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FARM STRATIFICATION AND MARKET SEGMENTATION IN AGRI-FOOD VALUE CHAINS

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Abstract

Whereas many smallholder farmers rely on rather diversified production systems, commercial market-oriented agri-food production is increasingly concentrated amongst midsize and larger farmers. We use data from the Value Chain Analysis for Development (VCA4D) project to (a) identify farm size structures in eight agri-food value chains in sub-Saharan Africa, (b) explain variation in farm size structure between commodities, and (c) discuss the implications for agri-food sector transformation dynamics.

Looking at the contribution of different farm size categories to the marketed value added by the farm sector, we identify three types of farm size structures: smallholder-based (sorghum and groundnut in Ghana and cocoa in Cameroon), bi-modal (green beans in Kenya and maize in Nigeria and Zambia), and midsize dominated (cotton in Ethiopia and aquaculture in Zambia). Smallholders produce more for own consumption and are linked to less remunerative sales at rural markets, while midsize and large-scale farmers tend to be engaged in more rewarding contracts for deliveries to urban markets, modern retail and export.

Our cross-sectional analysis shows high labour intensity and low value added in the midstream segment of the value chain as factors favouring smallholder-based systems. On the other hand, high capital intensity of the production systems and high-value added in the mid-stream favour midsize and large-scale dominated systems. Changes in the farm-level production structure thus have direct implications for the organization of midstream trade and processing firms and shape the value added distribution between value chain stakeholders. Such farm-firm interactions are also influenced by country-level differences in urbanization, economic growth and market development. Crop-level differences offer particular opportunities for labour intensification in smallholder systems, while bimodal and large-scale systems rely more on input intensification.

The emergence of medium- and large-scale farms seems to be a key feature of agricultural transformation. The transition towards a bi-modal or large-scale dominated farm sector can boost agricultural productivity but, as such, can also be expected to be disruptive for existing smallholder farmers. The extent to which this transition is inclusive and can support structural transformation will depend to a large extent on the employment creation in the farm and mid-stream segments of the value chain that result from this transition.

Appropriate strategies for inclusive and sustainable agricultural and structural transformation thus require balanced access to resources, inputs, knowledge and markets for different agents throughout the value chain. Better access to finance, participatory innovation systems, professional education, and exchange networks for knowledge sharing arrangements are critical for pro-poor transition pathways.

Keywords: Farm Size Stratification; Productivity; Market Structure, Sales Outlets; Value Chain.

1. Introduction

Agricultural development policies in Sub-Saharan Africa predominately focus on smallholders; how they can increase their productivity and resilience, how they can be included in modern agri-food value chains, and how this can lead to structural transformation. Obviously, this is because smallholder farmers dominate Africa's agricultural sectors. In fact, between 60% and 75% of all farmers in Africa are estimated to be smallholders (Nyambo et al., 2022; Jayne et al., 2010.). For this reason, also agricultural development literature has this smallholder focus.

While this literature has led to important insights, studies that take a broader perspective on the agricultural sector and include mid-scale and large-scale farms in their analysis might offer new perspectives. For example, by studying the success of medium- and large-scale farms, we could potentially gain new insights on why smallholders are struggling with gaining access to markets. Moreover, a better understanding of the role of medium- and large-scale farm in agricultural development—including their linkages with smallholders and the broader economy—could be helpful in designing farm-size differentiated agricultural development policies.

Agricultural development depends on intensive interaction between farmers and value chain agents ("firms") involved in production, processing and trade. The structural farm-size composition is therefore a reflection of the competitive relationships at land, labour, capital and commodity markets (de Janvry et al., 1991). Typical farm size structures emerge in response to requirements of scale and the prospects of innovation that influence crop and technology choice and cover prevailing (production and market) risks.

In many countries, there is a trend over time towards more complex production systems and farm size differentiation. In most low income countries, the number of farms increased (due to fragmentation) and their average farm size went down, whereas in middle income countries this trend reversed (Lowder et al., 2016). Small farms play a critical role in the absorption of rural labour, but larger farms are better able to respond to market challenges: their mechanization and standardization lead to further farm concentration. Jayne et al. (2010) conclude that most smallholders are unable to produce more than a marginal surplus or participate meaningfully in commodity markets and that the marketed agricultural surplus is exceedingly concentrated among a small group of medium-size and large producers. Collier & Dercon (2014) therefore question the exclusive commitment to smallholders and argue for a much more open-minded approach to different modes of production.

In this paper we aim to assess the contribution of different types of farms (smallholder, midsize and large-scale) to the marketable surplus and total value added of different agri-food commodities in sub-Sahara Africa (SSA), in order to better understand how primary production is structured and how this may be related to market organization. At the input side, the existing heterogeneity in farming structures is found to reflect differences in capital and labour intensity of the production process. At the output side, prospects for further processing and innovation are shaped by access to markets and the size of the mid-stream sector. Particular attention is given to the role of mid-size farms in commercial agri-food value chains, and the implications of changes in (midstream) market linkages for the structure and organization of primary production.

Interlinkages between agricultural production and market structures are scarcely studied and still many issues remain to be clarified. Early studies focused on the inverse relationship between farm size and factor productivity as an explanation for the 'survival' of the peasantry. More recent studies find that especially midsize farms exhibit high total factor productivity

(Muyaga & Jayne, 2019). Another stream of literature analyses how value chain relations influence farm size structure and farmer (cooperative) organization, paying particular attention to the role of contract farming and other procurement relationships (Liverpool-Tasie et al., 2020). Modern value chains easily exclude smallholders that cannot comply with quality and traceability criteria.

Finally, there are many studies that try to explain farm concentration from a political economy perspective, making widespread market and governance failures responsible for the growing rural poverty (Timmer, 1997).

Against this background, we formulated the following three Research Questions (RQs) underlying this study:

1) What is the prevailing farm size structure for several agri-food value chains in selected sub-Sahara Africa countries?
2) What input and output market factors explain the variation in farm-size structures between commodities and countries?
3) How does the prevailing farm-size structure influence agri-food sector transformation and what does it mean for agricultural development policy and smallholder participation?

We first outline some major trends in farm size distribution in sub-Sahara Africa and then, using the data generated by the Value Chain Analysis for Development (VCA4D) project, we assess the causes and consequences of these changes, focussing on (input and output) market structures as a major variable. For this analysis, we rely on a simple schedule (see Figure 1) that tries to identify relationships between typical farming structure performance parameters (such as farm size, factor use, marketable surplus) with a range of value chain indicators (such as firm structure, resource intensity and market share). Given the cross-section character of VCA4D data, we cannot fully assess causality between these processes. The type and character of the linkages between 'farms' and 'firms' are considered critical for the rural social structure and determine to a large extent how inclusive agrarian transition processes can become.

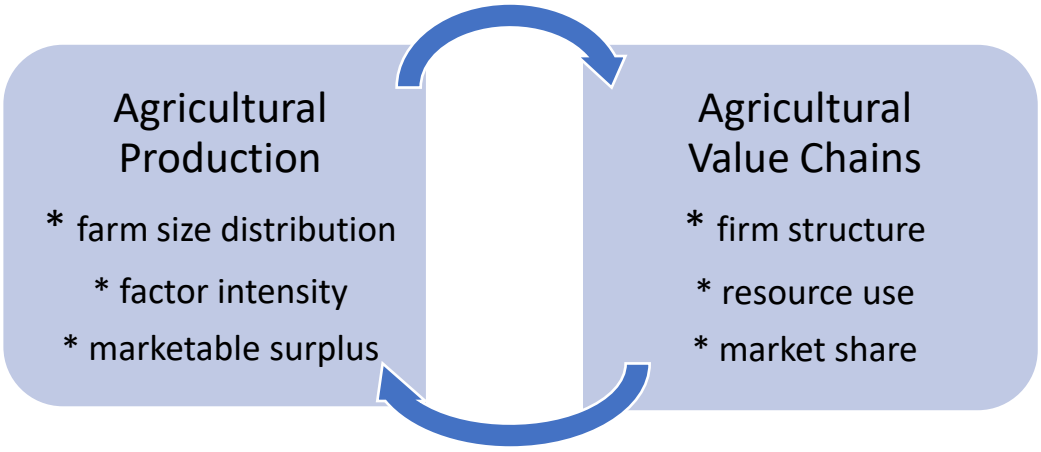


Figure 1: Schedule for linking farms and firms

The remainder of this paper is structured as follows. Section 2 presents recent developments in farm size distribution in sub-Sahara Africa. Section 3 outlines the methodological approach and Section 4 describes the data. In Section 5, linkages between farm stratification and input and output markets are analysed, followed by a discussion on wider implications for agri-food transformation processes in Section 6. Section 7 concludes with some policy implications.

2. The changing agricultural production structure in Sub-Sahara Africa

Whereas many smallholder (family) farmers rely on rather diversified production systems, commercial market-oriented agri-food production is increasingly concentrated amongst midsize and larger entrepreneurial farmers (Jayne et al., 2019). This so-called 'bifurcation' of production systems impacts the use of technologies, shaping differences in land and labour productivity. This is accompanied by a further segmentation of downstream markets, with smallholders linked to local and regional market outlets and midsize farmers engaged in contracts with modern retail and international markets.

With the growing urbanization of the population, market demand for commercial agricultural products in urban areas is rapidly increasing. Instead of relying on (peasant) smallholders, midsize and larger farmers tend to have a larger share of their production available for market supply and become more important in commercial value chains due to their higher reliability, better ability to meet standards, and lower transaction costs (Barrett et al., 2017). In addition, production systems become more capital-intensive and economize on wage labour.

Von Braun and Mirzabaev (2015) show, using long-term data, average farm sizes are decreasing in some lower income countries but increasing in most middle income countries and emerging economies, including several East and Southern African countries. Moreover, in countries which are experiencing farm size decreases, the rate of decrease has decelerated, and some developing countries now experience a slight and recent increasing trend in their average farm sizes.

In sub-Sahara Africa, many countries show strong decreases in average farm size during the last decades, ranging from more than 70% in Kenya and DR Congo to 50% in Malawi and 25-30% in Ethiopia, Uganda and Mali (see Table 1).

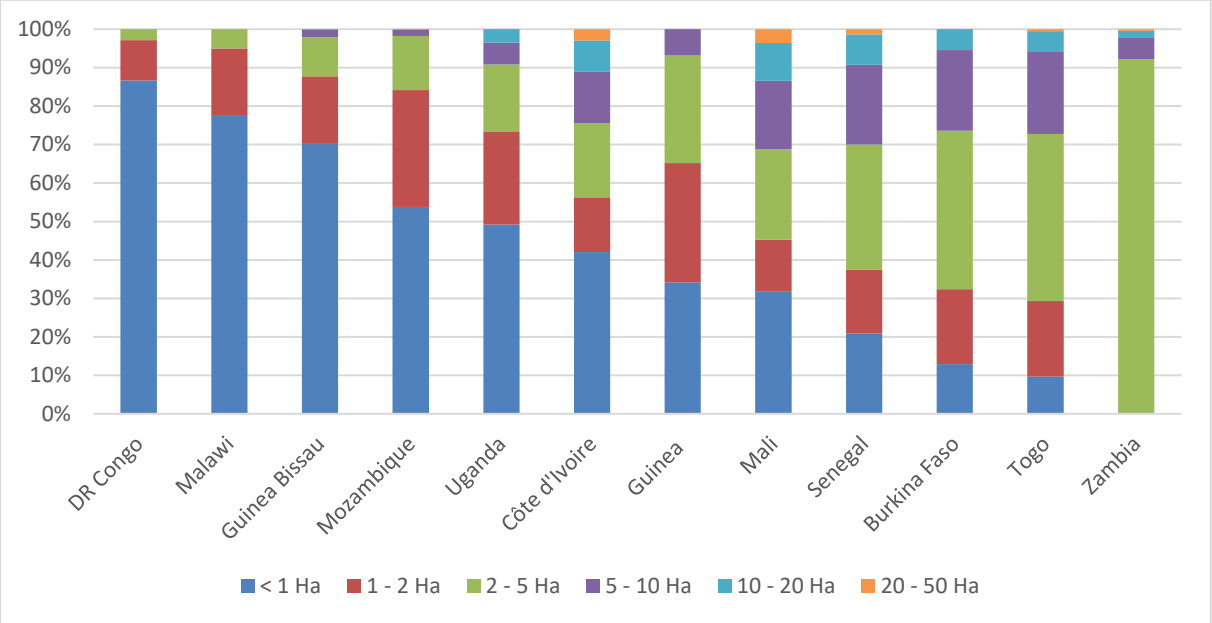
Table 1: Trends in average size of agricultural holding, 1960 - 2000

Country	Average size of agricultural holding (ha)					Trend
	1960	1970	1980	1990	2000	
Ethiopia	..	..	1.4	0.8	1.0	decrease
Kenya	11.7	4.1	2.5	..	..	decrease
Uganda	3.3	..	..	2.2	..	decrease
Madagascar	1.0	..	1.3	..	0.9	decrease
Malawi	..	1.5	1.2	0.7	..	decrease
Cote d'Ivoire	..	5.0	..	..	3.9	decrease
DR Congo	..	2.3	..	0.5	..	decrease
Guinea - Bissau	3.0	..	..	1.1	..	decrease
Senegal	3.6	..	..	..	4.3	increase
Sierra Leone	..	1.8	1.6	..	..	decrease
Cape Verde	..	..	1.5	1.3	1.0	decrease

Source: Authors' compilation using FAO (2013a) ; Note: ".." indicates data not available.

The landholding structure strongly varies between countries (see Figure 2). In countries like Malawi, Guinea Bissau and DR Congo close to 90% of all holdings have a size below 2 ha. In Western African countries (Mali, Burkina, Senegal, Togo and Guinea) somewhat larger holdings prevail due to more arid conditions and engagement in livestock activities.

Figure 2: Agricultural holdings by farm size (1990/2000).



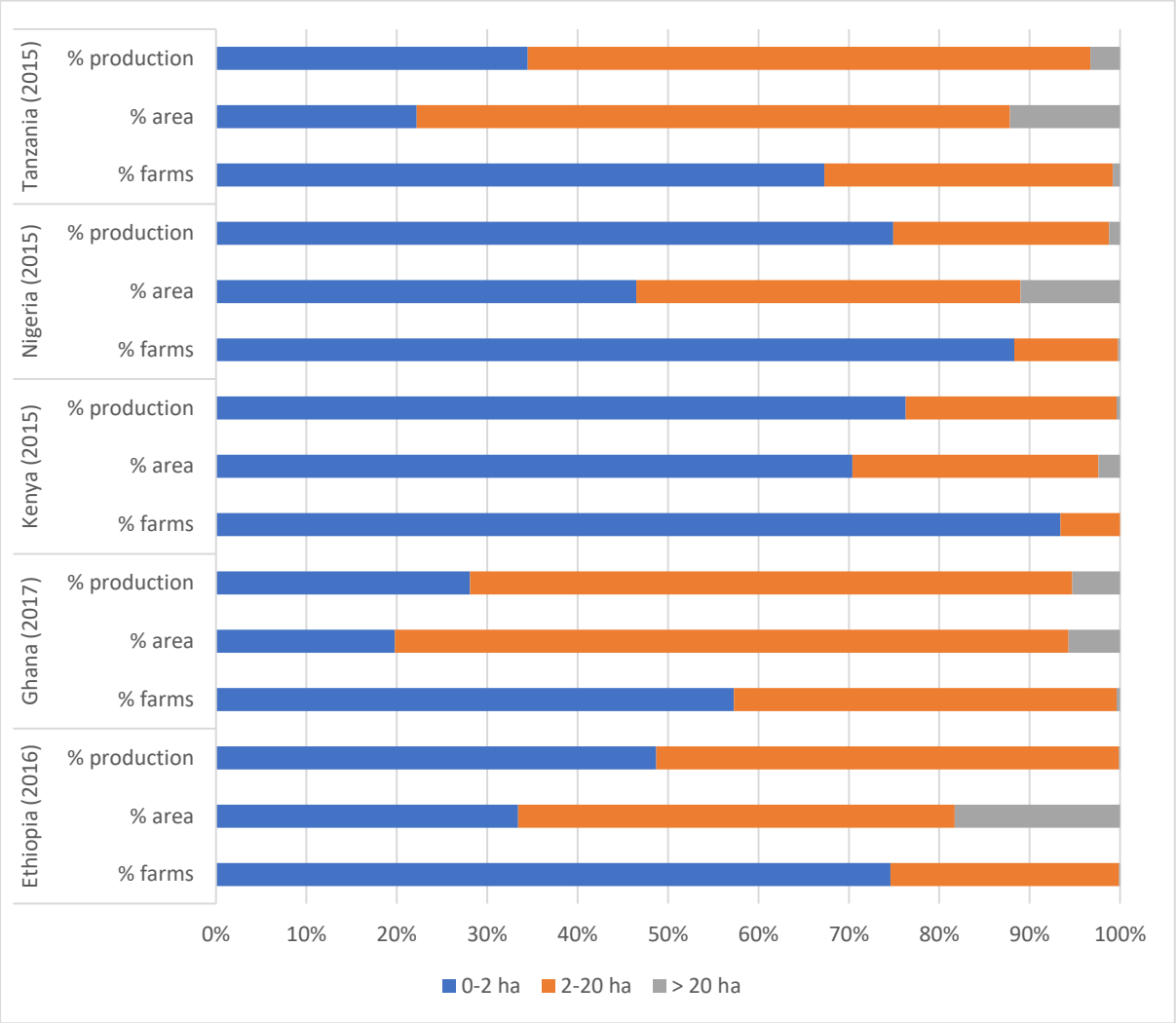
Source: Authors' compilation using FAO (2013a).

Studies by Jayne et al. (2016) and Jayne et al. (2021) confirm that the share of land accounted for by small-scale (0-2 hectares) holdings is generally declining in most sub-Sahara African countries, whereas medium-size farms (2-20 ha) are gradually becoming more important. Both in terms of cultivated area and in terms of contribution to (commercial) crop production. The number of mid-size farms is growing rapidly and medium-scale farms will soon account for the majority of operated farmland and generate a growing share of the marketable food in many African countries (see Figure 3).

On the other hand, Houssou et al. (2016) find for Ghana a rising number of medium- and large-scale farms that is associated with successful transition of small-scale farmers rather than entry of medium or large farms into agriculture, reflecting small-scale farmers successfully breaking through the barriers of subsistence agriculture into more commercialized production systems. Notably, these results diverge from the patterns observed in Zambia and Kenya, where that the emergent farmers came mostly from the urban elite.

We are well aware that typical property rights and customary traditions influence the current farm size structure. These may have a profound impact on the prospects for farm subdivision (inheritance) and the possibilities for transferring land rights. These particularities of African land market are further discussed by Bassett and Crummey (1993).

Figure 3: Distribution of Farms, Cropping Area & Crop Production by Farm Size

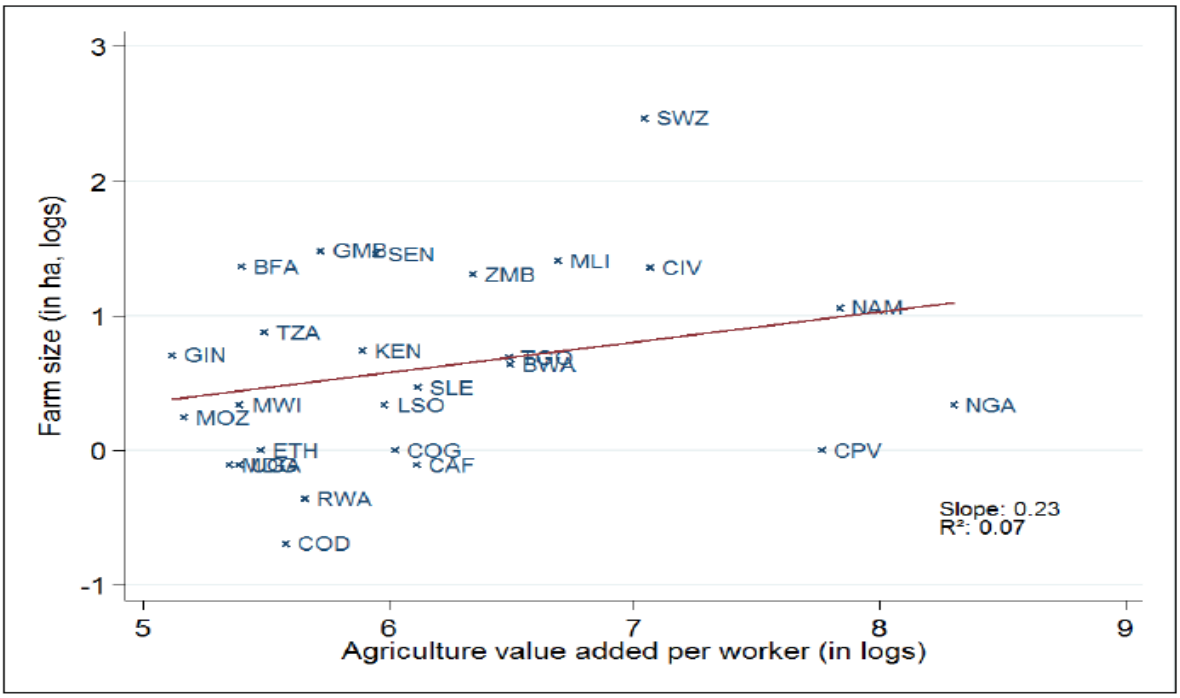


Source: Jayne et al (2016)

An important literature on small differentiation concerns the relationship between farm size and crop yields (land productivity). Many studies find an inverse relationship between farm size and crop yields, particularly when agriculture is labour-intensive and involves little mechanization (Ali and Deininger 2015). Labour market imperfections are the most prominent explanation for this inverse relationship, with small farms applying excessive (sub-optimal) amounts of family labour. On the other hand, as agricultural production gets more capital-intensive, the inverse relationships between farm size and crop yields may fade or even reverse (Ali and Deininger 2015). Other studies have found a U-shaped relationship between farm size and crop yields. Oluwatoba et al. (2021), for example, study a representative sample of farmers from Ogun and Kaduna state in Nigeria and find that an inverse relationship exists up to 22 ha, but that productivity increases with farm size afterwards. The average turning point for small-scale farmers who stepped-up and became medium scale is already at 11 ha, in contrast to 22 ha for those who stepped in (new farmers).

This inverse relationship does not hold when we look at labour productivity. Macro-level cross-country comparisons in Sub-Saharan Africa (SSA), for example, show that larger average farm sizes are, in fact, positively associated with agricultural value added per worker (see Figure 4). This is in line with the hypothesis that small-scale farms apply large amounts of (family) labour. It can also be explained by the better access to mechanization technologies and higher labour supervision costs by larger farms that favour capital intensification.

Figure 4: Farm size and agricultural value added in Sub-Sahara Africa



Source: Word Development Indicators, World Bank, Lowder et al. (2014), FAO.

DEFINITIONS

Throughout this report, the following definitions are used:

- Gini ratio: percentage of total production value produced by different shares of the farmer population (ranking farm types from smallest to largest contribution to value added) compared to uniformity (1 = perfect inequality; 0 = perfect equality).
- Capital intensity: the ratio between depreciation costs and total value added.
- Labour intensity: the ratio between hired labour costs (wages) and total value added.
  NOTE: *this does not include self-employment in farming and midstream activities*
- Intermediate inputs intensity: the ratio between intermediate goods and services costs and total value added.
- Value added: the difference between the price of a product or service and the cost of producing it.
- Marketed value added: percentage of production sold (production value minus value of inputs) times the share of the harvest sold.

3. Methodological Approach

3.1. Data

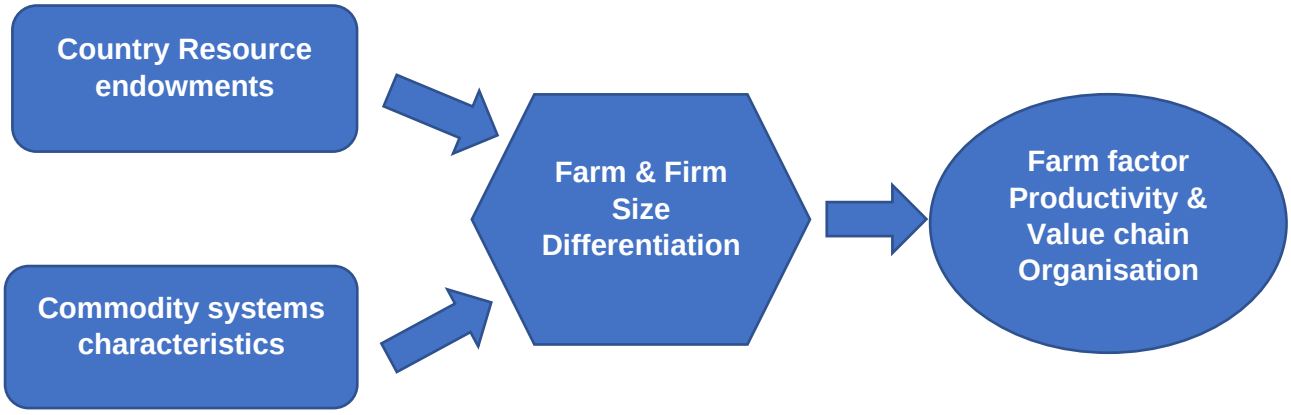
This study mainly uses data generated by the Value Chain Analysis for Development (VCA4D) project. VCA4D performs value chain analyses across a range of agricultural commodities and countries in order to appraise their contribution to growth and job creation, taking into account the sustainability and inclusiveness of these value chains. A value chain refers to the sequence of production processes from the primary production to its end uses. It is a system of different types of actors orientated towards the markets (farmers, collectors, processors, wholesalers, retailers). VCA4D uses a common data collection and analysis approach to study different commodities in different countries. This approach includes a functional analysis that provides a general description of the value chain, a detailed economic-financial diagnosis of its different stages, an analysis of its governance structure, a social analysis, and an environmental analysis. The purpose is to provide decision makers with evidence-based information to support inclusive and sustainable development strategies.

3.2. Methodology

In our assessment of the relationship between farm structure and value chain organization, we use a mixed-methods approach. The stratification of primary production for different types of farm households is based on the VCA4D functional analysis. For each value chain a different farm classification system has been developed, and therefore it is difficult to make comparisons between countries and even commodities. We maintain the small – medium – large continuum in terms of farm size and production volume, but rely on aggregate value added for comparative purposes. Particular attention is given to the midsize farms (between 3 and 20 ha) and large farms (> 20 ha) that are using large amounts of wage labour and produce a sizeable commercial surplus.

We rely on an analytical framework (see Figure 4) to understand the differentiation in farm size (primary production) and firm size (midstream trade and processing) that is shaped by country-level enabling conditions (population growth, urbanization, economic development and trade orientation) and by commodity-system characteristics (such as factor intensity, contracting framework and output market requirements). We also identify how the farm-firm linkages lead to differences in performance outcomes.

Figure 4: Analytical framework for analysing VC interactions



We start with a preliminary analysis of the value added structure for the production of different agri-food commodities in sub-Saharan countries. These competitive relationships on markets are related to different contextual factors (socio-economics and demographics) that influence factor intensity in production. Finally, we assess at cross-country level the possible association between farm size distribution with the importance of value added creation in midstream segments of the value chain.

We compare in more detail the production structure of labour-intensive commodities (maize in Zambia and Nigeria; sorghum in Ghana)) and more capital-intensive commodities (green beans in Kenya; cotton in Ethiopia; aquaculture Zambia) in order to identify major opportunities and constraints for engagement of smallholders into more remunerative market segments.

3.3. Description of selected value chains

From the VCA4D project portfolio, we select 8 studies that cover different categories of products and production systems in Sub-Saharan Africa (see References). The selection of cases from the Sub-Saharan region allows us to control, to some extent, for some contextual variation. This should enable us to compare the importance of some 'typical' farm-firm relationship in VC for different categories of products.

We focus on a set of eight value chains where secondary information is available about global farm size structure and market organization, and arrive at the following sample:

- Green beans in Kenya: involves primary production by some 20.000 scattered smallholders delivering on spot markets and 32.000 mid-size family farmers delivering green beans on contract, alongside some 60 large farms that control 45% of market deliveries. This bimodal production structure is linked to a marketing structure where a few packhouses and canning factories control 90% of all processing and sales. Half of the production is exported as fresh or canned beans, whereas 40% is rejected and remains for domestic consumption and 10% is lost and used for animal feed and compost.

- Maize in Zambia: production of the dominant food staple happens mainly by some 360.000 semi-subsistence smallholders and close to 1 million commercial family farms with different degrees of input intensification and market orientation. Nearly half of production is locally consumed (partial commercialization) and the other half is processed into flour. Trade is dominated by local aggregators and larger traders, and processing by local brewers and industrial millers. Most maize is traded through spot market exchange alongside, but a few large farms are vertically integrated with animal production. Public subsidies for fertilizer and seed (the so-called Food Security Pack) are used to control production costs and reduce prices. Low downstream efficiency and limited profitability are combined with acceptable margins in trade and (larger scale) processing.

- Maize in Nigeria: half of the maize is produced by more than 2.5 million local smallholders and the other half is divided between some 350.000 more commercially-oriented small- and midsize farms and a few (very) large farms. Employment in maize sector is estimated at 23 million of jobs (mainly self-employment), of which 10% in midstream activities. The maize market is divided between informal and formal segments: most smallholder maize is consumed locally, whereas midsize and large farms supply maize to larger (peri-)urban markets in the South. Postharvest losses are high (15%) and half of domestic production is used for feed milling and food

processing. Margins in production and processing are attractive, but trade margins are thin due to high competition.

- Sorghum in Ghana: some 175.000 low-input smallholders and 47.000 more technically advanced smallholders are responsible for 98% of all sorghum production. One-third of output is locally consumed, and post-harvest losses are 12%. From the marketed surplus, 80% is used by local micro-brewers and 15% by industrial brewers. This smallholder-dominated production structure is linked to a rather decentralized midstream trader and processor organization with low entry costs and very lucrative margins.

- Groundnut in Ghana: primary production is dominated by 375.000 family farmers that produce about 90% of output, complemented by some 28.500 small- and midsize producers that deliver the remainder under contracts with buyers. Market orientation is diversified, including informal and formal aggregators and a whole range of different processors (paste, flour, kulikuli, snacks). The groundnut value chain offers employment to some 440.000 self-employed and 350.000 wage workers, but wages are far below living income standards. Women play a key role in production, trade and processing. The informal value chain with a large number of SMEs accounts for 88% of all processing activities.

- Cocoa in Cameroon: mixed production structure dominated by 200.000 smallholders producing 70% of output that is sold at local spot-markets alongside 90.000 family farmers producing the remainder under contract conditions. Production involves some 100.000 seasonal workers. Aggregation is divided between 1500 local intermediaries and organized cooperatives that control 40% of production, of which 1/3 is certified. There are 3 local processing plants that buy 22% of production (processed into butter and paste) and 6 large multinationals that control major share of exports. Main profits are realized by export traders, while cocoa VC also remains important for fiscal levies.

- Cotton in Ethiopia: production is divided between 7.000 traditional and 19.000 semi-modernized family farms, and a few very large commercial farms that use irrigation and modern inputs and control 2/3 of the land and the value added. The traditional cotton sector generates 60.000 self-employed jobs, whereas in the modern sector 40.000 jobs are created. Local spinning and traditional weaving are gradually replaced by industrial ginneries and spinning mills, as well as several medium- and large size oil processing mills. The development of cotton is promoted by government to substitute imports and eventually to promote exports, but high production costs and low value chain efficiency remain important constraints.

- Aquaculture in Zambia: production is divided between 1.100 semi-subsistence artisanal farms, 850 small-scale commercial farms and some 30 specialized medium and large pond and cage farms that control almost 75% of total production and 90% of value added. Fish production and consumption has been growing fast, partly also by imports. There are important backward linkages to hatcheries and feed industry. While local sales at wet markets is mainly done through a large number of women retailers (city ladies), the farmed fish is controlled by one wholesaler that buys fish under contracts and distributed to supermarkets and dedicated stores.

4. Farm size structures in eight agri-food value chains in Sub-Saharan Africa

4.1. Farm typology

Each VCA4D report provides a farm typology which is commodity-specific. Foremost, this typology is based on farm size (small, medium, or large). Often this is combined with other farm characteristics, such as market orientation (subsistence, commercial, or mixed), marketing channel (e.g., spot market, contract farming, aggregator) or the production system (e.g., use of external inputs, pond vs. cage aquaculture, irrigated or rain-fed agriculture, etc.). The farm size categories—small, medium, and large—are country- and commodity-specific. Each farm type has an estimated farm size based on observed "model" farmers considered representative for this farm type.

Table 3: Farm-size typology for each agri-food value chain

Country	Commodity	Farm type	Average farm size (ha)	Number of farmers	
				#	%
Kenya	Green beans	1. Small-scale (spot market)	0.1	19664	38%
		2. Small-scale (linked)	0.1	32397	62%
		3. Large-scale	50	61	0%
Zambia	Maize	1. Small-scale (low input use)	0.8	362885	25%
		2. Small-scale (medium input use)	0.9	742590	52%
		3. Small-scale (high input use)	2.4	325451	23%
		4. Medium-scale (rainfed)	18.8	1500	0%
		5. Large-scale (irrigated)	100	100	0%
Nigeria	Maize	1. Small-scale (spot-market)	1.5	2440600	87%
		2. Small-scale (linked)	3.5	281600	10%
		3. Medium-scale	9.4	72600	3%
		4. Large-scale	100	3500	0%
Ghana	Sorghum	1. Small-scale (low inputs)	1.5	173140	78%
		2. Small-scale (high inputs)	2.5	47180	21%
		3. Medium-scale	5.6	350	0%
		4. Large-scale	106.3	4	0%
Ghana	Groundnut	1. Small-scale (spot-market)	0.76	374089	93%
		2. Small-scale (linked)	0.96	27337	7%
		3. Medium-scale	3.12	1224	0%
Cameroon	Cocoa	1. Small-scale (shadow, spot-market)	1.5	200000	68%
		2. Small-scale (shadow, linked)	2.5	45000	15%
		3. Small-scale (sun, linked)	3	45000	15%
		4. Medium-scale	12	3000	1%
		5. Large-scale	25	300	0%
Ethiopia	Cotton	1. Small scale (traditional)	0.5	7000	27%
		2. Small scale (modern)	0.8	19000	73%
		3. Large-scale	403.5	90	0%
Zambia	Aquaculture	1. Small-scale (pond, semi-subsistence)	0.1	1100	55%
		2. Small-scale (pond, commercial)	0.5	853	43%
		3. Medium-scale (pond)	18.8	7	0%
		4. Large-scale (pond)	31.3	13	1%
		5. Large-scale (cage)	N/A	12	1%

Table 3 gives an overview of the farm typologies used in the eight selected value chains.[1] The farm types are ordered by farm size. Following these farm types, we uniformed into three farm size classes into: small-scale as between 0 and 3 hectares, medium scale as between 3 and 20 hectares, and large-scale as above 20 hectares. This categorisation works for all eight commodities. However, within each size-category there is a lot of variation in average farm size. The average "large-scale farm" in the cocoa sector of Cameroon has 25 hectares, for example, while the average "large-scale" farm in the cotton sector of Ethiopia has over 400 hectares.

Looking at the number of farmers, there is an absolute dominance of small-scale farmers in all eight value chains. Medium and large-scale farmers constitute (much) less than 1% of the total number of farms in green beans in Kenya, Maize in Zambia, and Sorghum in Ghana. In the other value chains medium and large-scale farmers constitute between 1% and 3% of the total number of farmers. Cotton production in Ethiopia and aquaculture in Zambia have a relative large segment of more modern and commercial smallholder farmers.

4.2. Farm size and contributions to marketed value added

The contribution of these differently sized farms to total production value is, however, unequal (see Figure 5). Production value is computed as the product of estimated aggregate quantity produced by each farm type and the estimated average price received. While small-scale farms are also dominant in terms of their contribution to production value for sorghum and groundnut in Ghana, cocoa in Cameroon, and maize in Zambia, a more mixed production structure emerges for the other commodities. For maize in Nigeria and green beans in Kenya, there is more balance between small-scale farmers on the one hand, and medium- and large-scale farmers on the other. For cotton in Ethiopia and aquaculture in Zambia, the production structure is fully flipped when we look at the contribution to total production: even though large-scale farms constitute only a small part of the total number of farms in those sectors, they contribute a (large) majority to total production.

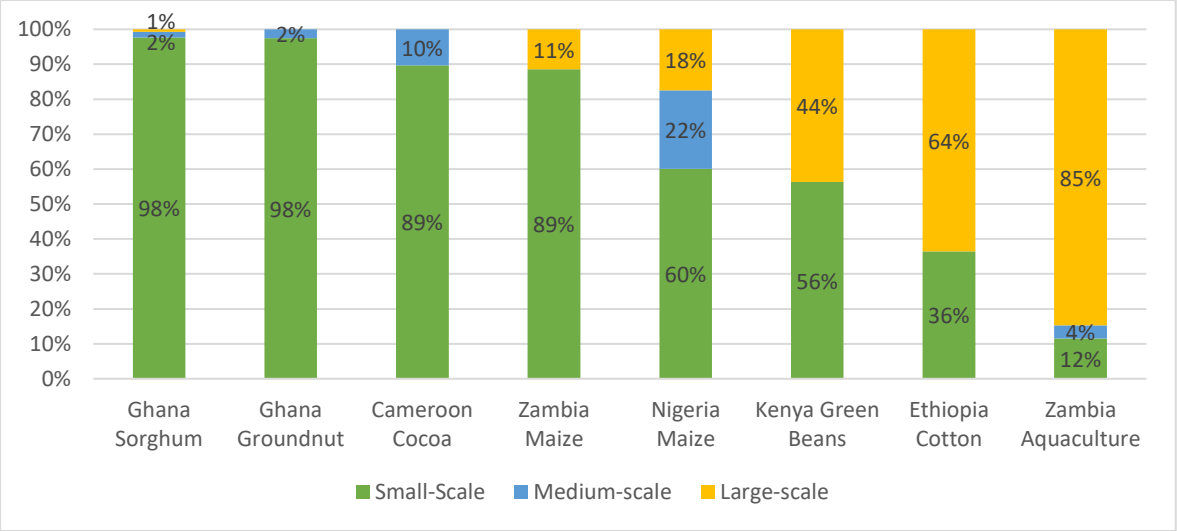


Figure 5: Contribution of different farm size categories to total production value.

[1] The names of the farm types are adjusted by the authors to create more uniformity.

The inequality in the production structure is further illustrated by Figure 6, which shows estimated inequality curves for the eight value chains. Each curve illustrates what percentage of total production value is produced by what share of the farmer population, ranking farm types from smallest to largest contribution. The dashed line is a situation with perfectly uniform production structures: every farmer producing the same amount. The figure illustrates the extent to which each value chain deviates from this uniformity. This inequality is captured by the Gini-coefficient, which is the area between the dashed line and the value chain-specific curves divided by 0.5 (the maximum area).[2] The highest inequality in the large-farm-dominated production structures can be found in aquaculture in Zambia and cotton in Ethiopia, with Gini-coefficients of 0.89 and 0.69, respectively. The most uniform are groundnut (Gini=0.06) and sorghum (Gini=0.22) in Ghana. The Gini-coefficients for the other commodities—maize, green beans, and cocoa—fall within the narrow range of 0.44-0.50.

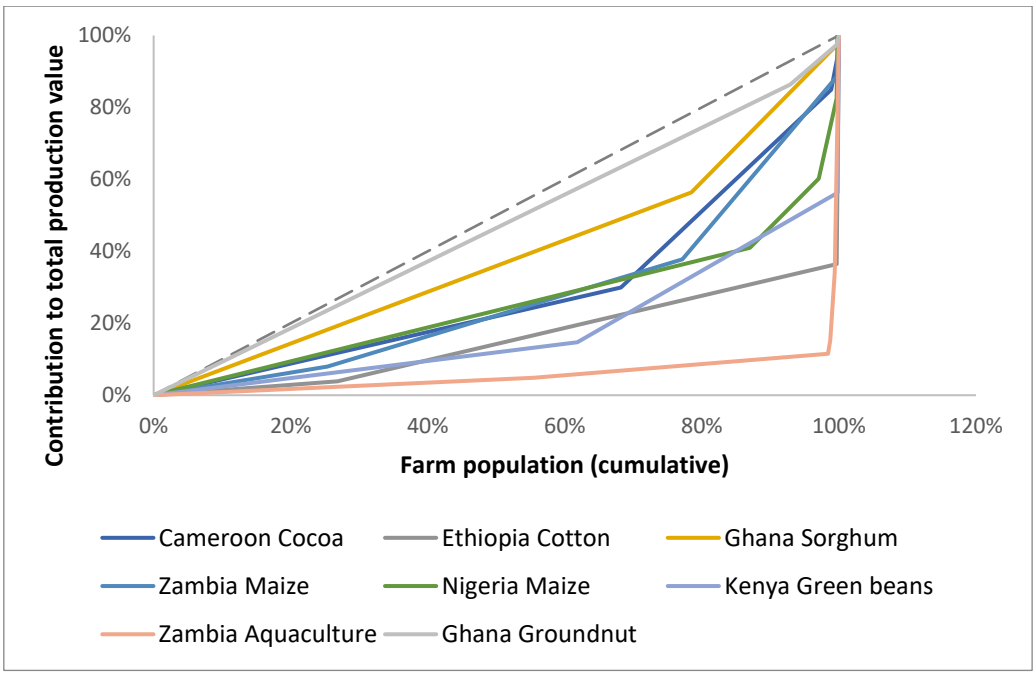


Figure 6: Inequality in contribution to production.

We can extend this analysis by looking at the marketed value added (see Figure 7). Marketed value added is defined as the percentage of production sold (production value minus value of inputs) times the share of the harvest sold. This indicator takes into account that smaller farmers tend to sell a smaller share of their harvest and consume a larger part themselves. By looking at value added, it also takes into account that some farm types might be more input intensive and have a lower net-contribution to total value added by the farm sector.

[2] The Gini coefficient is calculated by ranking the farm types based on farm size as indicated in Table 3 and calculating the cumulative share of each farm type in terms of the number of farmers and total production value (average price * total production). We plot these points in a graph and calculate the area below the graph. We divide this by the area below the dashed line (0.5).

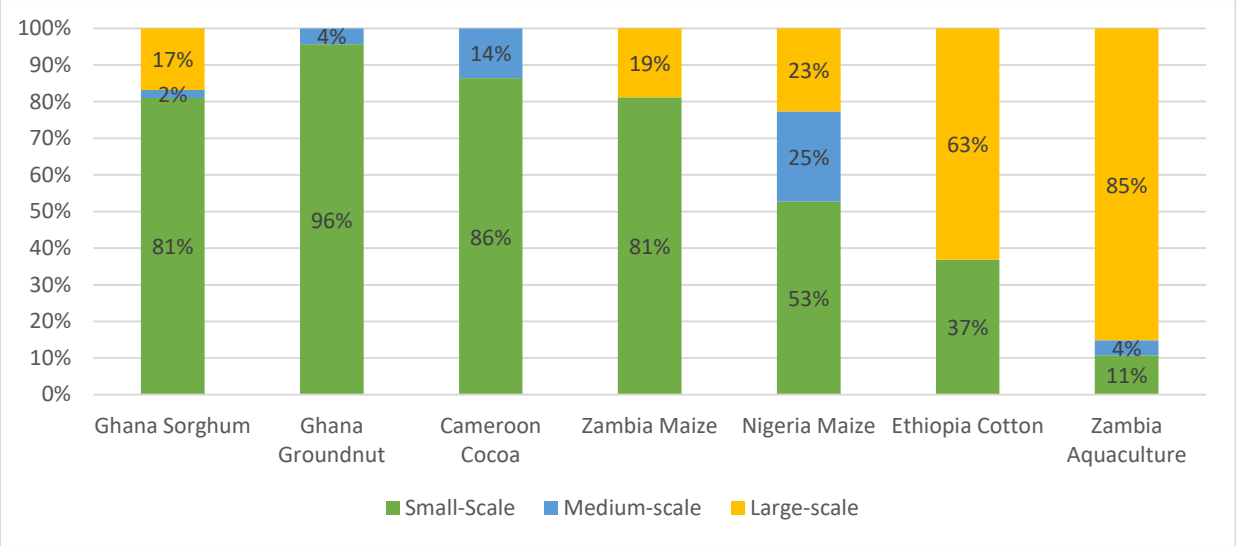


Figure 7: Contribution of different farm size categories to marketed value added.

Figure 7 shows that the contribution of medium- and large-scale farmers to marketed value added is higher than their contribution to total production in all sectors except for cotton in Ethiopia. This is most apparent for sorghum and groundnut in Ghana, for which the relative increase is sixfold and two-fold, respectively. For cash crops, such as cotton and cocoa, there is less of a shift, as these crops are not consumed by farm households.

Based on the analysis in this section, we can identify three types of product-market combinations:

A) **smallholder-based** agri-food production that is delivered at regional and (inter)national markets under rather limited processing requirements. Farmers are not fully specialized, rely on market exchange with multiple traders and also engage in off-farm employment. Typical examples are sorghum and groundnut systems in Ghana and the smallholder cocoa systems in Cameroon.

B) **balanced bimodal** agri-food production that includes both smallholders and medium-scale or large-scale farmers directed at urban markets and exports. Farmers are mostly devoted to commercial production and maintain verbal commitments or contractual relationships with upstream or downstream supply chain partners. This system is typical for maize production in Zambia and Nigeria and green beans in Kenya.

C) **large-scale dominated** agri-food systems that are fairly resource-intensive and are directed at multiple market outlets. Access to resources is fairly segmented and farmers are more specialized and dependent on market sales. Typical examples are found in the cotton production in Ethiopia and the aquaculture in Zambia.

4.3. Farm size and downstream value chain organization

Looking at the descriptions of the dominant downstream value chains for each farm-size (Table 4), we see a further bifurcation. Smallholders produce more for own consumption and are more likely to sell for, less remunerative, rural markets, either through direct sales or via small traders/processors. Medium-scale and large-scale farmers tend to participate in more formal relationships with, more remunerative, wholesalers targeting urban markets, large-scale industrial processors (e.g., breweries, millers, packers), exporters, and supermarkets. While medium-scale farmers typically use a wholesaler to reach these markets, large-scale

farms are able to reach those destinations directly. Green bean production in Kenya and cocoa production in Cameroon are important exceptions, with smallholders engaged in production for export markets. In the case of Kenya, this is realized through outgrower schemes (contract farming), while in the case of Cameroon smallholders are integrated in export markets through cooperatives.

Table 4: Dominant downstream value chain by farm-size typology.

Country	Commodity	Dominant downstream value chain by farm size		
		Small-scale	Medium-scale	Large-scale
Ghana	Groundnut	-> aggregators (informal) -> processors -> retailers	-> aggregators (formal) -> processors -> Supermarket and export	
Ghana	Sorghum	-> rural markets	-> aggregators -> wholesalers -> processors -> urban markets	
Cameroon	Cocoa	-> traders / cooperatives -> exporters	-> cooperatives -> exporters	-> exporters (direct)
Zambia	Maize	-> traders -> processors (small) -> rural markets	-> traders -> processors (large) -> urban markets	-> traders -> processors (large) -> urban markets
Nigeria	Maize	-> rural markets	-> aggregators -> processors -> urban consumers	-> aggregators -> processors -> urban consumers + feed markets.
Kenya	Green beans	-> processors (via contracts) -> export		-> processors -> export
Zambia	Aquaculture	-> rural markets	-> wholesalers -> urban markets	- >wholesalers -> urban markets
Ethiopia	Cotton	-> traders -> processors		-> processors (direct)

We look at the implications of these differences in production-market relationships in three ‘typical’ configurations using Sankey diagram for illustrating commodity flows. As shown in Figure 8, these material flows are structured in a rather distinct manner for smallholder-based value chains (sorghum in Ghana), bimodal value chain systems (green beans in Kenya) and large-scale dominated value chains (cotton in Ethiopia).

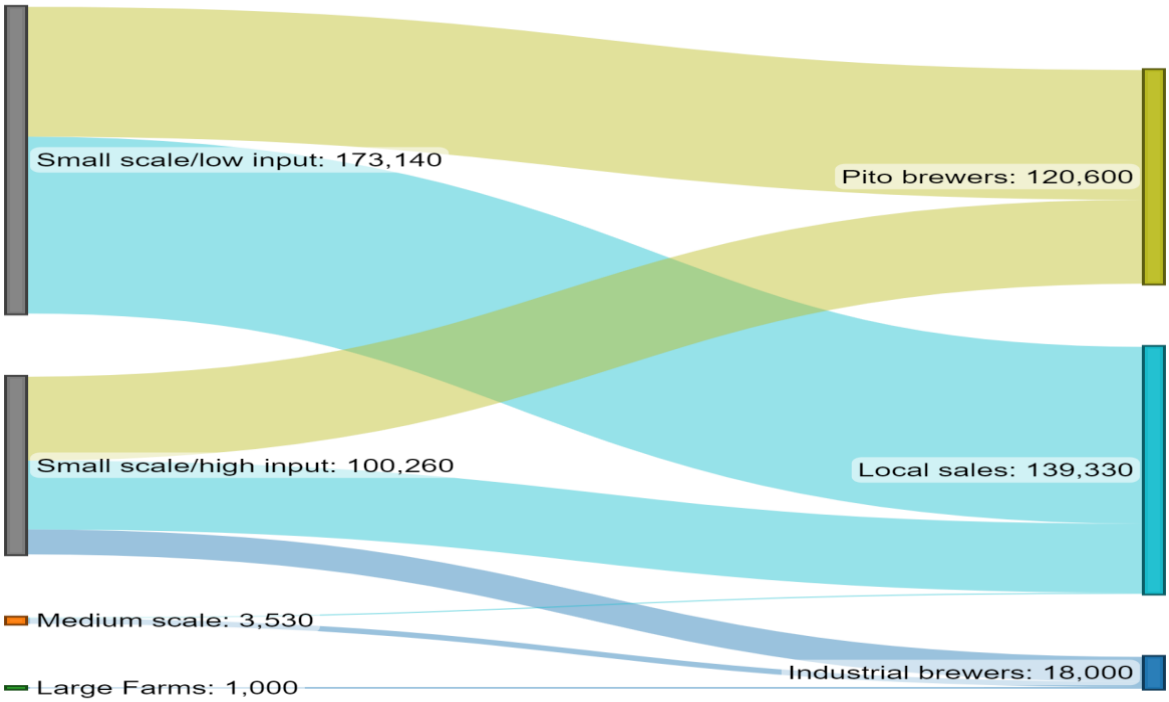
In the sorghum value chain in Ghana, scattered smallholder-based production meets its counterpart in very decentralised local processing and sales to local outlets. Average traded volumes are limited while competition is strong (due to low entry costs), leading to relatively small margins. In the green beans value chain in Kenya, smallholders working without and with delivery contracts deliver products to both export and domestic markets. Large farms are

mainly export-oriented (of fresh, canned and frozen beans), but their sub-standard products are sold locally.

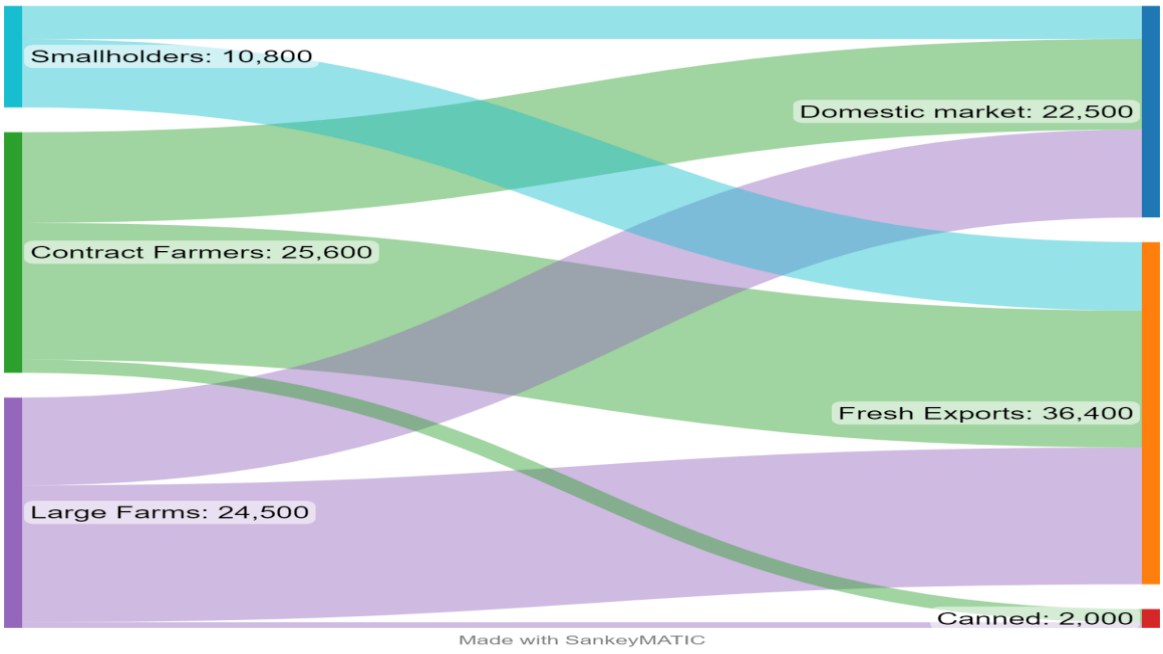
The cotton sector in Ethiopia is dominated by a few commercial farms that are linked through middlemen with a cluster of industrial spinners and cottonseed processors. Traditional farmers are only linked to local outlets. These two market segments coexist but hardly interact, mainly due to large differences in scale of operations and investment requirement.

Figure 8: Sankey diagrams for typical agri-food value chains

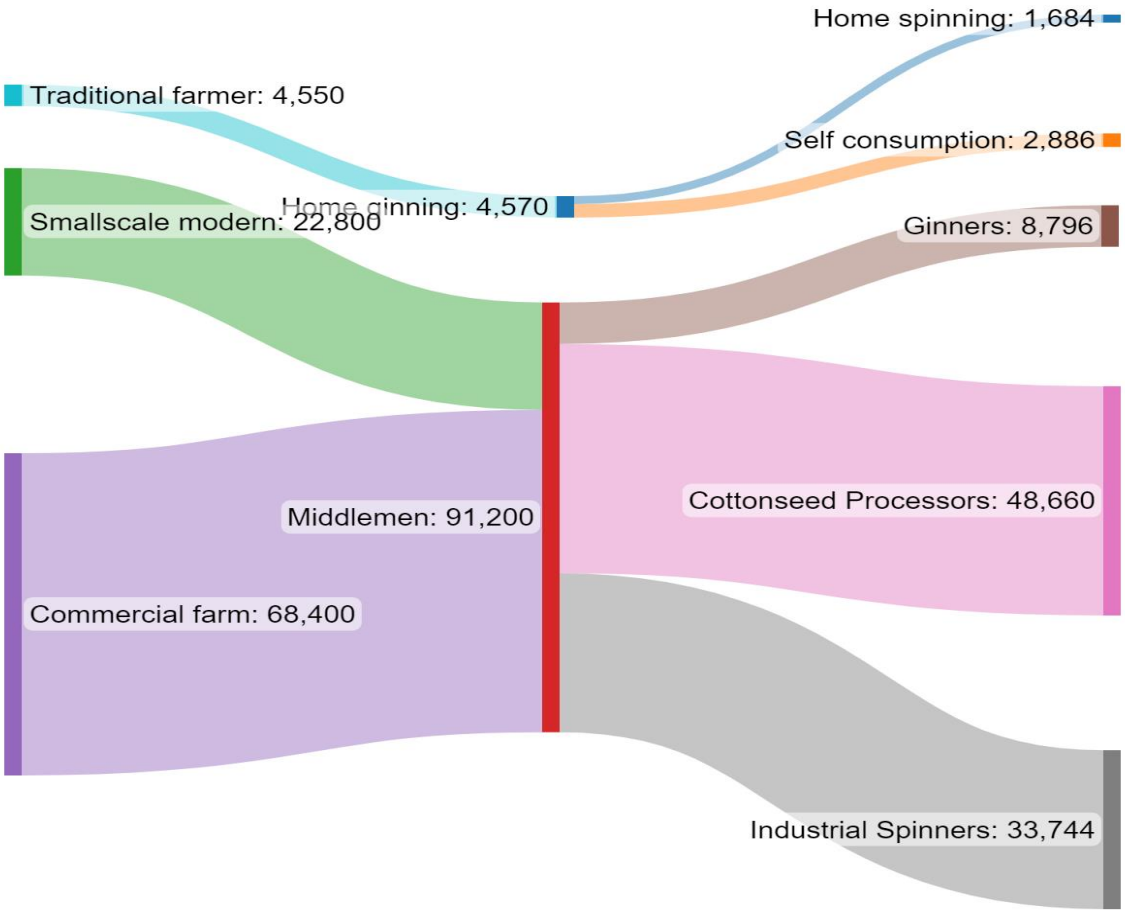
A. Smallholder-dominated value chain (sorghum in Ghana)



B. Bimodal value chain structure (green beans in Kenya)



C. Large-scale dominated value chain (cotton in Ethiopia)



5. Explanatory comparative analysis: Linkages between farm stratification and input and output markets

What explains these different production structures? In this section, we use the VCA4D data to test the following hypotheses:

a) Differences in population structure and socio-economic conditions influence farm size structure (Timmer & Akkus, 2008):
    - Population growth and urbanization tend to increase smallholder production and may reduce poverty;
    - Economic growth and market development favour midsize and larger farmers.

b) Differences in factor intensity explains farm size structure (and lead to differences in factor productivity)
    - High capital intensity disadvantages small-scale farmers;
    - High labour intensity favour small-scale farmers;
    - High intensity of intermediate services and goods used in the production process favour larger farmers.

c) The stage of value chain transformation explains farm size structure (see Barrett et al., 2022, Swinnen and Kuijpers 2020) :
    - Higher requirements for quality and food safety and related transaction costs favour mid-size and large farmers
    - More value-added creation in the mid-stream segment favours reliance on mid- and large-scale farmers.

5.1. Demography and socio-economic development

We expect that several country-level variables influence the production structure and market relationships. Demographic variables like population growth and urbanization level shape the market demand for domestic agri-food commodities and also influence future labour endowments for local production. Larger population growth is expected to enhance smallholder subdivision (fragmentation), whereas higher urbanization favours more commercially-oriented midsize producers.

Economic growth trends are an important indicator for the dynamics of the national economy, while poverty rates reflect the (lack of) inclusiveness of the growth process. Higher economic growth supports investments by midsize and large producers, whereas high poverty rates tend to conserve smallholder production as a safeguard against deprivation. Finally, more export-oriented economies that maintain global competitive relationships favour foreign investment and contract farming arrangements.

As shown in Table 5, Eastern African countries (Ethiopia, Kenya and - to a lesser extent - Zambia) have lower levels of urbanization and considerable poverty that create conditions for more smallholder-dominated agri-food production structures, even for export commodities like green beans. On the other hand, in Ghana (sorghum) and Cameroon (cocoa) the urban share of population already exceeds 50 % and poverty has substantially decreased, partly due to more market-oriented economic policies that favour midsize producers. Nigeria remains a special case with an extremely high poverty (especially in the Northern regions) but strong internal market development – trade between the Northern production regions and the

Southern consumption centres - that create conditions for a fairly balanced production structure combined with a more competitive marketing structure.

Table 5: Global forces influencing farm and firm size differentiation.

Source: World Bank and IMF

Country	Commodity	Population growth (2020)	Urbanization rate (%)	Poverty rate (2020)	Economic growth (2010-15)
Ghana	Groundnut	2.1	57	24	7.9
	Sorghum	2.1	57	24	7.9
Cameroon	Cocoa	2.6	58	30	4.8
Zambia	Maize	2.9	45	54	6.0
Nigeria	Maize	2.5	52	70	5.8
Kenya	Green beans	2.3	28	36	6.0
Zambia	Aquaculture	2.9	45	54	6.0
Ethiopia	Cotton	2.5	22	30	10.2

Further analysis of the relationships of structural transformation processes with differences in farm fragmentation (using the Gini coefficient as an indicator) and in market orientation (using the midstream share in VC total value added) reveals that production concentration and market integration are generally moving in a similar direction (see Table 5 and Annex 2). Within the demographic factors, urbanization has a larger impact on farm size concentration and market integration than population growth. In a similar vein, economic growth only shows marginal effects on farm production and market structure, but poverty reduction is clearly associated with more commercial farming and stronger market orientation. This is likely to be related to the increase in rural wage labour (with higher remunerations than subsistence farming) and the generation of renumerated employment in agri-food processing and trade.

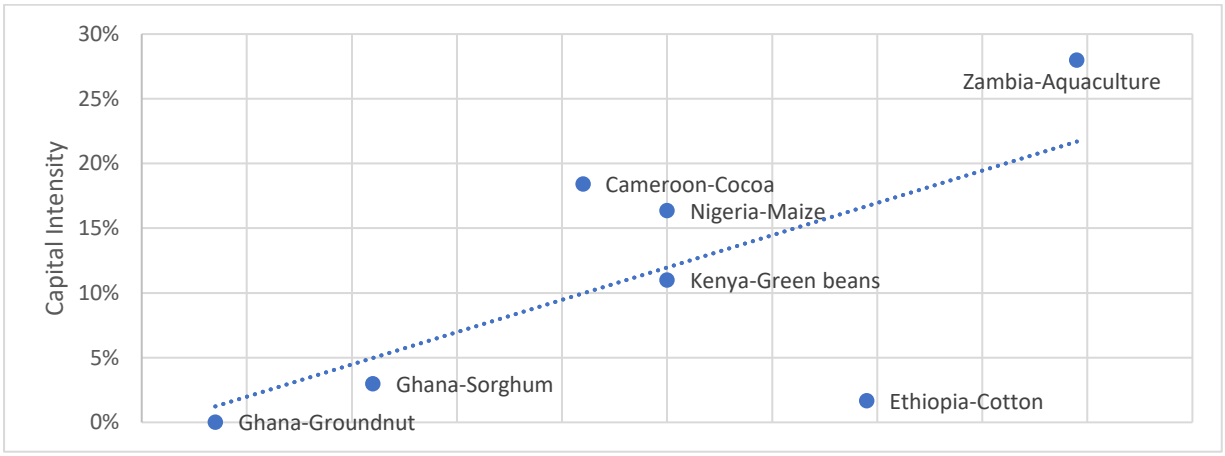
5.2. Factor- and input-intensity

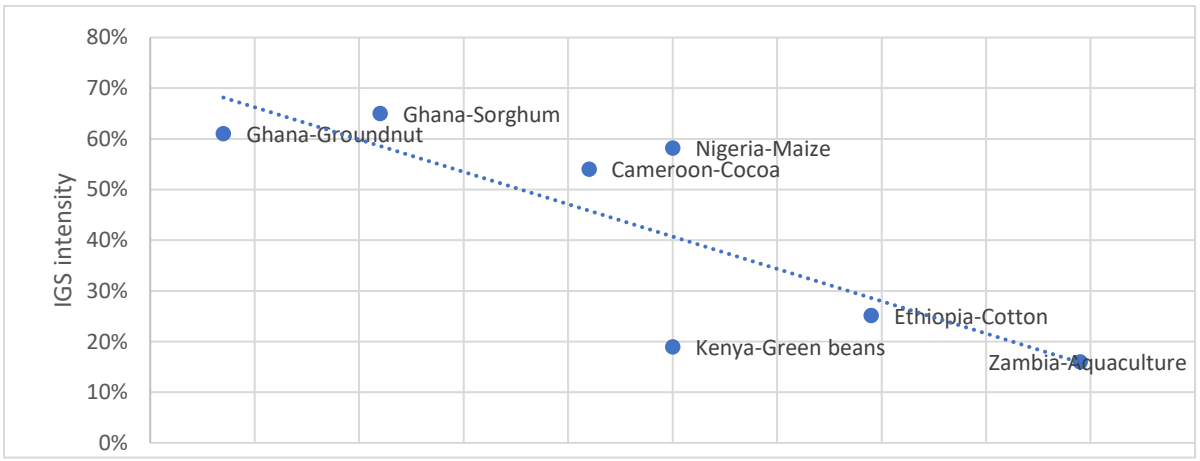
Following the literature review in Section 2, we expect small-scale farmers to have a competitive advantage over medium-scale and large-scale farmers if the production process is labour intensive, because family farms can access (cheap) family labour and have low labour supervision costs. Vice versa, we expect medium- and large-scale farmers to have a competitive advantage over small-scale farmers if the production process is capital and input intensive, because of better access to credit and input markets as a result of lower average transaction costs derived from economies of scale.

We test these hypotheses by conducting a cross-sectional analysis of the relationship between production structure (proxied by the Gini-ratio) and the intensity of capital, intermediate inputs, and labour in the production process. Capital intensity is estimated by the ratio between depreciation costs and total value added. Labour intensity is estimated by the ratio between hired labour costs (wages) and total value added. Since consistent data for family labour use are not available, the labour intensity will be substantially higher and labour productivity lower.

Intermediate inputs intensity is estimated by the ratio between intermediate goods and services costs and total value added.[3]

Figure 9 presents three scatter plots and the corresponding linearly fitted lines for each of three production inputs considered: capital, intermediate inputs, and labour. The figure provides evidence in support of our hypotheses regarding capital and labour intensity. Indeed, we find a positive cross-sectional relationship between capital intensity and the Gini-ratio, and a negative relationship between labour intensity and the Gini-ratio. Obviously, the direction of causation is unclear. While our theory is about how factor intensity for specific products determines whether larger or smaller farmers are more competitive, the causation is also expected to go in the other direction: prevailing farm structure might impact (average) optimal factor intensity. This would imply that changes in factor use might be an important outcome of the farm stratification process (see Section 6).





[33] Input intensity can be higher than 100% as the value added is what remains after deducting the costs for intermediate inputs and service from the total revenue generated.

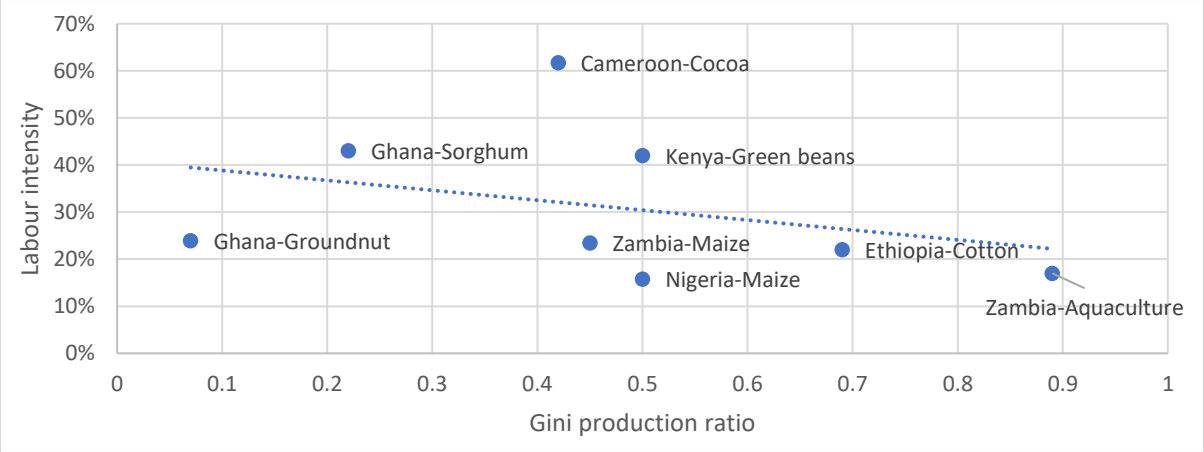


Figure 9: Farm size distribution (Gini ratio) and factor intensity.

Surprisingly, we find no evidence for a positive relationship between the Gini-ratio and input intensity. In fact, we find evidence that this is a negative relationship. This may be related to credit constraints or imperfections on input markets (as outlined by de Janvry et al., 1991).

5.3. Output markets and value chain structure

Figure 10 shows the relationship between the farm size structure (using the Gini ratio as indicator for relative inequality) and the importance of midstream firms (expressed as the share of value added realized in the post-harvest stage). A larger value added share generated outside primary production is associated with a more balanced farm size distribution (Gini < 0.3) with a greater role for midsize farmers. When the role of midstream agents in value added production is lower, smallholder farms dominate and farm size inequality is higher (Gini > 0.6). There are several countries and commodities with a rather mixed farm size distribution and a balanced share of midstream value added generation (see Annex 1).

This general picture may indicate that development of input and output markets (increasing the midstream VA) could be a helpful strategy to support a more equitable farm size distribution (although, again, we have no proof of causality). Smallholder farms dominate the production and marketing of many staple food crops (maize, sorghum, groundnut) that are used both for local consumption and (peri-)urban processing. Midsize farms dominate the production of highly commercial activities such as aquaculture (Zambia) and cotton (Ethiopia). Cocoa appears as a typical case of a smallholder-dominated crop with high commercialization rates where total value added is equally distributed between the production and the commercialization/processing stage.

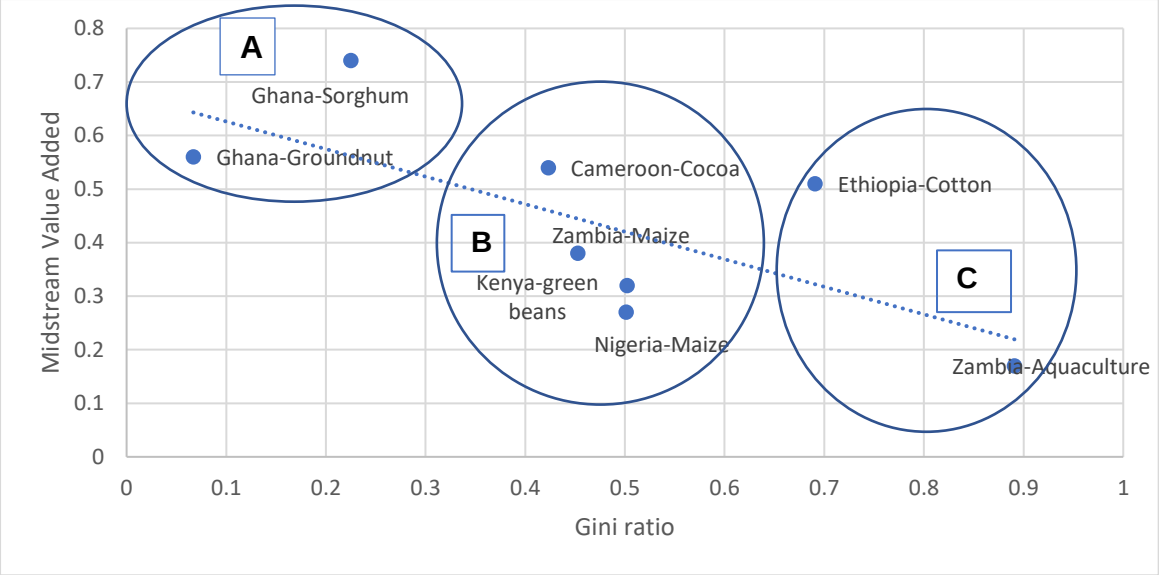


Figure 10: Farm size distribution (Gini ratio) and midstream value added share (%)

This pattern roughly confirms the finding by Liverpool-Tasie et al. (2020); that midstream firms are critical for providing key services (i.e. input supply, technical assistance, service contracts, etc.) to smallholder producers. Consequently, efforts to develop midstream enterprise activities are generally supportive to small-scale (commercially-oriented) producers.

6. Implications for agri-food sector dynamics

The before-outlined differences in farm stratification (at the production side) and value chain integration (at the market side) are expected to create conditions for diverging patterns of rural and agricultural development.

6.1. Differential impacts

The uni- or bimodal organization of production is intrinsically related to differences in factor intensity and market orientation (as shown in Section 5) and therefore provides specific opportunities for rural (factor) income distribution, knowledge exchange and technology development, for logistics integration and price competition, and for the generation of employment with (decent) incomes. These are explored further below.

Factor productivity

The farm size structure and production development at the supply side follows different patterns, ranging from smallholder-based to large farms-dominated systems. In a similar vein, different degrees of value chain integration are distinguished at the demand side, ranging from production-oriented towards midstream-focussed market dynamics. These differences are reflected for particular commodities and within particular countries in diverging patterns of the farm size-productivity distribution (see Annex 3). Only in cocoa production (Cameroon) and cotton production (Ethiopia), the inverse relationship between farm size and land productivity is confirmed (declining returns to scale). The production of aquaculture, sorghum and maize shows higher land productivity on large farms with limited effects for labour productivity. In green beans (Kenya), midsize farms show to have superior land productivity. An increase in

the number of medium-scale and large-scale farmers would therefore be expected to have a positive effect on land productivity.

The relationship between farm size on labour productivity seems less clear: The correlation seems generally weaker than for land productivity and the direction of the relationship varies strongly between products. While we see a somewhat positive relationship between land size and labour productivity for sorghum and cotton, we see a negative relationship for cocoa. For green beans and maize in Nigeria, the relationship seems to be non-linear with mid-size green bean farmers showing the highest labour productivity, while mid-size maize farmers showing lower labour productivity compared to both smaller and larger farmers.

Input use and Technology development

There are important differences in capital requirements and intermediate inputs use (see Section 5) that have implication for the diffusion of technologies between farms and marketing firms. Large-scale systems rely on more resource-intensive technologies and therefore need good access to input markets to enable further development. Smallholder-based systems tend to rely on low-input technologies that face productivity constraints. Bimodal systems can take advantage of technological possibilities (especially in processing) that also pay off in terms of production, especially when intermediate cooperative organizations are in place. A shift towards medium and large farm-sizes can particularly be expected to lead to a higher demand for labour saving technologies, including mechanization (Jayne et al., 2016) and thus may have an important effect for rural employment.

Employment and Incomes

Smallholder-oriented value chains systems offer wide opportunities for rural self-employment in small-scale production and local informal market exchange but create only limited employment in non-farm- and off-farm activities. More than 80% of employment in the SSA agri-food sector can be considered as informal (Mekonnen et al., 2022). The opposite holds for commercial large-scale value chains that generates higher incomes for permanent wage labourers and also provide opportunities for female (self-)employment in processing activities. The bimodal value chain also creates space for rural off-farm employment and female entrepreneurship but mostly in collection and trade, while processing remains rather basic. This may imply that – contrary to expectations – certain degree of bifurcation in production and marketing could provide some positive effects for rural employment and poverty reduction.

Market integration and Competition

More commercial value chains oriented towards local/regional markets usually have low entry costs and therefore high market competition. This is particularly the case at output markets, since credit availability remains restricted and therefore input markets (for seeds, fertilizers and packaging materials like bags) show oligopolistic characteristics. Marketing networks for large-scale oriented value chains need more developed logistics systems and trade and processing are fairly concentrated and permit limited price competition. Bimodal value chains have a high degree of market integration combined with limited price competition due to either contractual arrangements (green beans, cocoa) or pre-finance commitments (maize).

Knowledge & Information exchange

Exchange of knowledge and information has become a critical factor for supporting more inclusive and sustainable transformation processes. Information requirements in smallholder systems are fairly basic and horizontal exchange of knowledge is quite common. Knowledge and information for quality upgrading and food safety management become more important in

large-scale dominated commercial value chains where there are usually value chain leaders in charge of distribution of some critical specific inputs. Information exchange arrangements in bi-modal systems permit horizontal knowledge spillovers between farmers (i.e. distribution of best practices), but also include backward vertical linkages of standards imposed by processors on producers.

6.2 Implications for agricultural and structural transformation

This analysis of wider effects of different degrees of bifurcation in production and value chains for the sector development shows inclusive and sustainable development are not straightforward. It is very likely that trade-offs appear in rural and agricultural development outcomes during different stages of the transition from smallholder-based to bi-modal or large-scale dominated configurations. There are, however, important differences in the agri-food sector structure and organization that provide possible entry points for improving employment opportunities, investment and innovation options, and governance structures (see Table 6).

TABLE 6: Effects of farm/firm configurations on agricultural development

Type	Farm-firm configuration	Employment	Finance	Innovation	Technology	Governance
A	Smallholder-based	Self-employment	Short-term input loans	Local/Indigenous knowledge	Low-input	Associations
B	Balanced bimodal	Wage employment	Mixed portfolio	Product innovation	Mixed	Cooperatives
C	Large-scale dominated	Off/non-farm employment	Long-term fixed investments	Process innovation	High-input	Contracts

Smallholder-based configurations (Type A) are more diversified and strongly rely on self-employment, intermediary inputs and low-input indigenous technologies to compete with rather homogeneous products on local and regional markets. Bimodal regimes (Type B) include a mixed portfolio of activities and technologies that offer opportunities for product innovation and expansion of temporary and permanent wage employment. Large-scale systems (Type C) focus on more specialised products with more processing options for creating value added in downstream value chain segments.

The emergence of medium-sized and large-scale farms might offer opportunities for small-scale farmers but might also pose threats. On the one hand, smallholders might benefit if the emergence of larger farmers attracts investments in the non-farm stages of the value chain that would improve smallholder access to farm inputs, services and remunerative markets for agricultural products. Smallholders might also directly benefit from being in the proximity of medium and large-scale farmers as a result of knowledge spill overs (e.g., through demonstration effects or through employment (learning by doing)). Finally, in some cases, active and intentional cooperation between small and large-scale farmers is observed, such as in nucleus farmer-outgrower schemes where large well-resourced farms assist small farmers with services, farm inputs, or training and let them to use their marketing channels (see e.g., Hung Anh et al., 2019).

On the other hand, there are several channels through which small-scale farmers might be negatively affected by the emergence of larger-scale farm sector. Investments in larger scale farms might, for example, put downward pressure on prices as a result of increased supply

and competition. Small farmers might particularly be outcompeted on more remunerative market outlets that require compliance with high quality and food safety standards. Maertens and Swinnen (2009), for example, document a shift from smallholder contract farming to vertically integrated farming on large-scale plantations in the vegetable export sector in Senegal resulting from increasingly stringent GlobalGAP standards. Also, Schuster and Maertens (2013) conclude that the spread of private standards in the Peruvian asparagus export sector has led to decreased sourcing from smallholders and that certified companies source significantly less from smallholders than non-certified companies.

Small-sized farmers might also be affected through changing land markets if the large-scale farm sector emerges as a result of new non-local entrants (e.g., through national or international investments). Higher land prices resulting from increasing demand can have a differential effect on small farmers depending on whether they are stepping out or scaling up. Jayne et al (2014) estimate that a significant share of the available unused arable land in Ghana, Zambia, and Kenya is in the hands of non-local (national and international) investors, exacerbating land access constraints by smallholders. For those families stepping out of agriculture it does offer more opportunities to sell their land for a higher price, making this move more attractive.

To conclude, the emergence of medium and large-scale farms thus seems to be a key feature of agricultural transformation. The transition towards a bi-modal or large-scale dominated farm sector can boost agricultural productivity but, as such, can also be expected to be disruptive for the existing farm sector, resulting in winners and losers, depending on the type of product, smallholder characteristics, and the type of spillover effects on markets for farm inputs/services, farm output, and land.

The extent to which this transition is inclusive and can boost structural transformation will depend to a large extent on the employment creation in the farm and mid-stream segments of the value chain. Employment creation (hired labour) can particularly benefit the rural (and urban) landless poor and women and offers a pathway for smallholder farmers to leave the agricultural sector. Although, the evidence on the employment creation effects of bi-modal and large-scale dominated systems is scarce, evidence from the horticulture sector suggests these effects can be substantial. For example, the flower industry in Ethiopia employs 180.000 people of which 85% are women.[4] Moreover, the employment creation in the non-farm sector can also be substantial. Webber and Labaste (2010), for example, estimate that approximately 7.000 smallholders were involved in fresh vegetable export in Kenya, compared to 40.000-60.000 persons in the processing industry or as farm workers.

[4] According to the Ethiopian Horticulture Producer Exporter Association.

7. Discussion, Conclusions and Outlook

In this overview paper we used the empirical findings from production structure and value chain configurations in several sub-Saharan countries that were developed within the framework of the EU-Agrinatura program Value Chain Analysis for Development (VCA4D) to discuss and analyse how the structure of primary production ('farms') is linked to the organization of value chains ('firms').

We developed an analytical framework for assessing major causes for farm size differentiation, either based on (dis)economies of scale and scope or by strategies for intensification that enable further commercialization. For a long time, smallholder systems were highly efficient due to open access to land and relatively cheap family labour. The shift towards medium and large-scale farms that takes place in many sub-Saharan countries is strongly related to differential access to input and output markets that condition prospects for further intensification of agri-food production and processing. This creates additional value added value that will be captured by farms and firms. Market segmentation thus becomes a major underlying mechanism for farm differentiation.

Based on the VCA4D case studies, we were able to distinguish three different archetypes for farm-firm linkages (or product-market combinations) that range from smallholder production for local/regional staple food outlets to large-scale production for more differentiated urban and export markets. Country-level factors that might influence this trend are mainly related to progress in urbanization, economic growth patterns and market development due to poverty reduction. Crop-level differences offer particular opportunities for labour intensification in smallholder systems, while bimodal and large-scale systems rely more on input intensification.

The character and nature of interactions between farms and firms are difficult to grasp from cross-section data. We can hypothesize that in settings in an early stage of structural transformation and with a lower degree of market development, the farm size structure dominates the value chain interactions. Land reallocation is then required to support a more commercial family farm sector for further market integration. Bimodal systems with coexistence of different farm types emerge at intermediary stages of structural transformation and can be relatively stable as long as access to land, finance and more differentiated output markets remains guaranteed. Large-scale systems are associated to more industrial and urbanized societies that search for efficient procurement of agri-food commodities, offering (off/non-farm) employment in downstream segments of the value chain. Their dynamics is therefore primarily determined by the value chain organization that 'imposes' specific farming conditions (through standards and contracts).

The implications of this differentiation in farm size and market structures for socio-economic development deserve thorough attention. Opportunities for access to finance, generation of employment opportunities and participatory innovation systems are critical for inclusive and sustainable rural and agricultural development. Investment in building collateral for borrowing, enhancing professional schooling for young people, and exchange networks for knowledge sharing and diffusion of innovation could all contribute to pro-poor transition pathways.

Further understanding of the socio-economic effects of market incentives and institutional regimes for shaping the agri-food system farm & firm binomium is helpful for identifying an appropriate strategies for inclusive and balanced input intensification throughout the value chain. This requires deeper insights in the market and non-market interactions and the power relations (including bargaining) between production and market stakeholders that influence processes of exchange and income formation.

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He joined KIT Royal Tropical Institute in 2019 and broadened his expertise by working on topics such as international responsible conduct, integrated landscape approaches, and nature conservation. He has worked in/on Africa (Egypt, Ethiopia, Liberia, Mozambique, Rwanda, South-Africa, Tanzania, Uganda), Asia (Bangladesh, Indonesia), Latin America (Brazil), and the Caribbean. He has done research on a wide range of value chains and commodities, including aquaculture, dairy, cocoa, cereals (rice, wheat, barley, maize), palm oil, poultry, horticulture, soy, beans, and plantains (matooke). [r.kuijpers@kit.nl]

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ANNEX 1

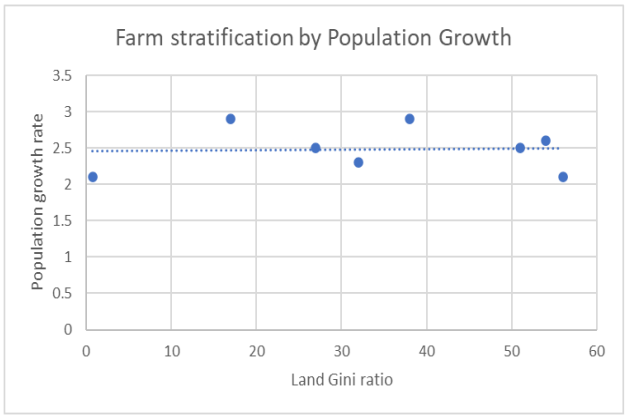
TABLE A1: Comparison of agri-food farm & firm structures

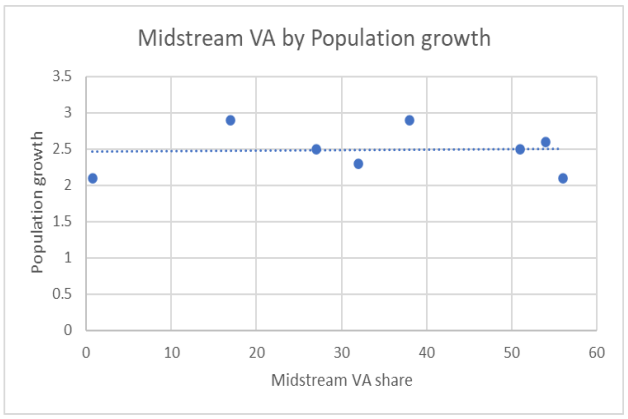
Country	Commodity	Average farm size (ha)	Gini ratio	Share VA Agricultural Farms (%)	Share VA midstream Firms (%)
Ghana	Groundnut	0.78	0.07	56	44
Ghana	Sorghum	1.75	0.22	74	26
Cameroon	Cocoa	2.02	0.42	54	46
Zambia	Maize	1.25	0.45	38	62
Nigeria	Maize	2.03	0.50	27	73
Kenya	Green beans	0.15	0.50	32	68
Zambia	Aquaculture	0.17	0.89	17	83
Ethiopia	Cotton	2.13	0.69	51	49

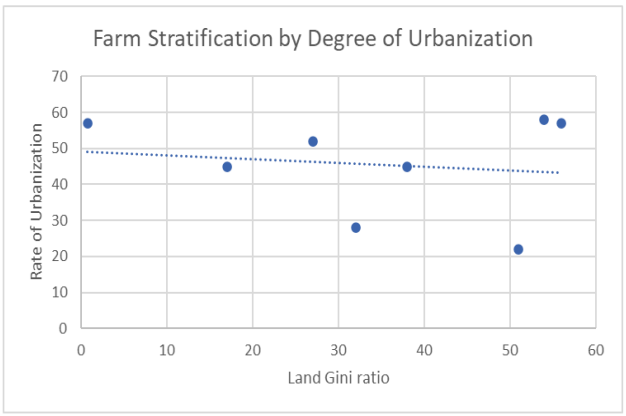
Table A2: Global forces influencing farm and firm size differentiation.

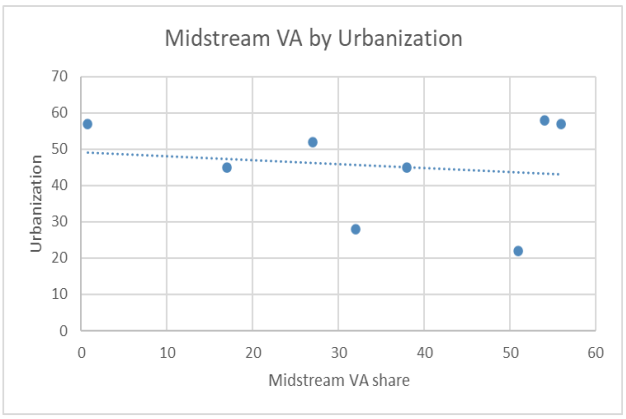
Country	Commodity	Population growth (2020)	Urbanization rate (%)	Poverty rate (2020)	Economic growth (2010-15)
Ghana	Groundnut	2.1	57	24	7.9
	Sorghum	2.1	57	24	7.9
Cameroon	Cocoa	2.6	58	30	4.8
Zambia	Maize	2.9	45	54	6.0
Nigeria	Maize	2.5	52	70	5.8
Kenya	Green beans	2.3	28	36	6.0
Zambia	Aquaculture	2.9	45	54	6.0
Ethiopia	Cotton	2.5	22	30	10.2

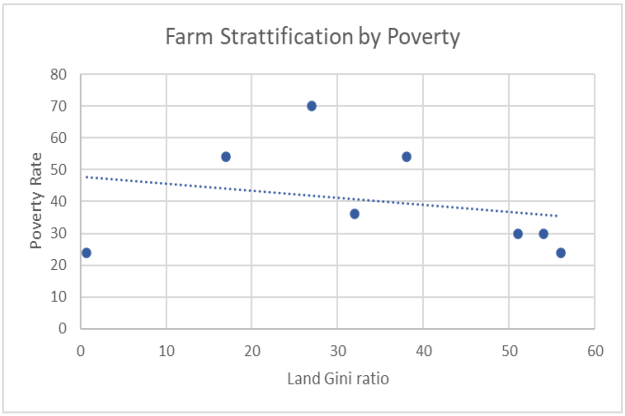
Annex 2: Structural transformation, Farm differentiation & Market integration

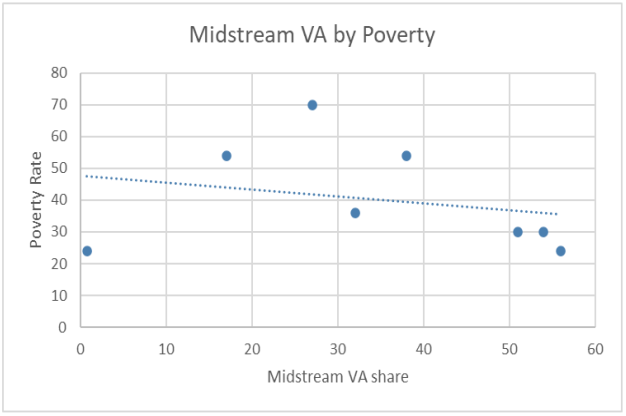


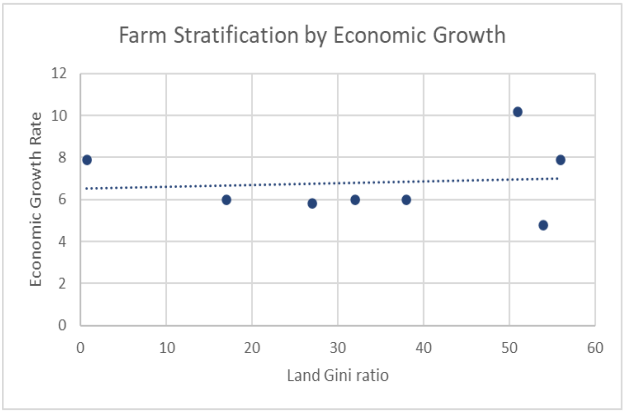


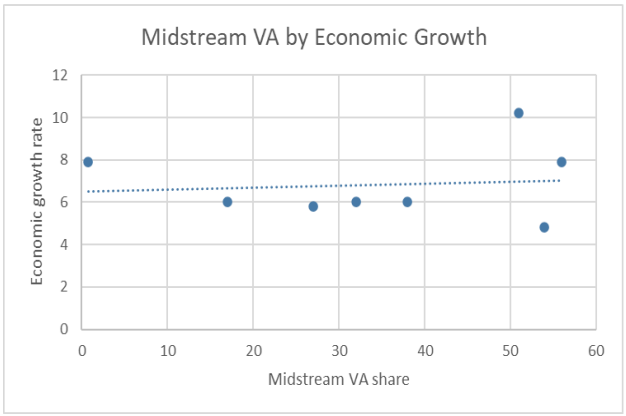












Annex 3: Production structure and factor productivity