Smallholders in agro-industrial production: Lessons from rural development at new frontiers from a comparative analysis of Ghana's and Indonesia's oil palm sectors

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Keywords: oil palm, rural development, cross-country comparison, mixed methods

JEL Codes: O100, O570, Q010

Declaration of competing interest: none.

Acknowledgements
This research was financially supported by the German Research Foundation (DFG) through two different grants. First, grant number RTG1666 (GlobalFood) and second, project number 192626868 –in the framework of the collaborative German-Indonesian research project CRC 990 (SFB): "EFForTS, Ecological and Socioeconomic Functions of Tropical Lowland Rainforest Transformation Systems (Sumatra, Indonesia)". Support was also provided by the Federal Ministry for Economic Development and Cooperation through the project "Large-scale land acquisitions and social conflict".

Abstract

By successfully including smallholders, the oil palm boom in Southeast Asia has contributed significantly to rural economic development and poverty alleviation, notwithstanding its huge environmental costs, in particular through deforestation. Palm oil production in other world regions is currently picking up, including in Africa. Yet, it is uncertain whether the positive socioeconomic impacts from Southeast Asia can be replicated elsewhere. Little development gain may thus accompany severe environmental harm at these new agricultural frontiers. To shed light on the (prospective) role of oil palm for rural development, we perform a systematic comparison of Ghana's and Indonesia's oil palm sectors at the macro and micro level, focusing on smallholder inclusion, using a mixed-methods approach. We identify important differences in oil palm development policies: Until recently, Ghana's policies were aimed at establishing large-scale plantations and processing facilities, typically under full or partial government control. In contrast, Indonesia early on focused on smallholder involvement and support, coupled with an increasing role of the private sector. These different strategies result in very different agricultural and livelihood outcomes for smallholders in the two countries: Comparing survey data from the two countries, we show that partly artisanal smallholders in Ghana face higher production costs and lower profits – albeit Indonesian smallholders still exhibit a critical yield gap compared to plantations. Also, unlike in Indonesia, the poverty incidence among Ghanaian oil palm producers is increasing. While the Indonesian experience thus clearly highlights the development opportunities of smallholder inclusion into agro-industrial production, our analysis also hints at the challenges that need to be addressed to make this model work under the present conditions at Africa's frontiers.

1. Introduction

The increase in worldwide vegetable oil demand has led to a transformation of land use and substantial changes in the agricultural landscape. Most pronounced is the expansion of the Southeast Asian oil palm sector and its socioeconomic and ecological effects, which have been analyzed extensively (Grass et al., 2020; Obidzinski, Andriani, Komarudin, & Andrianto, 2012; Qaim, Sibhatu, Siregar, & Grass, 2020; Sayer, Ghazoul, Nelson, & Boedhihartono, 2012). Overall, the oil palm boom has contributed to economic growth, rural development, and poverty alleviation, in particular in Indonesia and Malaysia, the two biggest palm oil producers in the world (Basiron, 20017; Edwards, 2019a; Kubitza, Krishna, Alamsyah, Qaim, 2018; Rist, Feintrenie, & Levang, 2010). These economic benefits came with very severe ecological impacts, as oil palm plantations are established on previously biodiversity-rich forests and peatlands (Dislich et al., 2017), resulting in a substantial loss in tropical rainforests and biodiversity (Meijaard et al., 2020; Vijay, Pimm, Jenkins, & Smith, 2016). The expansion of oil palm plantations on previous forest lands has slowed down in Indonesia and Malaysia since 2010, partly due to environmental concerns (Austin, Schwantes, Gu, & Kasibhatla, 2019; Gaveau et al., 2018). Although it continues in selected frontier regions, for example, on the Indonesian islands of Kalimantan and Papua, and other countries of the region, for instance, Thailand (Indonesian Bureau of Statistics, 2021; Saswattecha, Hein, Kroeze, & Jawjit, 2016; Obidzinski, Dermawan, & Hadianto, 2014).

Meanwhile, palm oil production in other world regions, including in Africa, picks up. Oil palm originates in West Africa and is an integral part of the agricultural landscape, but the sector has not (yet) seen a boom comparable to Southeast Asia's. However, large-scale investment projects have been initiated in selected countries of the region with, so far, rather local socioeconomic and environmental impacts. In Liberia and Sierra Leone, land concessions for new plantations have been granted exceeding 400 000 hectares in each of the two countries. In this paper, we zoom in on Ghana, where more than 40 000 hectares of new concessions for

oil palm have been added since 2000.[1] Oil palm has not yet been associated with contract farming at scale – a significant factor for oil palm as a driver of broad-based rural development in Indonesia – nor with large-scale deforestation in the region (Corley & Tinker, 2016; Okoro, Schickhoff, Böhner, & Schneider, 2016). The sector's increasing prospective importance in West Africa (Carrere, 2013) carries important opportunities – particularly in terms of agricultural growth and rural income improvements – and severe risks, most notably of deforestation, and social risks, for example, regarding access to land for smallholders. These risks and opportunities are shaped, of course, by the scale and speed of oil palm development; they are also shaped by the public and private governance of and policies towards the sectors. Some lessons can be learned from the Southeast Asian experience, but differences in initial conditions and context limit the transferability of these experiences.

To shed light on the (prospective) role of oil palm for rural development, we systematically compare Ghana and Indonesia's oil palm sectors at the macro and micro level. To the best of our knowledge, no such systematic comparison exists. This paper aims to yield insights into which conditions, policies, and institutional features were or will be conducive or harmful to a positive contribution of the oil palm sector to rural development, focusing on smallholders' livelihoods. We use a mixed-methods approach and combine (1) comparative macro analyses of the sector's historical and prospective performance as well as associated institutional and policy developments, (2) comparative micro analyses based on original survey data of the production methods, productivity, and profitability, including across marketing channels, and (3) a comparative analysis of poverty headcount ratios across producer types.

We identify differences in the focus of policy interventions and programs by the Indonesian and Ghanaian governments. While Ghana's policies were aimed at establishing large-scale plantations and processing facilities, typically under full or partial government

[1] All figures are authors' calculation using data on land acquisitions for oil palm plantations from Land Matrix (2021).

control, smallholder involvement was a critical ingredient of Indonesia's palm oil strategy very early on. In addition, Indonesia encouraged private sector participation and foreign investment in the sector. Comparing survey data from Ghana and Indonesia, we show that, relative to Indonesia, oil palm producers in Ghana face higher production costs and have substantially lower profits. This is despite smallholders in Indonesia exhibiting major yield gaps as well – compared to plantations. These findings are linked to one important difference between the two countries: The continued existence of an artisanal oil palm sector in Ghana (and other parts of West Africa), which remains without government support and struggles to compete with the modern industrial value chain. We observe that unlike in Indonesia, the share of oil palm producing households in Ghana slightly decreased in recent years, while poverty headcount ratios increased, implying a crowding-out effect of smallholder producers. The potential future expansion of agro-industrial palm oil production may benefit but may also harm this (sub-)sector. While the Indonesian experience thus clearly highlights the development opportunities of smallholder inclusion into agro-industrial production, our analysis also hints at the challenges that need to be addressed to make this model work under the present conditions at Africa's frontiers. Policy action that affects smallholder farmers and millers, particularly those involved in the artisanal supply chain, is required (e.g., improve coordination of supply chain, increase the rate of technology adoption, improve market access, and establish cooperatives).

The paper is structured as follows: Chapter 2 discusses the development of both oil palm sectors from a policy perspective. Chapter 3 compares micro-level survey data on production methods, productivity, and profitability among Ghanaian and Indonesian oil palm producers. Chapter 4 evaluates the relationship between oil palm and rural development based on Indonesia's existing evidence and descriptive analyses using the Ghana Living Standard Survey (GLSS). Chapter 5 discusses the findings and concludes.

2. History, policies, and the development of the palm oil sector

Oil palm originates in West Africa as an essential part of the local culture, cuisine, and economy (Khatun, Maguire-Rajpaul, Asante, & McDermott, 2020). Traditionally, farmers produce oil palm on their land. They sell oil palm fruits to consumers or artisanal millers at the local market or manually process palm oil. In Ghana, smallholder produced oil palm was the leading foreign exchange earner until the beginning of the twentieth century (Carrere, 2013; Ministry of Food and Agriculture Ghana [MoFA], 2011). Post-independence, the Ghanaian government aimed at promoting the sector (MoFA, 2011).

In Indonesia, oil palm production began in the mid of the 19th century when the Dutch colonizers brought seeds from Africa to Bogor in Java. During the colonial phase, the oil palm sector played a minor economic role (Gatto, Wollni & Qaim, 2015). In 1968, the Indonesian government integrated former-Dutch plantations into 28 state-run companies as the first step towards sector development after Indonesian independence (Larson, 1996). Thus, the 1960s mark the beginning of both Ghanaian and Indonesian governmental efforts to develop the respective oil palm sectors.

In both countries, the first phase of governmental efforts marks an era of high state involvement and control, with a strong focus on the establishment of state-owned and state-operated oil palm plantations (Huddleston & Tonts, 2007; Larson, 1996). At this time, smallholder farmers produced 93% of the Ghanaian oil palm supply, with only one large estate in the sector (MoFA, 2011). From the 1960s onwards, several development plans were launched that led to the establishment of large-scale plantations and processing facilities, either under partial or full government control. These plantations' establishment contributed substantially to the approximately 6-fold increase in area under oil palm cultivation between 1970 and 1990 (MoFA, 2011). This phase marks the beginning of a top-down development approach in Ghana, despite an already existing artisanal and smallholder dominated value chain. The state-operated plantations and mills did not (successfully) establish market linkages to oil palm producing

smallholders through, e.g., contracts or cooperatives, which led to the coexistence of two separate value chains that persists until today. Instead, smallholder land was dispossessed for plantation establishment, which worsened the living conditions of the local rural population and the surrounding environment (Carrere, 2013).

While the Ghanaian government exclusively focused on developing state-owned operations at that time, the Indonesian policy portfolio was more diversified. Initially, the Indonesian government also focused on establishing such state-run companies, mainly in Sumatra (Larson, 1996), and later in Kalimantan and Papua (Obidzinski et al., 2014; Casson, 2000). However, from the early 1980s onwards, the Indonesian government actively involved and supported smallholders (Gatto, Wollni, Asnawi, & Qaim., 2017; Zen, Barlow, Gondowarsito, & McCarthy, 2016). The first steps towards smallholder support were the government transmigration programs. The programs were implemented to reallocate people from the overpopulated islands Java and Bali to scarcely populated islands such as Sumatra (Fearnside, 1997). The so-called transmigrants were given approximately two hectares of land for settlement, food production, and cash crop – mainly oil palm production (McCarthy & Zen, 2016). In the mid-1980s, the Indonesian government formulated a new policy that enabled large private companies and foreign investors to convert forest areas into oil palm plantations. Private sector involvement was further encouraged through easier access to credit for plantation establishment, new crop planting, and crushing facilities. This policy was fundamental to enable cooperation between companies and local smallholders under the Nucleus Estate and Smallholder (NES) scheme (Larson, 1996). A nucleus estate consists of a company plantation and surrounding smallholders who sell oil palm fruits to the plantation for processing (Feintrenie, Chong, & Levang, 2010). The transactions were arranged through contracts. Under these contracts, land, credit, village infrastructure, agricultural inputs, and training were provided to smallholders – not only transmigrants but also autonomous households – from the local governments in association with the private oil palm companies (McCarthy & Zen, 2016;

Rist et al., 2010). Private companies also employed farmers as plantation laborers to bypass the initial years of unproductive oil palm cultivation (Gatto et al., 2017).

The 1990s and 2000s were a phase of decentralization and market orientation in the Ghanaian and Indonesian oil palm sector. In Ghana, the state-owned plantations had proven unsuccessful and economically unviable due to capital constraints, poor planning, and management. Consequently, some plantations were abandoned or sold, followed by attempts to vitalize the sector under decentralized control (Byerlee, Falcon, & Naylor, 2017; Carrere, 2013, Dzanku, Asante, Quarmine, & Hodey, 2020). Previously state-owned plantations were privatized, including the four largest Ghanaian estates.[2] The renewal and expansion of oil palm plantations by private companies might have led to a substantial increase in area under oil palm cultivation around that time, as illustrated in figure A1 in the Appendix. Despite political efforts, attracting foreign direct investments, particularly for establishing company plantations and processing plants, largely failed, and the Ghanaian oil palm sector stagnated. Consequently, Ghana lost its position as a palm oil exporter and became a significant importer of Southeast Asian palm oil (Byerlee et al., 2017).

At the same time, the Indonesian government fully retracted its active involvement in oil palm plantation establishment and management. The transmigration program was also stopped. Private companies continued their involvement and led direct negotiations with local farmers (McCarthy, 2010), which required the establishment of farmer cooperatives for mediation (Larson, 1996; McCarthy & Cramb, 2009). Nevertheless, many negotiations were not successful without the government's active role. Rising inter-village inequality has been reported between oil palm-cultivating villages and the non-adopting villages (Gatto et al., 2017; McCarthy, Gillespie, & Zen 2012). Eventually, existing contracts between farmers and companies expired (Qaim et al., 2020). At this point, most plantation expansions occurred

[2] Benso Oil Palm Plantation (BOPP), Ghana Oil Palm Development Corporation (GOPDC), Twifo Oil Palm Plantation (TOPP). National Oil Palm Limited (NOPL) plantation.

independent of government programs (McCarthy et al., 2012), and the number of independent oil palm adopters increased as knowledge about oil palm production disseminated, and farmers perceived financial returns as high. Moreover, credits, planting materials, and inputs were easily accessible as the input and credit market developed because of the liberalization. The adoption of oil palm became self-sustaining and shifted from a government-led to a market-oriented phase (Gatto et al., 2017).

In 2003, the Ghanaian government initiated the oil palm development program under the President Special Initiative (PSI) by the New Patriotic Party (NPP). The PSI-Oil Palm approach sought to link farmers to existing mills and establish new mills by inviting strategic investors. The objective was to develop large-scale agro-processing and export companies complemented by modern processing facilities. However, by late 2007, within five years of being launched, the implementation of the PSI-Oil Palm program had stalled entirely (Ofosu-Budu & Sarpong, 2013). A subsequent oil palm master plan from the MoFA (2011) recommends establishing large contract farming schemes and upgrading existing larger mills to link companies and smallholders. This marks the first Ghanaian policy plan that focuses on developing smallholder production by supporting their inclusion in the industrial value chain. However, the sole focus on widening the industrial value chain remains, and artisanal market participants, who still constitute the majority of producers, remain without policy attention. Since 2016, the NPP, the party that previously launched the PSI, had been (re-)elected. This renewed the political interest in developing the Ghanaian oil palm sector. In addition to the previous policy objectives, the NPP focused on environmentally sustainable production (Khatun, 2020).

Indonesia is the largest palm oil producer globally, with oil palm as the number one export product (Food and Agriculture Organization [FAO], 2020). Oil palm is cultivated on more than 14 million hectares of land, of which approximately 2.7 million smallholders cultivate 40%. Additional 4.2 million laborers work on oil palm plantations (Ministry of

Agriculture Indonesia, 2019), a quarter of Indonesia's total agricultural labor force (Indonesian Bureau of Statistics, 2016). However, the economically successful expansion of the sector came at environmental and social costs. Rapid oil palm expansion was achieved through extensive deforestation. The sector's expansion had been a complex process that involved several parties with diverse interests. Local and national governments had limited resources and were under constant pressure to increase income through taxation. Private oil palm companies needed access to more fertile lands with road connectivity. Smallholders wanted to improve their living conditions but were wary of losing their private and community lands (Zen et al., 2016). These conflicting interests and lack of a strong legal framework to govern the land resources led to social and environmental problems. Tenure conflicts, violation of community rights, illegal land clearing, deforestation, biodiversity loss, and other social and environmental issues have been reported continuously in the oil palm frontiers of Indonesia (Abram et al., 2017; Levang, Riva, & Orth, 2016; Li, 2015; Obidzinski et al., 2012; Vijay et al., 2016). These problems instigated negative perceptions of the Southeast Asian oil palm sector by the international society. Subsequently, the Roundtable on Sustainable Palm Oil (RSPO) certification was established to ensure environmental sustainability in oil palm production and quality worldwide. It requires the producers to implement globally accepted sustainability and best management practices on their plantations, mills, and associated smallholder farms. Whether the RSPO certification contributes to a more sustainable development path is not yet sufficiently understood (Cattau, Marlier, & DeFries, 2016; Ruysschaert & Salles, 2014). The Indonesian government argues that RSPO is overly strict, discouraging key actors from producing oil palm (Brandi et al., 2015; Choiruzzad, 2019). Consequently, the Indonesian government issued its own version of certification in 2011, called Indonesian Sustainable Palm Oil (ISPO). Despite political efforts to counteract the environmental consequences, the Southeast Asian oil palm sector is highly criticized, and future land expansions are frowned upon (Hidayat, Offermans, Glasbergen, 2018).

Compared to Indonesia, the Ghanaian oil palm sector only experienced moderate yet steady growth, with higher growth rates since the early 2000s, after decentralization. Currently, over 300.000 hectares of land are cultivated with oil palms. About 80% of this land is managed by smallholders (Ofosu-Budu & Sarpong, 2013). Ghana produces approximately 2.6 million tons of FFBs annually, equivalent to around 2% of the annual Indonesian production of over 115 million tons. However, despite moderate growth rates in production (figure A2 in the Appendix), Ghanaian palm oil exports increased rapidly by almost 10-fold since 2008 (figure A3 in the Appendix), potentially due to the increased involvement of private processing with the nucleus estates. Table 1 shows that the role of private companies in the Ghanaian and West African oil palm sector continues to increase. Since 2000, 34 new land concessions were approved for the establishment of large oil palm estates in West Africa. This constitutes a transfer of 1.5 million ha of land, mainly to transnational companies. Compared to other regions, 52% of the oil palm related land concessions in Africa and 13% of ones worldwide occur within West Africa.

Table 1: Oil palm land concessions in West Africa since 2000

	Domestic		Transnational		Total	
	# Deals	Size (ha)	# Deals	Size (ha)	# Deals	Size (ha)
Benin	1	5.000	0	-	1	5.000
Cote d'Ivoire	0	-	3	129.000	3	129.000
The Gambia	0		1	200.000	1	200.000
Ghana	3	unknown	11	39.539	14	39.539
Guinea	0	-	1	5.000	1	5.000
Liberia	1	220.000	3	241.018	2	461.018
Nigeria	8	193.309	8	152.962	16	346.271
Sierra Leone	1	32.441	7	277.570	8	310.011
West Africa	14	450.750	34	1.045.089	46	1.495.839
Africa	21	637.026	72	2.234.667	93	2.871.693
Global	167	2.778.215	289	9.134.900	456	11.913.115

Note. All figures are authors' calculation using data on land acquisitions for oil palm plantations from Land Matrix (2021).

While the Indonesian oil palm expansion can be directly associated with large-scale deforestation, no such relationship has been observed in the Ghanaian context yet (figure A4 in the Appendix), and oil palm currently plays only a minor role in deforestation (Khatun et al., 2020). However, Ghana has one of the highest deforestation rates within Africa, and 50% of

the deforestation is due to agricultural expansion. Due to the expected future oil palm expansion and the increasing role of international large-scale plantations, RSPO became involved in the Ghanaian sector to promote best management practices and support an environmentally sustainable sector expansion (Khatun et al., 2020) encouraged by the currently reigning party.

3. Characteristics of the oil palm sectors

3.1. Business models and marketing channels

Different supply chain models coexist in Ghana, ranging from integrated agro-industries procuring from company plantations and contracted farmers to small-scale producers who sell fruits to artisanal processors or local consumers. The integrated industrial supply chain includes privatized large-scale plantations with processing facilities and small-, medium- and large-scale farmers linked to the plantations through various contractual agreements. These include contracted smallholders that produce on their lands or company lands, with or without financial or in-kind assistance. A substantial share of these contracted farmers (partly) adopted commercial oil palm cultivation through the contracts. This results from the types of contracts offered in this setting, which largely include the establishment of new smallholder (monoculture) plantations on credit. To the best of our knowledge, only two nucleus schemes exist (at this time) that contract artisanal oil palm producers with established plantations through simple procurement contracts. The industrial supply chain is well-coordinated, produces the improved oil palm variety tenera, and processes CPO for the export market at 20-30 tons per hour per facility (Huddleston & Tonts, 2007; Ruml & Qaim, 2021).

The artisanal supply chain actors include small- and medium-scale farmers and artisanal millers, who continue to produce 75% of the annual Ghanaian supply (Byerlee et al., 2017). They either sell their harvest directly to consumers at the local market, manually process palm oil on the homesteads, or sell oil palm fruits to smaller mills (Ruml, Ragasa, & Qaim, 2020). The artisanal mills use manual or semi-mechanized processing techniques, have an approximate

processing capacity of up to 1 ton per hour and produce approximately 60% of the country's palm oil (Byerlee et al., 2017; Osei-Amponsah et al., 2012). The artisanal milling sector is of crucial economic importance and dominated by women (Dzanku et al., 2020; Etuah et al., 2020). They oversee the post-harvest handling, particularly the manual picking and processing of the fruits and the marketing (Awusabo-Asare & Tanle, 2008). For most smallholders, artisanal millers and small local buyers are currently the only market outlet.

In Indonesia, no artisanal supply chain exists, and the market setting is exclusively industrial. Market transactions are well coordinated among smallholder farmers, private national and international companies, and government-led companies. The private and government-led companies are the forerunners in the sector with their own processing facilities. By now, market transactions are mainly coordinated through local traders without any forms of contractual agreements (Gatto et al., 2015).

3.2. Production methods and productivity gaps

Both the Ghanaian and Indonesian oil palm sectors denote productivity gaps. The Indonesian productivity gap refers to productivity differences between smallholders and large-scale plantations. The Ghanaian productivity gap refers to overall low sector productivity compared to international competitors. Average land productivity in Ghana (West Africa) is substantially lower than in Indonesia (Southeast Asia), with 3-6 tons compared to 17 tons per hectare per year (figure A5 in the Appendix). The low productivity level in Ghana is due to the large share of small-scale producers in the sector, who produce far below the farmers' productivity levels in Indonesia. Ghanaian smallholders face a myriad of production challenges that limit their productivity, including market risk and uncertainty, lack of access to finance and appropriate production inputs, lack of extension services and information, and land tenure insecurity. These challenges are especially pronounced in the artisanal supply chain, which is fragmented and requires coordination among supply chain actors (MoFA, 2011; Rhebergen et al., 2016). Low

market coordination poses risks and uncertainties to farmers and millers, which is elevated by price risks. In addition to strong price fluctuations across seasons and buyers, FFB supply exceeds national processing capacity in peak seasons, which leads to a sharp decline in prices and wasted product. These fluctuations particularly affect independent producers with no guaranteed market outlet and fixed price, as contracted farmers in the industrial value chain have (MoFA, 2011).

Like in many African countries, most farmers do not have the ability or collateral to source formal financing for plantation establishment or expansion, which are capital-intensive (Adeleye, Osabuohien, & Asongu, 2020; Herrmann, Jumbe, Bruentrup, & Osabuohien, 2018). In Ghana, land is often not the most limiting factor for smallholder oil palm cultivation as most households are too financially constrained to cultivate all the land they own (Ruml and Qaim, 2020a). Production inputs for oil palm are costly, and due to financial constraints, farmers underutilize agrochemical production inputs and use inferior planting materials and low yielding varieties. Unsatisfactory palm nutrition, incomplete crop recovery, inappropriate fertilization, and poor canopy management limit yields and call for agriculture extension services (Byerlee et al., 2017; MoFA, 2011; Rhebergen et al., 2018).

Traditional oil palm production is labor-intensive. Manual labour is required throughout the production cycle, from nursery preparation, planting in fields, tending, ring weeding, pruning, to harvesting. Also, traditional production and processing technologies are labor-intensive and lead to low oil extractions, which exacerbate productivity losses. The inefficient milling methods are associated with low levels of mechanization, low levels of technology, and poor CPO quality (Byerlee et al., 2017). Despite the low productivity, artisanal processors process 60% of the annual palm oil, currently without assistance (Osei-Amponsah et al., 2012).

Although smallholders in Indonesia produce at a higher productivity than their Ghanaian counterparts, oil palm smallholdings provide a vast potential for yield increases, as the current yields are far below plantation standards. In 2018, the oil palm productivity of smallholder

farms was approximately 14 tons/ha per year. This number is substantially lower than the private company and government plantations' productivity and lower than the overall productivity of 17-18 tons/hectare. In Jambi province, the productivity gap between small- and large-scale producers is even more considerable. (Ministry of Agriculture Indonesia, 2019). Large yield gaps were reported due to limited knowledge about best management practices such as fertilizer dosage, length of harvesting intervals, and plant mortality, especially during the most productive oil palm phase. Some low productive farmers, especially those who adopted oil palm independently, did not receive technical and financial assistance, including agronomic extension services, input subsidies, and marketing support (Euler, Hoffmann, Fathoni, & Schwarze, 2016a).

3.3.Micro evidence on production methods and productivity

We present descriptive micro evidence on smallholder production methods, productivity, and profits in Ghana and Indonesia, using 2018 survey data. The Ghanaian data comprise 106 oil palm producing households in the artisanal marketing channel and 357 oil palm producing households in the modern and industrial marketing channel. The households in the modern marketing channel are contracted farmers who produce for large international palm oil processors Wilmar International Limited and Unilever[3]. The data is presented for each marketing channel separately to describe both artisanal and modern marketing channels and their differences. The Indonesian data were collected in the Jambi Province on Sumatra, a hotspot of the Indonesian oil palm boom. 243 oil palm producing households were sampled and interviewed in 5 districts[4], covering the largest part of the lowland area in the province.

Table 2 presents farm-and plot level descriptives, indicating that the difference in average farm sizes is minor across sectors and value chains, ranging from 5.6 to 6.7 hectares.

[3] For details on the contractual agreements and sampling strategy, please see Ruml & Qaim (2020a).
[4] For details on the sampling strategy, please see Chrisendo, Siregar, & Qaim (2020a)

However, Indonesian farmers have substantially larger oil palm plantations and are more specialized towards oil palm, with lower crop diversity. We further observe that the contracted farms in the industrial value chain in Ghana are more similar to the Indonesian farms than the artisanal farms, indicating the increased coordination in the modern marketing channel incentivizes similar production patterns.

Table 2: Farm- and plot-level descriptive

	Ghana		Indonesia
	Artisanal marketing channel	Modern marketing channel	
Farm-level	*n= 106*	*n=357*	*n= 243*
Farm size (in hectare)	5.67	6.44	6.72
	(6.02)	(6.13)	(7.97)
Area under oil palm cultivation (in hectare)	2.13	2.63	3.67
	(2.24)	(2.83)	(4.50)
Number of cash crops produced	2.74	2.24	1.61
	(1.23)	(0.84)	(0.51)
Plot-level	*n= 122*	*n=430*	*n = 336*
Plot size (in hectare)	0.52	0.50	1.85
	(0.26)	(0.27)	(2.22)
Plot use prior to oil palm plantation			
Pasture (dummy)	0.48	0.47	0.26
	(0.50)	(0.50)	(0.44)
Forest (dummy)	0.41	0.17	0.14
	(0.49)	(0.38)	(0.34)
Other crop cultivation (dummy)	0.11	0.35	0.22
	(0.31)	(0.48)	(0.42)
Purchased as oil palm cultivation (dummy)			0.25
			(0.43)
Received from government (dummy)			0.12
			(0.33)
Production inputs			
Chemical fertilizer use (dummy)	0.03	0.13	0.61
	(0.18)	(0.34)	(0.49)
Herbicide use (dummy)	0.50	0.54	0.60
	(0.50)	(0.50)	(0.49)
Labor days per hectare per year	195.16	77.93	52.22
	(197.53)	(74.08)	(88.36)
Hired labor days per hectare per year	46.62	40.67	15.20
	(100.31)	(63.41)	(25.21)

Note: Labor days are standardized to 5 hours/day for all sectors. Standard deviations in parentheses.

Indonesian oil palm plots are larger on average, with 1.85 hectares compared to 0.52 and 0.5 hectares in Ghana which are mostly monoculture plantations. Smaller plot sizes are a result of credit constraints and a lack of financial support. In Ghana, 89% of the plots on artisanal farms were originally pastured or forest lands. In the modern marketing channel,

farmers transformed pasture lands and other cash crop plantations into oil palm plantations and have a substantially lower share of previous forest lands. This indicates a substitution of cash crops in the modern marketing channel rather than expanding agricultural lands into forest areas. Thus, farmers in the modern marketing channel adopt oil palm to replace other cash crops, mostly cocoa, rubber, and citrus. In contrast, farmers in the artisanal value chain originally extended their crop production on previously uncultivated lands. In Indonesia, this trend is similar to the Ghanaian contract farmers. An exception is that 37% of the sample plots were purchased by or given to the households in the form of set-up oil palm plots by the government. It is reasonable to assume that these 37% of the plots were pasture or forest lands prior to plantation establishment.

The lower part of Table 2 describes input use across sectors at the plot level. Plot fertilization in Ghana currently plays a minor role. Only 3% of the artisanal value chain plots were treated with chemical fertilizer in the 12 months prior to the survey. This share is slightly larger in the modern marketing channel, with 13% of the plots being treated. On the contrary, in Indonesia, 61% of the plots were treated with chemical fertilizer. The lack of fertilization in the Ghanaian oil palm sector greatly contributes to the low productivity, as discussed above. Herbicide use is higher in all sectors; in Ghana, 50-54% of the plots are treated, and in Indonesia, 60% of the plots. As discussed above, the artisanal sector in Ghana is more labor-intensive. The FFBs can only be sold in small quantities, and due to a lack of large buyers and market coordination, post-harvest handling is often required. Farmers manually pick the fruits out of the FFBs and manually process palm oil. Thus, labor requirements are higher in the artisanal value chain with 195 days per hectare per year than 78 days in the modern value chain and 52 days in the oil palm sector in Jambi. This has direct implications for farm employment. Artisanal farms generate 47 days of employment per hectare per year compared to 41 days in the modern value chain and 15 days in Indonesia. Low usage of technologies and machinery further explains the difference in labor intensities between the Ghanaian and Indonesian sectors.

Table 3 illustrates the average per hectare productivity and profitability and confirms the above-discussed productivity gaps. Average per hectare productivity is substantially lower in Ghana, with 6.7 tons per hectare in the artisanal value chain and 8.4 tons per hectare in the modern value chain. Smallholder productivity in Indonesia is substantially higher, with over 14 tons per hectare on average. Per hectare production costs are highest for the artisanal farmers in Ghana, who spent close to 980 international dollars per hectare and year. It should be noted that this does not include costs for plantation establishment or expansion. Costs are substantially lower in the other two value chains, with 580 and 593 international dollars per hectare and year. This difference can be explained by the high labor costs in the artisanal sector. We further find that per hectare revenues are similar for both Ghanaian sectors, and substantially lower than average revenues in Indonesia. On average, Ghanaian farmers receive less than 50% of the revenue per hectare compared in international dollars. This difference in production costs and revenues leads to similar findings for per hectare profits. Not surprisingly, artisanal farmers in Ghana receive the lowest profits with 628 international dollars per hectare and year. This underlines the economic vulnerability of the artisanal value chain participants, who are not competitive compared to the contracted farmers. Comparing the modern Ghanaian marketing channel with the Indonesian one further shows that producing oil palm in Indonesia is on average three times more profitable than in Ghana. This is not only because of the difference in productivity and production costs but also due to the lower price per ton offered in Ghana. The last row of Table 4 shows that Ghana's average per ton price is between 45 and 60 international dollars lower than in Indonesia. This difference in offered prices is potentially due to the high transaction costs for buyers in the Ghanaian sector. Until today, the sector is fragmented with only a little coordination and infrastructure development. Moreover, few large international contractors hold monopsony power in the regions and set prices accordingly.

Table 3: Productivity and Profitability

	Ghana		Indonesia
	Artisanal supply chain	Modern supply chain	
	n=82	*n=318*	*n = 243*
Yields per hectare of oil palm (in tons)	6.69	8.44	14.27
	(4.06)	(4.36)	(11.42)
Production costs per hectare of oil palm (int.$)	979.16	580.15	593.38
	(1870.95)	(792.76)	(1628.05)
Revenues per hectare of oil palm (int.$)	1607.16	1590.85	3631.73
	(1316.88)	(1046.07)	(5477.88)
Profits per hectare of oil palm (int.$)	628.00	1010.7	3038.35
	(1982.60)	(1216.32)	(5651.30)
Price per ton of oil palm (int.$)	184.74	170.06	229.97
	(77.44)	(12.66)	(116.38)

Note: All values presented in Table 3 are in international dollars for direct comparability. The purchasing power parity for Ghana and Indonesia are 1.899 and 4762.637 LCU per international dollar, respectively, in 2018. This value is derived from the World Bank Database https://data.worldbank.org/indicator/PA.NUS.PPP?locations=ID-GH. Standard deviations in parentheses.

4. Rural development and poverty impacts

The contribution of the oil palm expansion in Southeast Asia to rural development and poverty alleviation has been analyzed in recent years (Qaim et al., 2020). Studies have shown the effects of oil palm cultivation on different layers, ranging from household, village, regional, to the national level (Edwards, 2019a; Euler, Schwarze, Siregar, & Qaim, 2016b; Gatto et al., 2017; Santika et al., 2019a).

At the household level, oil palm adoption increased household incomes and expenditures (Euler et al., 2017; Feintrenie et al., 2010; Kubitza et al., 2018). Benefits arise through higher selling prices and profits than more traditional crops such as rubber and rice (Feintrenie & Levang, 2009). Moreover, oil palm cultivation requires less labor than previously cultivated rubber, enabling households to expand their farms and participate in off-farm employment, thus generating additional incomes (Chrisendo et al., 2020a; Euler et al., 2017). Non-farm households benefit through employment in the sector, which was found to improve their living conditions (Bou Dib et al., Krishna, Alamsyah, & Qaim, 2018; Rist et al., 2010). These changes led to improved household nutrition (Chrisendo, Krishna, Siregar, & Qaim, 2020b), household health, education, asset ownership, and family planning (Dradjat 2012; Euler 2016b; Kubitza & Gehrke, 2018).

Economic benefits at the village and regional level include positive effects on village assets, including road and market infrastructure, electricity, schools, and healthcare facilities (Edwards, 2019b; Gatto et al., 2017; Rist et al., 2010; Zen et al., 2016). At the national level, oil palm production contributed to poverty alleviation, indicated by lower poverty rates in areas surrounding oil palm plantations (Dradjat, 2012; Susila, 2004) and a faster decline in poverty rates (Edwards, 2019a). Significant economic improvements have also been reported for other parties involved in the supply chains, such as traders and intermediaries (Bou Dib et al., 2018; Euler et al., 2017; Feintrenie et al., 2010). However, it should be noted that the transition did not benefit all households and villages at the same level. Local settings and other social indicators play an important role (Santika et al., 2019a; Santika et al., 2019b).

Despite the increasing economic importance of the West African oil palm sector, no such studies exist for this context. Some studies compare participation in the modern value chain through contract farming to the artisanal supply chain in Ghana. They find that participation in contract farming leads to higher household assets and perceived security (Väth & Kirk, 2014), lower agricultural labor requirements (Ruml & Qaim, 2021), and higher household incomes (Ruml, Ragasa & Qaim, 2020). If production inputs and assistance are provided through the contract, participation leads to higher production intensity and land productivity (Ruml & Qaim, 2020a), which underlines the severity of the capital constraints in the sector. However, participation in the modern value chain is also associated with lower employment, particularly of female laborers (Ruml & Qaim, 2021) and high levels of dissatisfaction due to a lack of transparency and (perceived) opportunistic behaviour of the contracting companies. The contracting companies are few, do not overlap catchment areas, and hold monopsony power in the regions. Farmers in the modern marketing channel wish to exit the contractual agreements yet are legally bound to the companies who have the plots as contract collateral (Ruml & Qaim, 2020b). Despite the undesired effects on farmer dissatisfaction, existing studies show that participation in the modern supply chain is

economically beneficial for farmers and contributes to rural development and poverty alleviation.

No empirical evidence exists that analyses the economic benefits of participation in the artisanal value chain. Thus, it is unclear whether oil palm production, in general, is beneficial compared to the production of other cash crops in the West African context. A recent article found that 12% of the surveyed oil palm farmers are clearing their oil palm plots to re-adopt rubber production. Reasons are a lack of credit to re-establish plantations with old palms, land grabbing for rubber and oil palm plantations by large companies and (perceived) opportunistic behaviour of palm oil buyers and companies (Agricultural Policy Research in Africa, 2020). The data presented in the paper further indicates that artisanal farmers are not competitive due to a lack of support and market coordination, which leads to low technology adoption, high production costs, fluctuating prices, and low profits. Similarly, artisanal millers will face increasing competition through large companies with processing facilities. This underlines the vulnerability of the artisanal value chain actors to the top-down development approach pursued by the government, which potentially leads to the crowding out of artisanal producers, implying adverse effects on rural development and poverty alleviation.

To shed more light on the potential role of oil palm in rural development in this context, we investigate the relationship between oil palm production, welfare, and poverty status among farm households in Ghana descriptively to provide first insights. For the analysis, we use the last three rounds of the Ghana Living Standard Survey (GLSS) conducted in 2005/6, 2012/3, and 2016/7. The GLSS datasets are nationally representative household surveys administered by the Ghana Statistical Service, usually with technical and financial support from the World Bank[5]. Each wave of the GLSS dataset is an independent cross-sectional dataset that contains information on a wide range of demographic and socioeconomic factors. For comparability, we

[5] Households are selected using a two-stage stratified sampling design with specified enumeration areas (EAs) and primary sampling units (PSUs). The EAs are divided into urban and rural localities. Households are listed within the selected PSUs to form secondary sampling units (SSUs).

limit the data to farm households living in districts where oil palm is or was produced commercially in either of the three waves.

We separate the producers according to whether they produce oil palm or not to see whether oil palm producers are on average better or worse off. In addition, we compare them to cocoa farmers and specify a transition group that produces both cocoa and oil palm at a commercial scale. Cocoa is the leading cash crop in the investigated regions, and the transition towards oil palm is associated with a diversion away from, among other things, cocoa. Table 4 provides information on sample sizes and shares of producers in each of the three datasets. Overall, we observe a substantial variation of producer shares across datasets. It is indicated that the percentage of producers cultivating oil palm decreased from 9 percent in 2006 to approximately 6 percent in 2017. The share of producers cultivating both oil palm and cocoa increased during that time from 3.2 to 5.5. percent.

It should be noted that less than 1.5% of the sample oil palm farmers sell through contracts or cooperatives in the modern marketing channel. Thus, the sample captures almost exclusively artisanal farmers and provides the first evidence that the vast expansion and adoption of oil palm farming did not occur in the artisanal value chain. Instead, we find the first indication of crowding out in the artisanal value chain.

Table 4: GLSS sample information

	2006	2013	2017
Number of observations	1987	4177	1732
Oil palm producers	179	222	112
Cocoa producers	369	1295	299
Oil palm and cocoa producers	63	275	96
Other farms	1376	2385	1225
Household shares			
Oil palm producers	9.0 %	5.3%	6.4%
Cocoa producers	18.6%	31.0%	17.3%
Oil palm and cocoa producers	3.2%	6.6%	5.5%
Other farms	69.3%	57.1%	70.7%

Figure 1: Poverty headcount ratios, by type of producer (based on GLSS data)

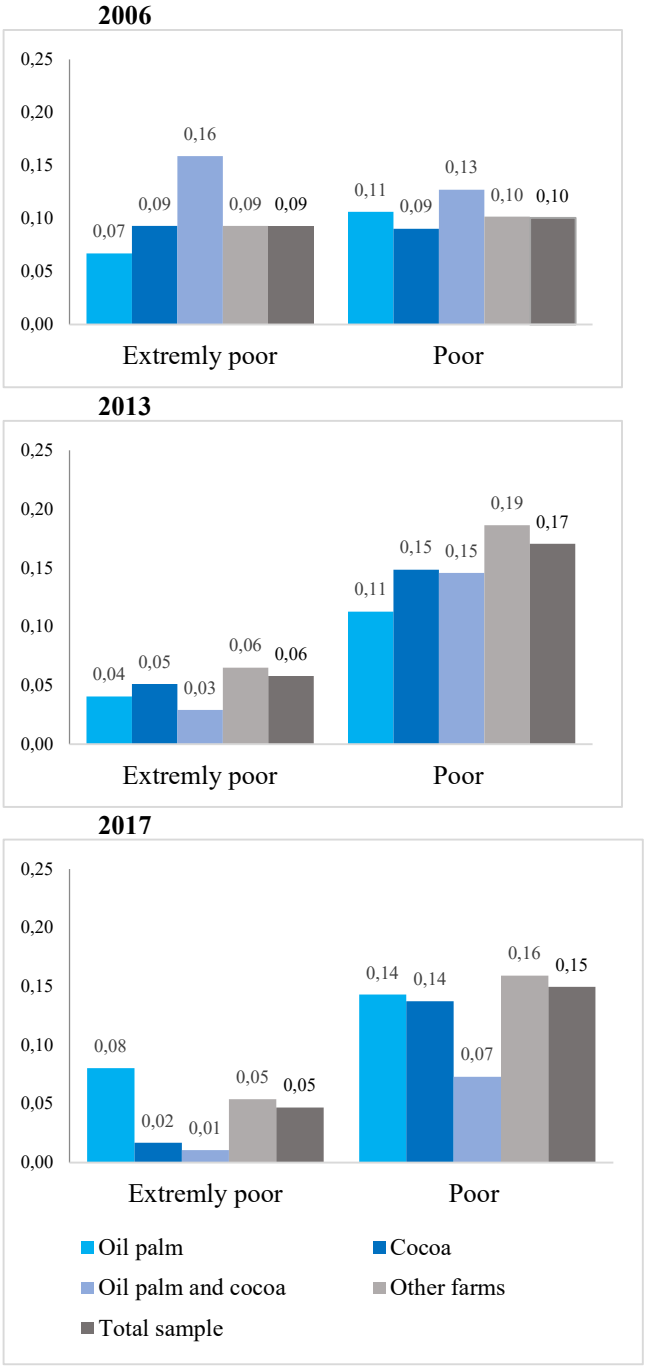

Figure 1 presents poverty headcount ratios by producer type, indicating the share of extremely and moderately poor households in our sample. Across the three datasets, the extreme poverty headcount ratio among oil palm producers is between 4% and 8%. In the 2006 and 2013 data, oil palm producers are among the least poor producer groups for extreme and moderate poverty, indicating a positive contribution of oil palm to poverty alleviation. Also, 2006 and 2013 data show that oil palm producers are better off than cocoa producers and producers who

commercially cultivate both oil palm and cocoa. 2017 data indicates a different relationship. Oil palm producers have the highest extreme poverty headcount ratio and are among the highest for moderate poverty. This provides the first evidence that poverty among (artisanal) oil palm producers is increasing.

Thus, we find that oil palm has the potential to contribute positively to rural development and poverty alleviation, with predominantly lower extreme and moderate poverty headcount ratios compared to other producers. Moreover, participation in the modern value chain through contract farming improved farm profits and household incomes substantially. However, at the same time, extreme and moderate poverty prevalence in the artisanal value chain is increasing. This is not surprising considering the discussed changes and challenges in the sector, increasing competition to the modern value chain participants. More comprehensive analysis controlling for other confounding factors is required to isolate the relationship between oil palm cultivation and poverty.

5. Discussion, conclusions, and policy implications

Despite the increasing prospective importance of the West African oil palm sector, its current and potential contribution to rural development is still unclear. Existing evidence focuses on the Southeast Asian sector due to the vast boom observed in recent decades. In this paper, we perform a systematic comparison of the oil palm sector in Ghana and Indonesia to shed light on the role of oil palm on rural development, particularly in the West African context. To do so, we compare policies and market channels at the macro-level and smallholder production patterns at the micro-level. Moreover, we compare poverty headcount ratios among oil palm and non-oil palm producers in Ghana to better understand the current role of oil palm in rural development in this context. This comparison led to essential findings, both at the macro- and micro-level.

At the macro-level, we find that Ghanaian and Indonesian policymaking strongly differed regarding early-on privatization and smallholder involvement and support. While Indonesia launched large-scale programs to involve smallholders and private companies early on, Ghana has focused on state-owned plantations and has struggled to involve private investors. The high coordination and competition in the Indonesian sector and the early-on smallholder support explain the significant differences in productivities between Ghanaian and Indonesian smallholders. However, the main difference between the Indonesian and Ghanaian palm oil sectors is the existence of an artisanal value chain in Ghana. Throughout the last decades, artisanal producers and millers have produced most palm oil to meet the local demand for direct consumption and industrial production. Currently, the Ghanaian government follows a top-down development approach through the establishment of large (mostly international) nucleus estate plantations that sell palm oil in the export market. Despite the potential for endogenous growth, artisanal supply chain actors remain without governmental support and face increasing competition with the expansion of the modern supply chain. Government attempts to link artisanal supply chain actors to the modern supply chain have largely failed, which led to the coexistence of two competing value chains.

These differences are also apparent at the micro-level. Artisanal producers in Ghana have the lowest productivity and profitability and the highest production costs due to low mechanization and technology adoption. Market imperfections are most severe in the artisanal value chain, with low coordination and consequently high market risk. Farmers receive no assistance and are severely credit constrained, which results in low levels of mechanization and technology adoption. The well-coordinated industrial supply chain contributed to rural development and poverty alleviation compared to producing oil palm in the artisanal value chain. This is not surprising because producers receive production contracts, which largely resolve market failures. However, the potential of oil palm compared to other crops in the sector, such as, e.g. cocoa, is unclear. Comparing oil palm producers to other farming

households in Ghana showed an increase in poverty prevalence among (artisanal) oil palm farming households. Until today (as of May 2021), the artisanal value chain actors are the backbone and majority producers in the Ghanaian oil palm sector. Continuing the current development approach is thus dangerous. We recommend rather utilize the existence of the artisanal producers and the local demand for palm oil to stimulate endogeneous growth through the strengthening of the artisanal value chain. Increasing the mechanization of artisanal millers could go a long way in stimulating growth. Higher processing capacities in the artisanal value chain cannot only increase miller incomes but provide a larger and more stable market outlet for independent producers, relieve the price pressure in peak seasons, and generate employment. As such, the establishment of large nucleus estates like in Indonesia is not the only way to improve market coordination.

Despite differences in productivity levels across value chains, sectors, and countries, smallholder productivity in Ghana and Indonesia is generally low. The discussed productivity gaps suggest a vast potential to increase production levels, and with that, household incomes through intensification in both countries. This includes improved plantation set-ups and better management practices. Farmers cannot acquire the essential information and technical innovations without support. Thus, large-scale extension services are required to spread information about *inter alia*, appropriate fertilization techniques, crop and canopy management, and proper harvesting intervals.

In Ghana, we further recommend that farmer cooperatives should be strengthened early on in the upcoming sector to ensure farmer bargaining power and market access in the future. This is particularly important in light of the rising dissatisfaction among both contracted and artisanal smallholders. Such cooperatives also provide a suitable platform for extension services and technology transfer. It was shown in the Indonesian context that such cooperatives are crucial in a transitioning sector and that a lack of farmer representation can lead to unfavorable economic distributions and social conflict.

In summary, oil palm expansion yields vast potential to contribute to rural development in West Africa. Current institutional challenges can be overcome by appropriate policymaking focusing on smallholder support, market coordination, and mechanization. This study has provided more insight into the challenges and opportunities in this sector. However, more evidence is needed to understand the role of oil palm on rural development beyond the Southeast Asian context.

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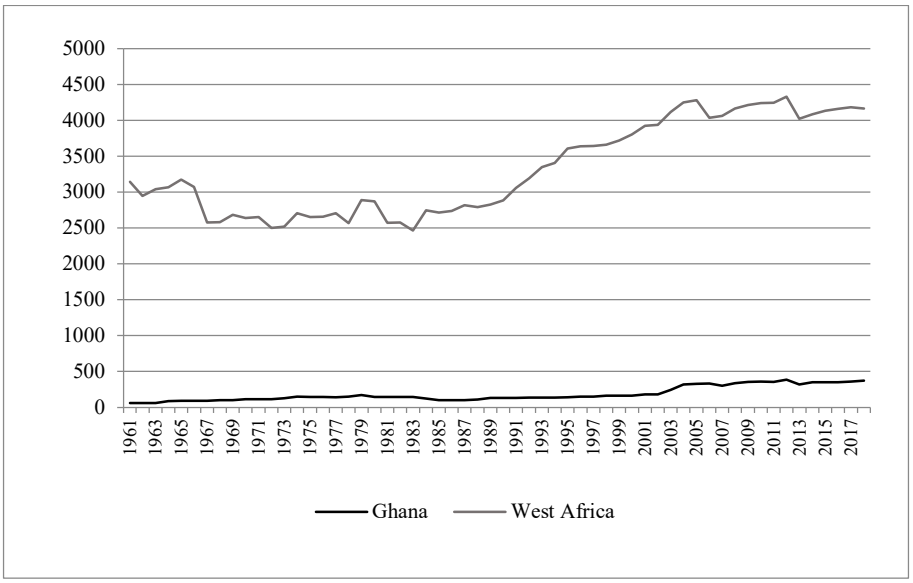
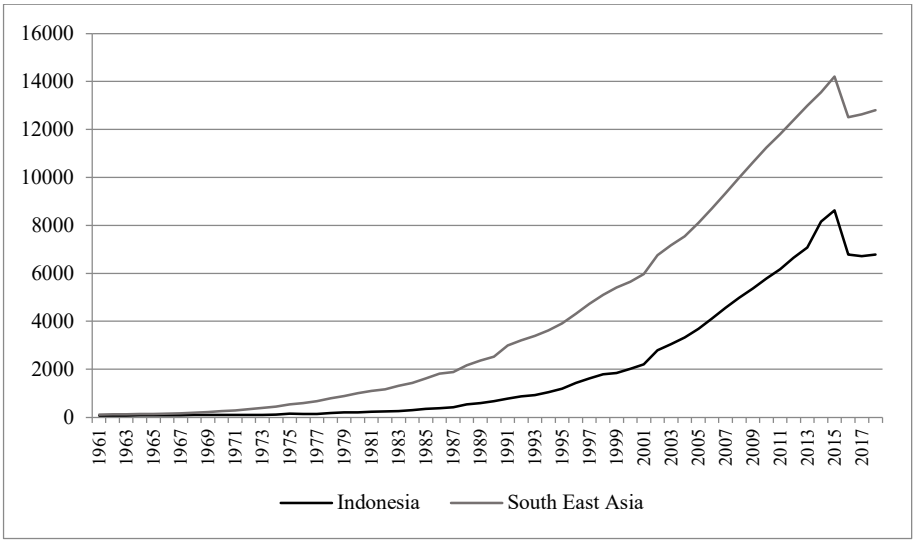
Appendix

Figure A1: Area harvested 1961-2018 (in 1000 hectares)

Panel A: Ghana and West Africa



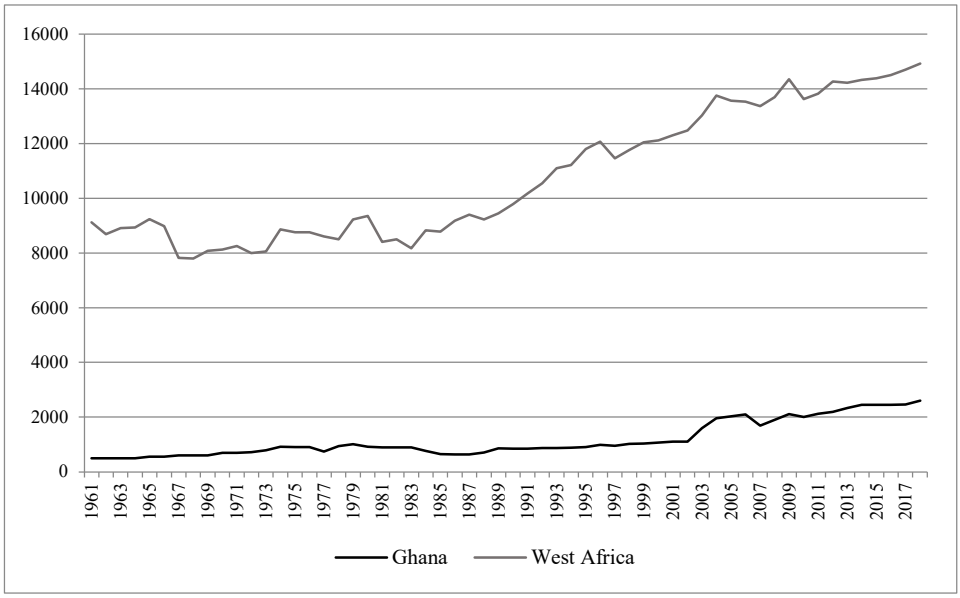
Panel B: Indonesia and Southeast Asia



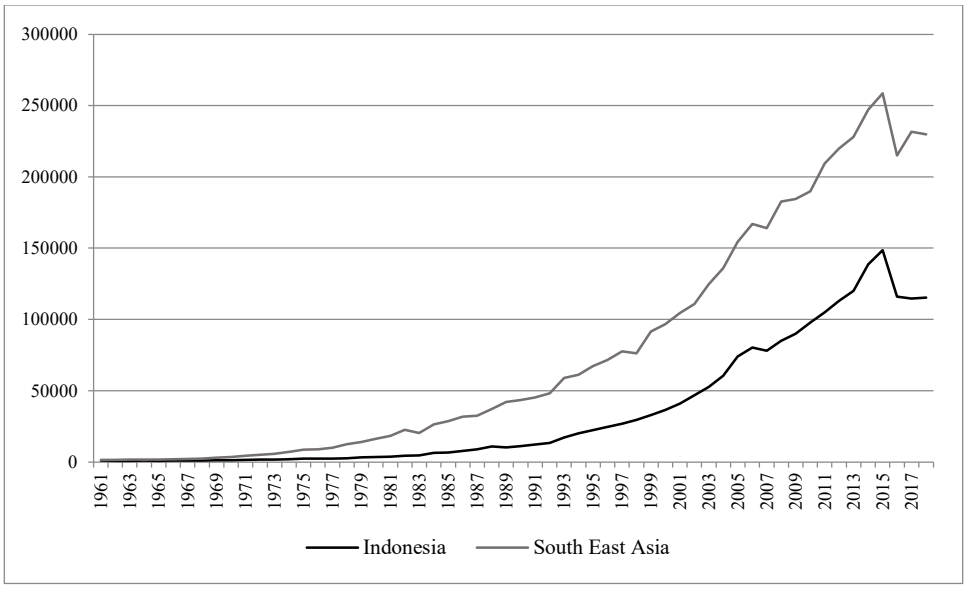
Source: Authors' illustration based on data from Food and Agriculture Organization-FAO (2020).

Figure A2: Production 1961-2018 (1000 tons of FFBs)

Panel A: Ghana and West Africa



Panel B: Indonesia and Southeast Asia



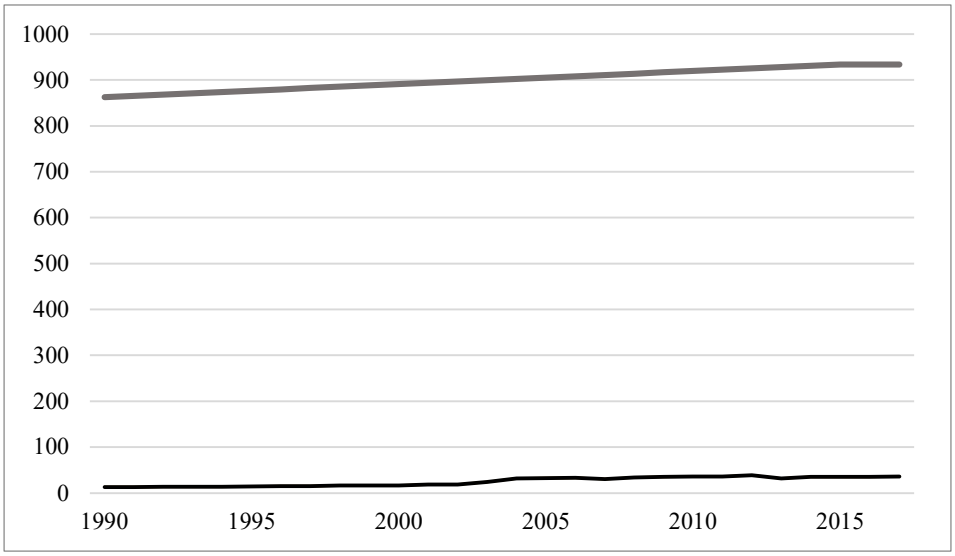
Source: Authors' illustration based on data from Food and Agriculture Organization-FAO (2020).

Figure A3: Ghanaian palm oil exports 1996–2017 (million US$)

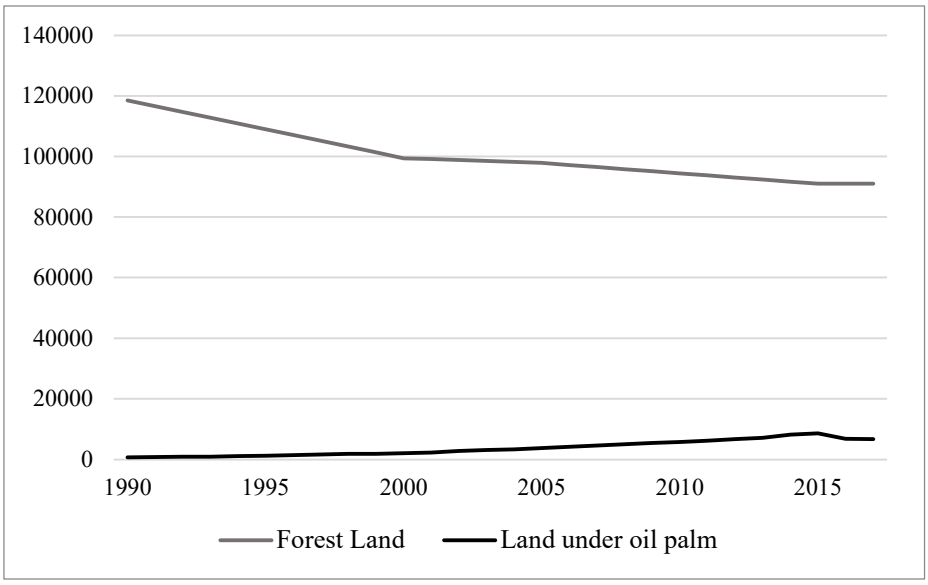
Source: Authors' illustration based on data from Food and Agriculture Organization-FAO (2020).

Figure A4: Oil palm cultivation and available forest lands 1990-2017 (in 1000 hectares)

Panel A: Ghana

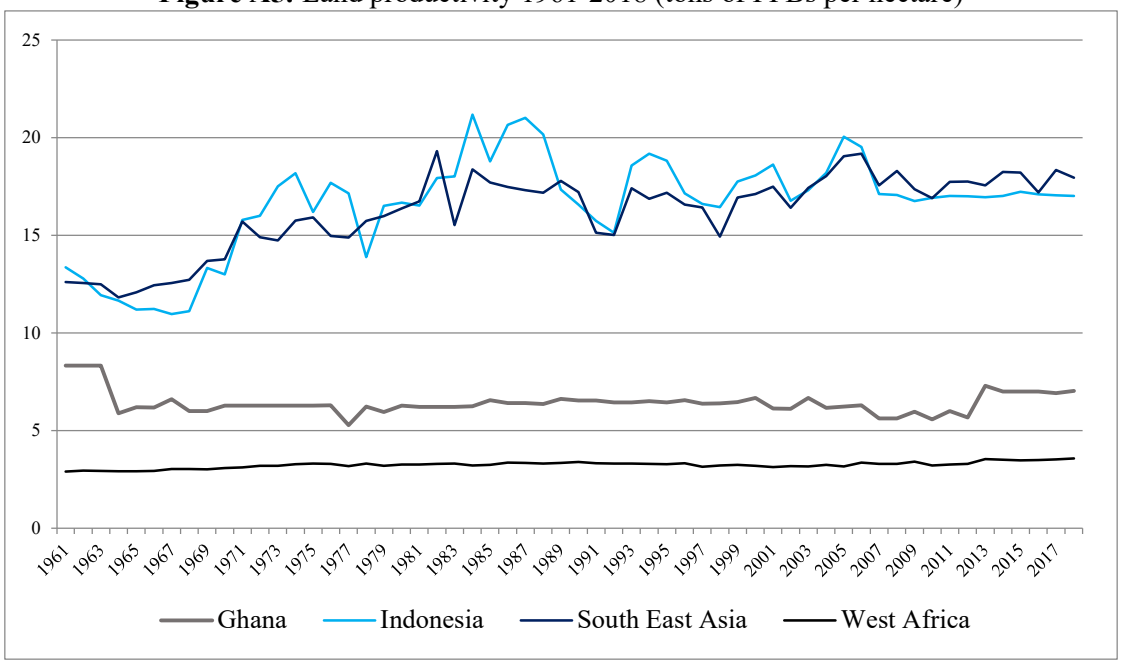


Panel B: Indonesia



Source: Authors' illustration based on data from Food and Agriculture Organization-FAO (2020).

Figure A5: Land productivity 1961-2018 (tons of FFBs per hectare)



Source: Authors' illustration based on data from Food and Agriculture Organization-FAO (2020).