

Livelihood considerations in land-use decision-making: Cocoa and mining in Ghana

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1. Introduction

In this teaching case study, students will be challenged to assume the role of a Ghanaian cocoa farmer, Kojo. After losing his crop to a fungal infestation, Kojo must decide whether to wait out the regrowth period before his cocoa trees bear fruit—several years during which he will be without a reliable source of income—or sell his land to an unlicensed mining operation for an immediate lump sum. Kojo's decision will have a lasting impact on his family, his environment, and the future of Ghana. By assessing this contemporary sustainability challenge from Kojo's perspective, students will develop a better understanding of the pressures that shape smallholder decision-making, the assistance provided to Ghanaian cocoa farmers by the Ghana Cocoa Board (COCOBOD), and the barriers to environmental sustainability in multi-stakeholder systems. The events described here were inspired by real circumstances and people encountered in Ghana in 2016, but the details of this case study are not a factual recounting of actual events.

2. Case overview

Cocoa has long been a mainstay of Ghana's economy. Shortly after gaining independence in 1957, the nation began a two-decade reign as the world's leading exporter of cocoa. By the early 1980s, however, productivity had collapsed due to a combination of falling prices, political instability, and drought: in 1983, rampant bush fires destroyed the majority of Ghana's cocoa producing forests. The revival of the cocoa sector began in the 1990s, with growth accelerated in the early

2000s due to an increase in the use of chemical fertilizer and pest protection (Essegbey and Ofori-Gyamfi, 2012; Kolavalli et al. 2012; Mulangu et al. 2017; Abbadi et al. 2019).

Today, Ghana is the world's second largest producer and exporter of cocoa (behind only Côte d'Ivoire). Production is primarily driven by 2 million smallholders, with farms no more than 4 ha in area (Afrane and Ntiamoah, 2011; Roldan et al. 2013). These farms are often passed down within families, becoming the primary fixtures around which they build their multi-generational lives. The importance of cocoa to these families' livelihoods is clear: surveys of cocoa farmers have found that nearly 80% consider cocoa to be their most important crop (Bymolt et al. 2018). In addition, when accounting for the secondary livelihoods supported by activities surrounding Ghana's cocoa industry, a 2011 study estimated that about 6.3 million people—26% of Ghana's population—depended on the cocoa industry for their livelihoods (Gockowski et al., 2011).

For many, the appeal of cocoa is due to it being a consistent source of income, rather than it being particularly profitable. Cocoa households in Ghana are estimated to earn, on average, just \$2.29 USD per person per day (in 2016 USD). However, the "guaranteed" market provided by the Ghana Cocoa Board (COCOBOD) has sustained cocoa as an attractive option for farmers (Bymolt et al., 2018).

The Ghana Cocoa Board is a government-controlled institution that strictly regulates Ghana's cocoa sector. In addition to fixing the buying price of cocoa within Ghana, which effectively guarantees farmers a minimum amount of money for their crop, COCOBOD provides direct support for farmers in the form of training and subsidized agricultural inputs (e.g., chemical fertilizers, fungicides, and pesticides). The Ghana

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Cocoa Board also oversees the development of hybrid varieties of cocoa that may increase yields. With the benefit of this support, farmers can typically realize a financial return on new plantings within a few years of maturation, after which their cocoa trees will produce fruit for 30–50 years. Hence, producing cocoa is commonly viewed as a reliable investment. That said, there is growing concern around unlicensed mining activity in Ghana: a lucrative alternative to cocoa, but one with troubling environmental implications.

Over the last twenty years, tens of thousands of migrants from China have traveled to Ghana, hoping to profit from the wealth of mineral reserves in the land beneath Ghana's dense forests. The arrival of these migrants led to intensified mining activity across the country, transforming the traditional practice of artisanal small-scale mining (ASM)—known in Ghana as *galamsey*—into a much larger, more disruptive industry with considerable effect on forest ecosystems and water quality (Antwi, 2014; Boateng et al. 2014). As unlicensed mines continue to expand, Ghanaian revenue is lost as gold is smuggled out of the country—\$2.3 billion dollars' worth in 2016—and local land, including cocoa plantations, is purchased from farmers and converted for mining (Boafo et al. 2019; Snapir et al. 2017).

This case study will challenge you to engage with the complexities of a contemporary sustainability issue through participation in the decision-making process of a Ghanaian cocoa farmer, Kojo. While this context may seem far removed from you personally, the global nature of the cocoa trade is such that you have likely consumed Ghanaian cocoa yourself. Therefore, you are involved—if only in some small way—in the decision that Kojo must make.

3. Prologue

A year ago, Kojo, lost his cocoa trees to a fungal disease, forcing him to clear his plot and re-plant his crop (Fig. 1). Now, Kojo must wait two to four years for his cocoa trees to begin producing fruit (Fig. 2). This interim period, during which Kojo will be without a steady source of income, threatens extended hardship for his family. The Ghana Cocoa

Board, the governing organization that is in place to help farmers like Kojo, can provide only so much assistance. Consequently, Kojo must make a decision: either weather the difficulty of several years with inconsistent income while his cocoa trees mature, or sell his land to miners seeking out precious metals. This would mean sacrificing his land and lifestyle, but the promise of an immediate lump sum of money is tempting.

4. The recommencement

Kojo knelt down to inspect the thickening bark of his young cocoa trees. Though the day hummed with the energy of droning insects and birdsong, he focused exclusively on the small plants at his feet. In order to supplement his income, Kojo was growing yams between his developing trees. Still, the revenue generated from these secondary crops was not enough to support his family. His wife, Adena, and their four children helped maintain the farm in order to avoid the cost of external laborers. However, his two oldest sons, seeing how unprofitable cocoa farming could be, planned to move to the city in search of opportunities outside of agriculture (Fig. 3). In the coming months, Kojo knew that he must decide between keeping the farm that he had inherited, or finding another way to provide for his family.

The long, laborious wait for his cocoa trees to mature would likely benefit him in the future: then, they would produce fruit for 30 to 50 years. However, the next few years, during which he would be without a reliable source of income, could devastate his family financially. Of course, there was also the risk of another outbreak or drought destroying his young crop. In recent years, climate change had exacerbated the threat of droughts in the region, stimulating annual wildfires that posed yet another threat to his cocoa trees (Fig. 4). In the face of all this uncertainty, there was an alternative, immediately profitable option for Kojo to consider: selling his land to an unlicensed mining operation. This would provide Kojo's family with money for their immediate expenses, and could potentially provide financial security for many years to come.

Indeed, it wasn't just the short-term outlook that weighed on Kojo.

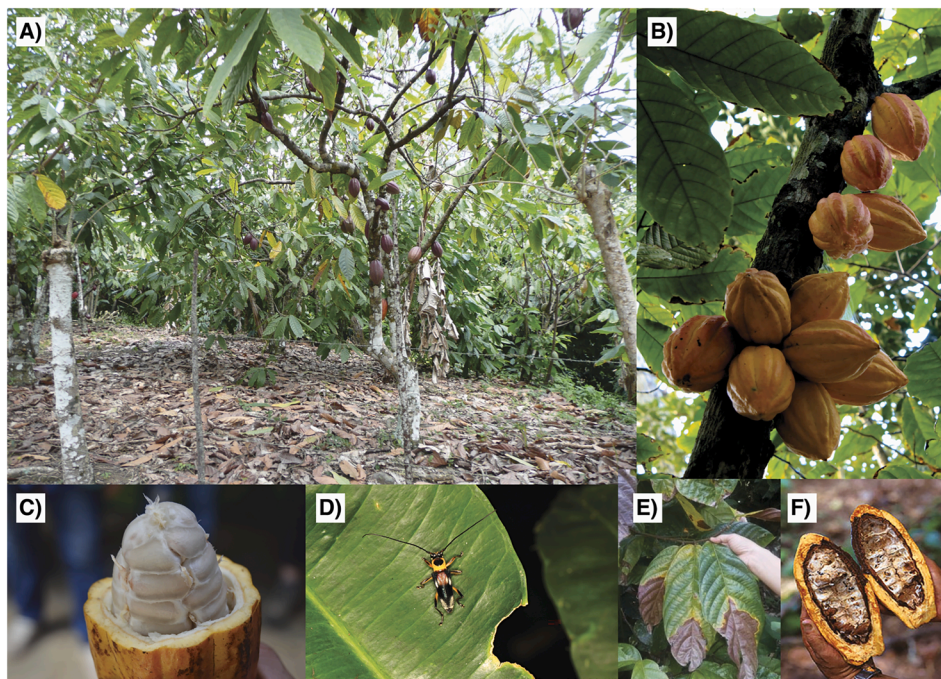


Fig. 1. A) Cocoa trees growing on a plantation. B) Healthy cocoa pods. C) Cocoa beans in a fresh cocoa pod. D) Longicorn beetle on a cocoa tree. The beetle damages the tree and provides an entry route for fungi. E) Cocoa leaf suffering from fungal disease (from Noveriza et al. 2018; CC BY). F) Diseased cocoa pod. Sources: <https://upload.wikimedia.org/wikipedia/commons/5/5a/Matadecacao.jpg>; https://upload.wikimedia.org/wikipedia/commons/a/ae/Cocoa_plantation.JPG; https://commons.wikimedia.org/wiki/File:Cocoa_beans_in_cocoa_pod_at_El_Trapiche_Costa_Rica.jpg; https://upload.wikimedia.org/wikipedia/commons/8/85/Glenea_lefebvrei_1.jpg; https://www.researchgate.net/publication/323532816_Effectiveness_of_several_dosage_formula_of_oil_and_nano_emulsion_of_citro

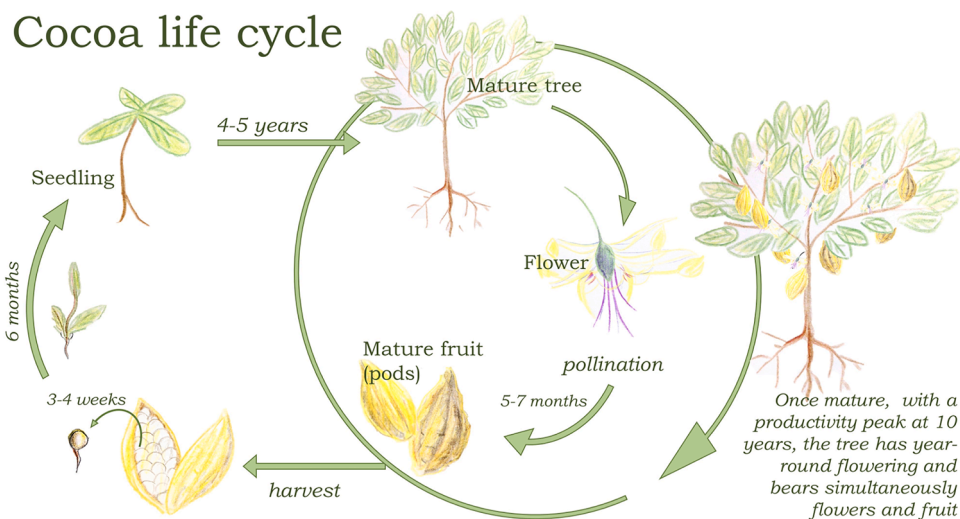


Fig. 2. The life cycle of a cocoa tree. From Boisselet (2018): Cocoa life cycle – timeline. Zenodo. <https://doi.org/10.5281/zenodo.1893629>. Used under a Creative Commons 4.0 license.



Fig. 3. A.) A busy street in the city of Kumasi, home to Africa’s largest open-air market. B.) People flock to the Kejetia Market for the opportunity to buy, sell, and trade. C.) The market from above. An estimated 10,000 stalls occupy a vast area in the city. Source: Erich Eberhard.

Even if he made it through the next few years, the long-term profitability of his cocoa farm was overwhelming. Though his mature trees would fruit for decades, and a minimum price for his crop was enforced by COCOBOD, he knew that he would be dependent on expensive agricultural inputs, including chemical fertilizers and insecticides, to maintain high crop yields. In the past, these expenses had cut deeply into his profits.

Frustrated by even this “best-case” scenario, Kojo wondered, “How did this reliance on expensive inputs come to be?” The answer, he found, was in Ghana’s colonial history.

5. Roots in colonial monocropping

Consider a Nestlé Toll House chocolate chip cookie, Starbucks’ hot cocoa, or any chocolate bar at a local convenience store. Consumers of

such products drove international trade in cocoa and a global chocolate market worth \$29.6 billion USD in 2019, with Europe and North America accounting for roughly 75% of global cocoa bean imports. The vast majority of this cocoa is exported from Africa, with Ghana alone responsible for 19.3% of the global cocoa bean exports. About half of Ghana’s cocoa bean exports are exported to Europe, and about one tenth go to the United States (MIT Observatory of Economic Complexity, 2019). While the global demand for chocolate creates opportunity for Ghanaian farmers like Kojo, the realization of this opportunity has historically relied on deleterious monocropping practices carried over from the colonial era (Jacques and Jacques, 2012).

Prior to colonization, farmers in Ghana employed agricultural techniques, inherited over generations, that emphasized growing a diversity of crops and recycling nutrients through the use of food compost and charcoal waste as fertilizer. However, after the arrival of European

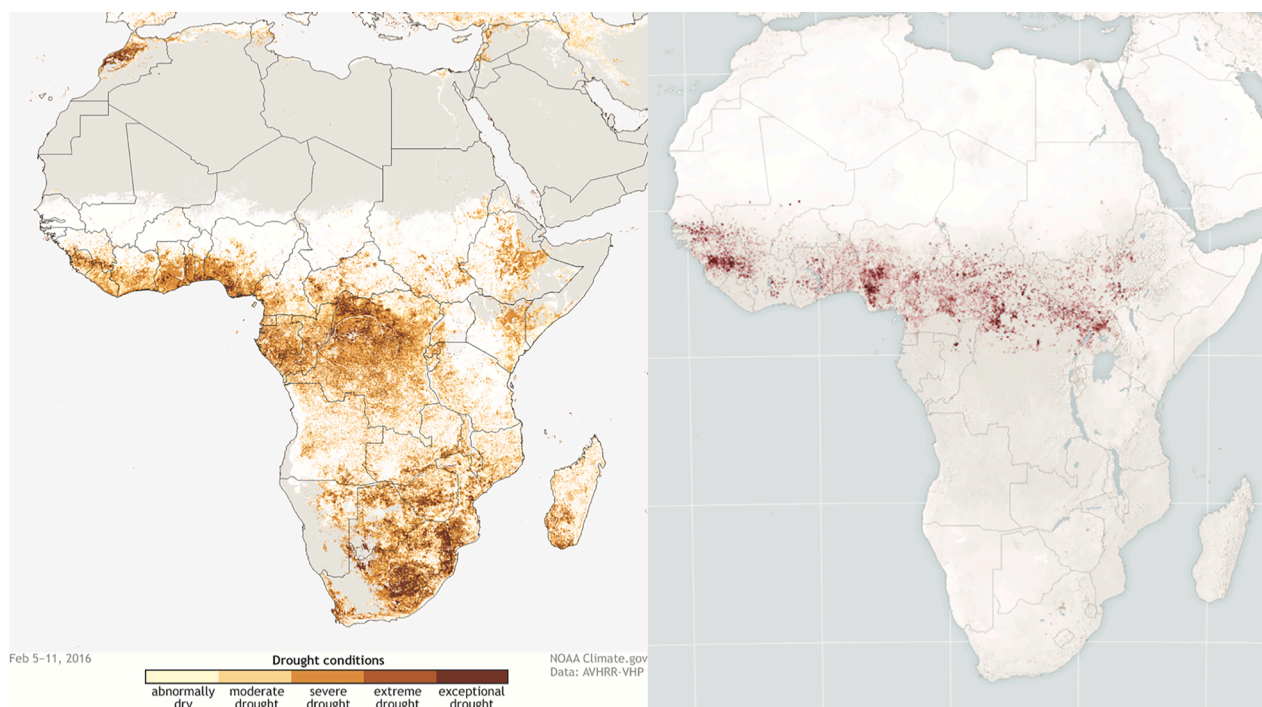


Fig. 4. Left: Drought conditions across Africa. Right: Wildfires across Africa in January 2017. Both images from NASA. <https://www.climate.gov/news-features/event-tracker/not-sorainy-season-drought-southern-africa-january-2016>; <https://phys.org/news/2017-01-nasa-wildfires-drought.html>.

colonists and their cash crop, cocoa, monocropping was promoted as a means of maximizing outputs in order to fuel a colonial economy. The practice of monocropping became entrenched, and it remains the prevailing agricultural strategy across Ghana's 6.5 million hectares of cocoa cropping area (Jagoret et al. 2020).

Over time, monocropping depletes soil of the nutrients essential to plant growth. The resulting infertility is often combated through the use of chemical fertilizers, but these alternatives can further disrupt soil ecology. Thus, monocropping threatens the long-term fertility of a farm, leading to situations like Kojo's, in which farmers must rely increasingly on expensive chemical fertilizers and crop protection in order to maintain productivity (Jagoret et al., 2020). In such cases, many farmers look to COCOBOD for assistance.

6. The Ghana Cocoa Board

In 1947, the Ghana Cocoa Board was created to help support struggling cocoa farmers. In particular, the organization was meant to protect farmers from volatile prices on the world market by setting fixed cocoa prices within Ghana. In subsequent years, COCOBOD began to provide other forms of assistance, including subsidized agricultural inputs, hybrid seedlings, and training. COCOBOD is also responsible for regulating the quality of Ghanaian cocoa by enforcing the Ghana Cocoa Specification standards and marketing the fruit on the global market.

The Ghana Cocoa Board regulates cocoa prices by fixing the minimum amount that Licensed Buying Companies (LBCs) must pay farmers for their crop. Licensed Buying Companies function as intermediaries between cocoa farmers and COCOBOD, transporting cocoa beans from farm-facing points of sale to centralized locations for quality-control before distribution.

The Board's direct support for farmers takes the form of four primary programs: Hi-Tech, which provides subsidized fertilizers; Cocoa Disease and Pest Control (CODAPEC), which provides free spraying of pesticides and fungicides; the Cocoa Research Institute Ghana (CRIG), responsible for providing hybrid cocoa seedlings that improve yields; and the Cocoa Health and Extension Division (CHED), which provides training for

farmers. In practice, both Hi-Tech and CODAPEC are criticized for their ineffectiveness, with the delayed distribution of insufficient quantities of fertilizer and infrequent spraying being common frustrations among cocoa farmers such as Kojo (Houssou et al. 2017; Kumi and Daymond, 2015). This support is further qualified by the fact that eligibility for fertilizers is restricted to those who have their cocoa farms inspected by CHED, and by the fact the free spraying supplied by CODAPEC is funded with deductions from cocoa sales (Steijn, 2016; Bymolt et al. 2018). When support from COCOBOD is insufficient, farmers turn to purchasing inputs from a public distribution system, which has itself been criticized for inefficiency (Houssou et al. 2017).

Current agricultural practices, some held over from the colonial era, contribute to a cocoa sector that depends on COCOBOD for regulatory, material, and educational support. When that support falls short, growing cocoa becomes less profitable, and many begin to seek alternative sources of income.

7. A farmer's struggles

Though COCOBOD ensured that he received a fixed minimum amount for his cocoa, Kojo was skeptical that he would receive the support that he needed to successfully restart his farm. Though he qualified for subsidized fertilizers, he frequently needed to supplement the Hi-Tech program's small and infrequent provisions with fertilizers he purchased himself. Furthermore, he was angry with CODAPEC, whose infrequent spraying he blamed for the outbreak that destroyed his farm. Would he need to begin purchasing his own fungicides, too? Kojo tensed at the thought of his profit margins narrowing. After reflecting on his options for a few days, Kojo decided to visit his friend Kwame and ask for advice.

8. An enticing option

For many years, Kwame, who lived in the Atiwa District, had also struggled to support his family with the profit from his cocoa farm. When he lost money on his harvest a few years ago, he took a drastic step

in order to make ends meet.

By that time, Kwame had been approached by an unlicensed mining operation that was interested in buying his farm. These groups purchase land, often from struggling and vulnerable farmers, and prospect it to acquire precious metals or minerals such as gold (Abdulai, 2017). This relatively small-scale practice, referred to as artisanal mining, or *galamsey* in Ghana, is an important source of income for many people around the world (IGF, 2017).

Licensed mining operations are subject to oversight by Ghana's Ministry of Land and Natural Resources, which controls the scale of mining and the circulation of minerals, but unlicensed artisanal groups have no legal permits and therefore try to operate without drawing attention from the local government. It is estimated that 85% of artisanal mining groups in Ghana operate illegally. Their gold production has increased dramatically over the last few decades, due in part to an influx of migrants from China (Antwi, 2014; Boateng et al. 2014; Abdulai, 2017).

Ultimately, Kwame had decided to sell his farm. The unlicensed mining operation paid him up front and in full, which allowed him to afford the food and medicine that his family desperately needed.

Afterwards, the miners cleared all vegetation from Kwame's farm and began leaching toxic materials into the surrounding land and water (Fig. 5). This affected not just Kwame's plot, but also the surrounding community. The pollutants eventually killed bordering vegetation, and neighboring farms began to lose their crops.

Furthermore, the money that Kwame received for his land dwindled quickly: an amount that he had hoped would accommodate his family for many years lasted only a few. When this money ran out, Kwame had to find another way to provide for his family. With his former farm razed by the mining operation, he was forced into a difficult job market.

Kojo left Kwame's house feeling more conflicted than ever. Selling his farm had proven to be far from a perfect solution for Kwame, and Kojo chided himself for not considering the impact that his decision might have on the community he called home: including the surrounding forest that he had long admired for its dawn chorus and diverse wildlife. What, exactly, would be the environmental ramifications of selling his farm?

9. Environmental considerations

Before considering the environmental impacts of artisanal mining, it is important to acknowledge those of cocoa agriculture. Like many cocoa



Fig. 5. Land disturbances at artisanal mining site in Talensi District, Upper East Region, Ghana. .

Source: https://commons.wikimedia.org/wiki/File:Land_disturbances_at_ASGM_site_at_Talensi_District,_Upper_East_Region,_Ghana.jpg

farmers in Ghana, Kojo had inherited his land. There were several members of Kojo's community, however, without land of their own. These individuals were among the most impoverished in the area, and had turned to slash-and-burn methods to clear forest for farmland (Fig. 6). Eventually, even those in Kojo's relatively advantageous position may be pressured to expand their existing holdings into the surrounding forest. If the productivity of their land declined, perhaps as the result of monocropping practices and a lack of access to chemical fertilizers, they would be forced to put more land into production to maintain adequate crop yields.

Deforestation is one of the world's most pressing environmental crises. Globally, 888,000 square miles (2.3 million square kilometers) of forest were lost between 2000 and 2012, and, each year, the total area of forest lost is roughly equal to the size of the United Kingdom (Fig. 7) (Hansen et al., 2013; Pappas, 2013; Harvey, 2019). With the loss of forests comes the degradation of important ecosystem services upon which human wellbeing depends. Forests act as carbon sinks that help to regulate global climate and, locally, they provide essential food, shelter, and fuel security to nearly two billion people worldwide (Betts et al., 2017; Harvey, 2019). They are also home to an incredible range of biodiversity, including some of the planet's most endangered species. Historically, cocoa agriculture has been a primary driver of deforestation in Ghana and throughout West Africa (Ruf and Zadi, 1998; Ruf et al. 2015).

Since 2000, however, the Forestry Commission of Ghana has led a

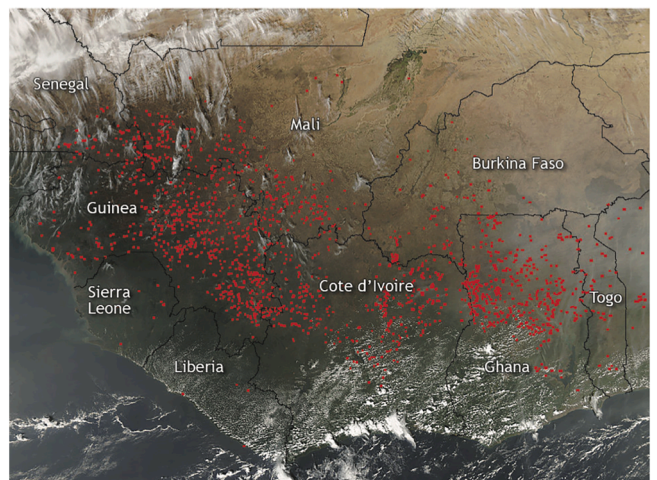


Fig. 6. Top: Forests are cleared by using a method known as slash and burn. Bottom: Agricultural burning revealed by satellite imagery; red dots are agricultural fires on December 8, 2003. Sources: https://commons.wikimedia.org/wiki/File:Slash_and_Burn_Agriculture_Shifting_Cultivation_Thailand.jpg; <https://earthobservatory.nasa.gov/images/12451/fires-in-west-africa>.

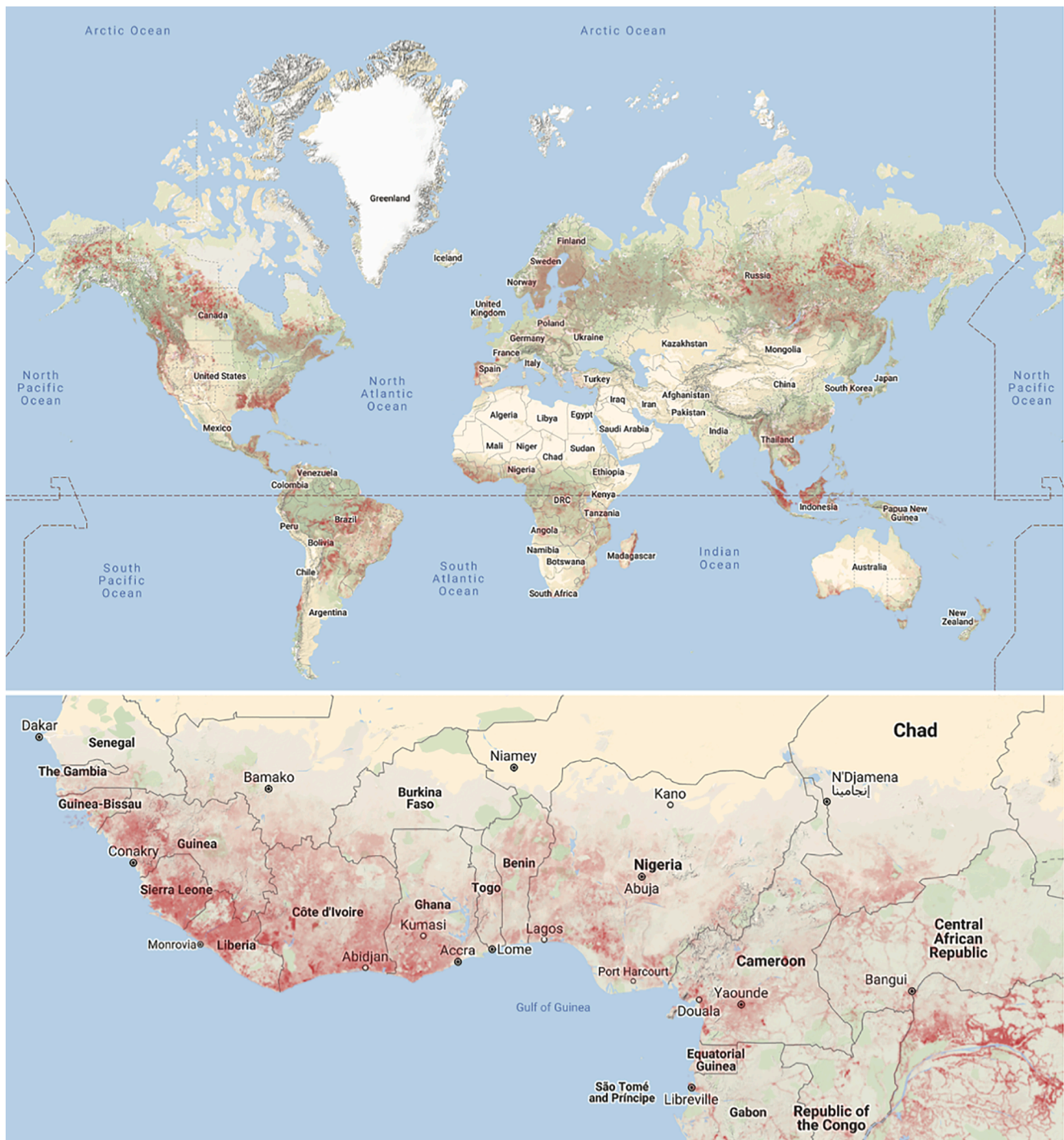


Fig. 7. Time-series imagery reveals deforestation globally (top) and across West Africa (bottom) over the period 2000–2018. Deforestation indicated by red shading. Modified from Hansen et al. (2013).

national reforestation effort with variable success. Between 1990 and 2010, the total area of forested land (canopy density >15%) in Ghana increased by over 400,000 ha. It's important to note, however, that the increase in forested area came primarily from large increases in open forests: forests with canopy cover between 15% and 60%. In contrast, closed forests, those with canopy cover greater than 60% were reduced by nearly a million hectares—a rate of nearly 50,000 ha per annum. Not all forests are created equal, and these closed forest habitats typically support more biodiversity than their open counterparts (Food and Agricultural Organization of the United Nations Global Forest Resources Assessment, 2015). Since 2010, Ghana has lost roughly 1 million

hectares of forest cover with canopy density greater than 15%, nearly half of which with canopy density greater than 50%. The rate of forest loss has also increased, up from 19,548 ha per annum in 2010 to 151,767 in 2018 (Mongabay). The primary driver of this accelerating deforestation is shifting agriculture (Global Forest Watch).

Expanding artisanal mining activity represents another threat to Ghana's ecosystems, as vegetation and soil are cleared away to accommodate the search for precious metals. The mining process itself results in dust pollution (Snapir et al. 2017), water pollution (Kusimi et al. 2014; Bansah et al. 2018), and the contamination of neighboring soils with mercury (Serfor-Armah et al., 2005, Mantey et al. 2020). These

pollutants not only threaten public health and the health of surrounding forest ecosystems, but also the productivity of neighboring cocoa farms, with farmers reporting wilting crops in areas near artisanal mines (Boateng et al., 2014; Aragón and Rud, 2016; Snapir et al. 2017).

While both cocoa agriculture and artisanal mining threaten environmental degradation, many argue that the latter is far more destructive. That gap is likely to widen as the Ghanaian government and private entities push for a more sustainable cocoa sector.

10. The future of cocoa in Ghana

In recent years, the pursuit of sustainable cocoa agriculture has gained steam around the world. In Ghana, COCOBOD recognizes the environmental costs of cocoa-driven deforestation, and has acknowledged that the loss of soil nutrients—from deforestation and monocropping—is the primary cause of declines in national cocoa yields (UNDP Ghana). In response, there is growing momentum for a return to the shade growing methods that preceded the sector's shift to monocropping. Shade growing refers to the practice of cultivating cocoa beneath the canopies of native trees. It is a form of agroforestry: the integration of trees and shrubs into crop areas with the goal of improving yields and limiting environmental degradation. With cocoa, shade growing is of interest for two main reasons. First, retaining or restoring forests within cocoa production areas helps to maintain carbon sinks, habitat connectivity in critical biodiversity hotspots, and sources of subsistence foods and fuels. Second, in contrast to monocropping, more diverse plant communities better maintain the ecological processes that underpin soil fertility, and thus support crop growth without the need for chemical fertilizer inputs.

The vision of sustainable cocoa agriculture holds promise, but remains to be realized. There is general agreement that the successful implementation of sustainable practices depends on overcoming barriers including, but not limited to, issues of smallholder finances, training, and land tenure (UNDP Ghana, 2016, Dompreeh et al. 2021). In addition, because competition between plants in agroforestry systems can reduce crop productivity, and because agroforestry systems do not match the carbon sequestration services and biodiversity value provided by undisturbed forests, any successful form of sustainable agriculture must optimize the tradeoffs between economic, social, and environmental goals (Blaser et al., 2018).

Along with agricultural practices, Ghana's trade policies are slated to change in the coming years. In 2021, Ghana's president, Nana Akufo-Addo, announced that Ghana will significantly reduce exports of raw cocoa beans to external trading partners and will instead process as much as half of all cocoa yields into chocolate for export. This decision parallels similar decisions by other countries wishing to maximize the earned revenue from commodities such as, for example, palm oil (Indonesia), nickel (Indonesia), and iron ore (Brazil). For Ghanaian cocoa, raw beans are almost entirely exported to other countries for processing into chocolate. The profit margin from chocolate sales is large, but very little of that revenue flows to Ghanaian citizens. Such systems are rooted in colonial practices and difficult to break away from. Hence, this new policy represents an ambitious effort to reclaim some of the wealth created by Ghana's cocoa bean exports, positively impacting the Ghanaian economy across scales—from individuals to the national government. Only time will tell if this restructuring of the cocoa sector will lead to meaningful improvements in wellbeing for smallholder farmers and others indirectly employed in the cocoa trade.

11. A decision made

After another day's work, Kojo sat outside his home and watched the sun retreat below the horizon. Tomorrow, he expected a call from a prospective miner who had offered to purchase his land for a large lump sum of money. He was also expecting a call from a COCOBOD representative, who wished to set up a meeting to inspect his farm for the

upcoming year. The time for contemplation was drawing to a close: Kojo had to decide between accepting the money and abandoning his farm, or weathering the next two years without a reliable source of income in the hope that his investment in cocoa would pay off.

If he kept his cocoa farm, it could become a source of income for up to fifty years. Also, he would prevent the environmental degradation associated with artisanal mining. Turning down the money from the miners, however, would be a gamble. If COCOBOD didn't provide Kojo with sufficient and timely agricultural inputs, he would be forced to purchase supplementary supplies with his own money, cutting into his profits. He was aware of efforts to transition to more sustainable production practices, but he suspected that the process would be too slow and expensive.

Also, if there was any unexpected setback or disruption of his farm before his plants reached maturity, Kojo risked losing everything. Furthermore, by turning down the money, he would effectively be turning down the opportunity to provide immediate financial security for his wife and children. The decision at hand was not as simple as maximizing his future income. Kojo's decision would have a real, immediate impact on his family.

Kojo wondered how long the money from the miners would last. How would he earn money down the road if he sold his farm now? He wondered whether his family could wait for a reliable source of income for another two years. Would they be able to survive?

He also considered the broader implications of his decision? Did farmers like him have an obligation to practice sustainable agriculture to protect Ghana's forests? Was it ethical to ask them to do so at their own expense? What could groups such as COCOBOD do to make sustainable cocoa agriculture a more realistic option for farmers like Kojo?

Kojo gazed out over his farm, trying to soak up every detail that the evening light permitted. He tried to envision how it would appear after having been ravaged by miners: clearing vegetation and displacing topsoil in the age-old quest for the earth's riches. They would have no regard for the generations of labor that had cultivated the scene before him. It was hard to picture. Equally hard to picture, however, were the years of additional suffering that might be inflicted upon his wife and children should he insist on maintaining his farm. Kojo stood and, trying his best to clear his troubled mind, went indoors to join his family.

Tomorrow morning, Kojo must make a decision. What would you do?

CRedit authorship contribution statement

Erich Eberhard: Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing, Funding acquisition. **Jessica Hicks:** Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing, Funding acquisition. **Adam C. Simon:** Conceptualization, Methodology, Writing – review & editing, Supervision, Funding acquisition. **Brian K. Arbic:** Conceptualization, Methodology, Writing – review & editing, Funding acquisition, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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