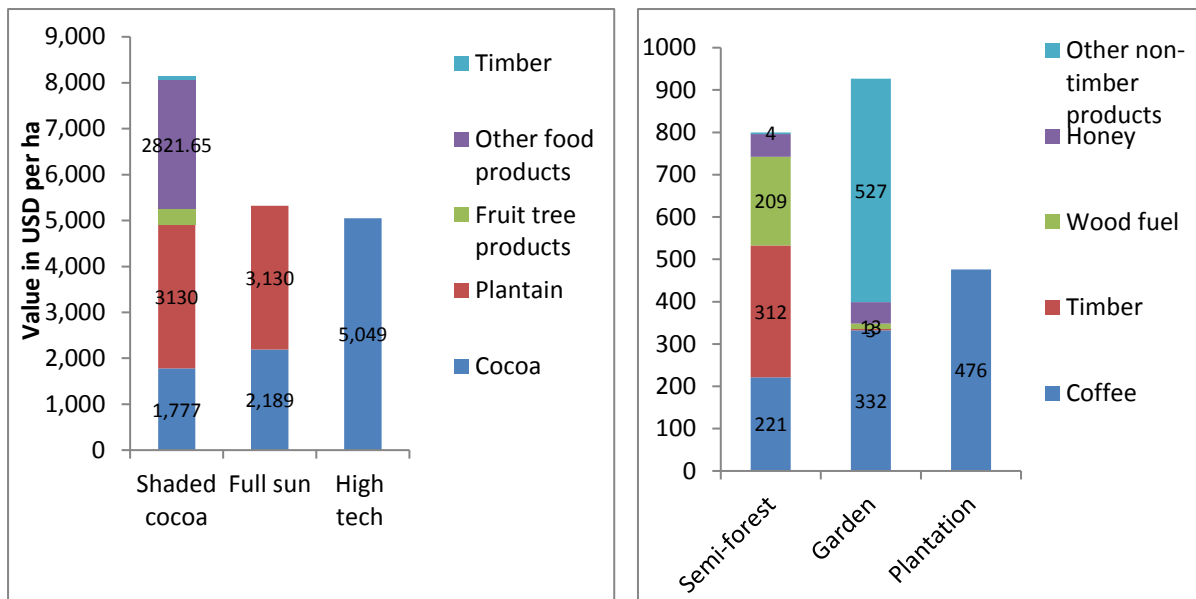
---

<sup>1</sup> Details on the data sources for the specific ecosystem services are provided in Table A3 and A4 in the Annex.

**Table A: Summary of the value chain for agroforestry cocoa and coffee in Ghana and Ethiopia**

<b>Value chain stage</b>	<b>Agroforestry cocoa in Ghana</b>	<b>Agroforestry coffee in Ethiopia</b>
Production	<ul style="list-style-type: none"> <li>-Most cocoa in Ghana is produced by smallholder farmers (0.4-4 ha). &lt;10% of cocoa farmers are large scale.</li> <li>-Production systems: 50% shaded cocoa, 50% unshaded cocoa.</li> </ul>	<ul style="list-style-type: none"> <li>-95% of coffee in Ethiopia is produced by smallholder farmers (&lt;2 ha).</li> <li>-Production systems; forest coffee (10%), semi-forest (30%), garden coffee (50%), plantation coffee (10%).</li> </ul>
Processing	<ul style="list-style-type: none"> <li>-70-80% is exported as raw beans</li> <li>-The remaining 20-30% is processed in Ghana in to semi-finished products (liquor, butter and powder).</li> </ul>	<ul style="list-style-type: none"> <li>Processing mostly occurs within Ethiopia and is either;</li> <li>-Dry processing (sun-dried coffee)</li> <li>-Wet processing (uses a lot of water and generates a lot of waste water).</li> </ul>
Marketing and distribution	<ul style="list-style-type: none"> <li>-Marketing of raw beans is done through Ghana cocoa board (COCOBOD) which is a monopoly.</li> <li>-Most of the marketing and distribution of the final products occurs outside Ghana.</li> </ul>	<ul style="list-style-type: none"> <li>Marketing is done either through:</li> <li>-Cooperatives, or</li> <li>-Ethiopian commodity exchange (ECX).</li> </ul>
Consumption	<ul style="list-style-type: none"> <li>-&lt;5% of Ghana's cocoa products are consumed in Ghana.</li> <li>-The rest is exported and Europe is the biggest importer and consumer.</li> </ul>	<ul style="list-style-type: none"> <li>-40-50% of Ethiopia's coffee is consumed domestically.</li> <li>-The rest is exported with Europe being the largest importer (51% of the exports).</li> </ul>

Following the TEEBAgriFood Framework, we identified several visible and invisible benefits and costs within these value chains. Among the visible benefits and costs are the agricultural and food outputs and inputs (fertilizer, labor water, pesticides and so on) incurred within the production systems. For analysis at the production stage of the value chain, we compared agroforestry systems for both cocoa and coffee with other production systems commonly practiced in the study countries such as full-sun and plantation (high-tech) production systems. Compared to other production systems, coffee and cocoa yields were lower in the agroforestry systems. However, considering other provisioning services there are trade-offs between yields and other provisioning services such as timber, wood fuels and non-timber food products (NTFPs) as shown in Figure A.



**Figure A: Provisioning services across different cocoa and coffee production systems in Ghana and Ethiopia**

We also identified “invisible” benefits along the value chains, and one of the ecosystem benefits from both agroforestry systems in cocoa and coffee turned out to be biological pest and disease control. Agroforestry in cocoa systems in Ghana has a biological control mechanism to manage cocoa swollen shoot virus disease (CSSVD), one of the most challenging diseases affecting cocoa plants in Ghana. Shade-grown coffee similarly utilizes a biological control mechanism for the coffee berry disease. Other positive externalities in both agroforestry systems include; carbon sequestration, maintaining biodiversity, improving soil fertility, pollination services and soil erosion control. Some of the invisible costs identified within the value chains include; greenhouse gas emissions, waste water from processing, pesticide residues on soils and water, inequalities in distribution of benefits accruing from the value chain, and child labour. Table B presents a summary of the effect of various externalities on the four capital stocks – natural capital, financial capital, human capital and social capital.

**Table B: Positive and negative contribution of externalities to the capital stocks**

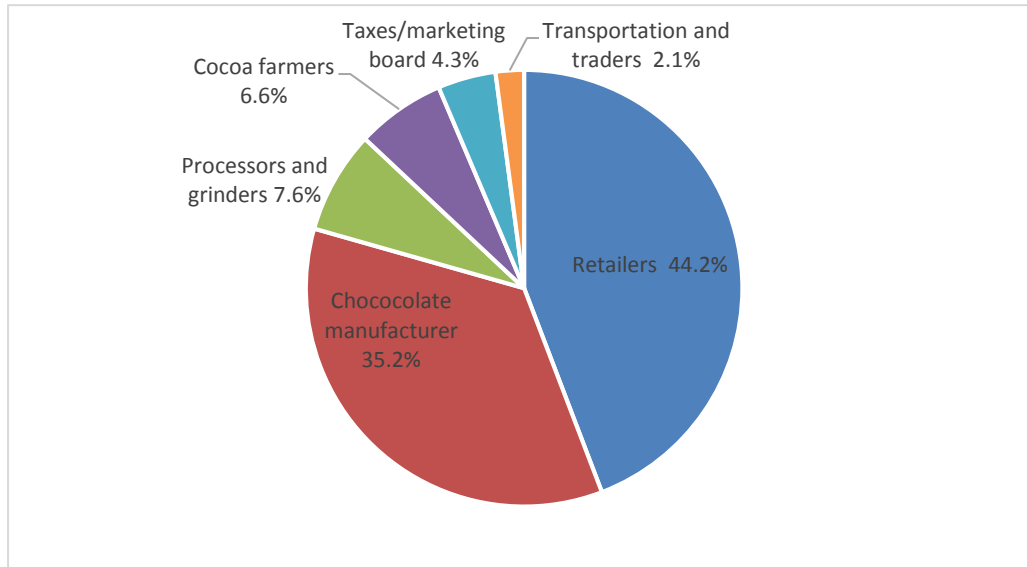
COCOA agroforestry (Ghana) externalities	Natural capital	Produced capital	Human capital	Social capital	COFFEE agroforestry (Ethiopia) externalities	Natural capital	Produced capital	Human capital	Social capital
Carbon storage	↑				Carbon storage	↑			
Biodiversity	↑				Biodiversity	↑			
Soil erosion control	↑				Soil erosion control	↑			
Biological pest control	↑				Soil formation	↑			
Soil nutrient stocks	↑				Nutrient cycling	↑			
Profitability of AF cocoa compared to full sun cocoa		↓			Pollination services	↑			
Certification premiums from agroforestry cocoa		↑			Water regulation & water treatment	↑			
Provisioning services		↑			Biological pest control	↑			
Processing inputs (e.g. energy costs)		↓			Profit margins		↑		
Water footprint	↓				Cultural value of coffee				↑
Water pollution from pesticides and cocoa processing waste	↓				Distribution of proceeds in the global value chain				↓
Waste emissions to soil from pesticide use (acidification)	↓				Certification premium from shade trees		↑		
Human health effects from pesticide use			↓		Water pollution from processing waste	↓			
Child health effects			↓		Aquatic life effect from coffee processing waste	↓			
Child labour effects				↓	Health effects from coffee processing waste			↓	
Greenhouse gases from cocoa production	↓				Greenhouse gases emissions from coffee processing	↓			
GHGs emissions during processing	↓				Greenhouse gases emissions from coffee transport	↓			
GHGs emission during transport	↓				Greenhouse gases emissions at consumption	↓			
GHGs emissions during packaging	↓								

Key<sup>2</sup> Strong positive effect    Medium positive effect    Weak positive effect  
 Strong negative effect    Medium negative effect    Weak negative effect

We found that for both value chains, producers (farmers) receive the smallest proportion of benefits compared to the other actors within the value chains. Particularly for cocoa, there are massive imbalances in the global cocoa value chain. Cocoa and chocolate manufacturing companies and retailers take up the bulk of the share -35% and 42%, respectively- while Ghana’s farmers take up only 6.6% as shown in Figure A. This calls for the need to promote domestic processing of cocoa in Ghana, so that Ghanaians receive a greater share of the proceeds from cocoa processing and retailing. Similarly, within the coffee value chain in Ethiopia approximately 14% of the value goes to the producers (farmers). The largest proportion (about 50%) goes to the exporters.

<sup>2</sup> For externalities within the production stage, arrows represent the agroforestry systems relative to the full-sun systems.

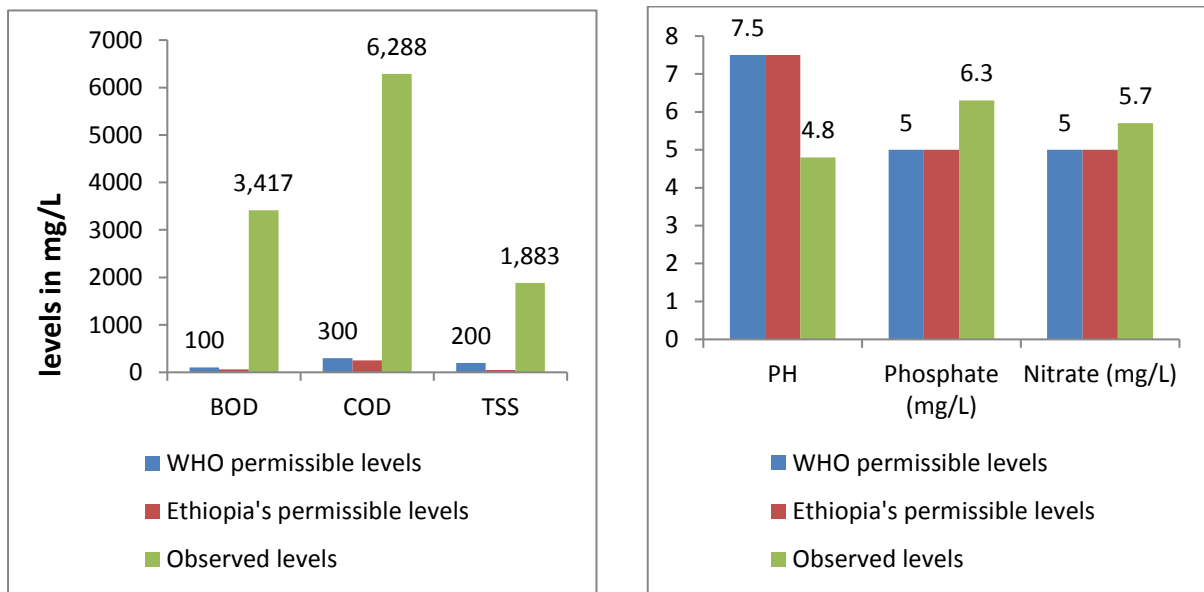
**Figure B: The share of benefits among actors within the cocoa value chain**



We also found that certification premiums play an important role in enhancing the profitability of agroforestry systems thus making them financially attractive to the farmers. The certification premium is paid in recognition of the “invisible” environmental benefits from agroforestry systems. In Ethiopia, certified shaded coffee farmers received a premium of about 21% of the value of regular coffee and this makes agroforestry systems attractive to coffee farmers. However, within the cocoa production systems in Ghana, the current premium paid to shade farmers is not enough to make the cocoa agroforestry systems as profitable as the full sun cocoa systems, even if such premiums were tripled. Thus, there is need to revisit the certification premium agenda and sensitize consumers within the cocoa value chain on the environmental benefits of shade trees to increase their willingness to pay for these benefits.

One major negative externality we identified within the coffee value chain is the pollution effect from processing waste. Processing waste from wet coffee processing in Ethiopia is a particularly large externality. The majority of the wet coffee processing industries in Ethiopia are located near rivers and the waste generated is directed into these water bodies. Findings show very high pollution levels within these water bodies which has consequently resulted in loss of aquatic diversity and negative health effects among the people living nearby. As indicated in Figure C, the observed pollution level as indicated by the chemical properties are much higher than the recommended levels (both World Health Organization (WHO) and Ethiopia’s permissible levels) indicating very high pollution levels in these water bodies. Measures that could address these negative externalities include tighter water discharge regulations, incentives for dry processing or generating bio-fuel from the waste, which is a financially viable enterprise that has not yet been exploited in Ethiopia.

**Figure C: Comparison of observed water quality levels in Ethiopian rivers with waste water discharge with the WHO and Ethiopia’s recommended levels**



Owing to the positive and negative externalities within these value chains, there is a need for policies that will ensure sustainable value chains. These policies should aim to enhance the positive externalities’ “invisible benefits” and reduce the negative externalities’ “invisible costs” within these value chains. One of the policies we recommend is the opportunity for the governments of Ghana and Ethiopia to join the REDD+ (Reducing Emissions from deforestation and forest degradation) programme so as to benefit from the carbon storage potential of agroforestry systems. Other policies include promoting certification premiums among agroforestry farmers in recognition of the ecological benefits that accrue from the agroforestry. To reduce the negative externalities associated with coffee processing, the government of Ethiopia can promote policies that require the coffee industries to either treat the waste water before releasing it to the water bodies, or invest in generating biofuel from the waste.