SYMBIOSIS BETWEEN COMMERCIAL SMALL-SCALE PRODUCERS AND MICRO, SMALL AND MEDIUM ENTERPRISES IN THE "HIDDEN MIDDLE":

EVIDENCE FROM THE HORTICULTURE VALUE CHAINS IN AFRICA AND ASIA

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Carolina Trivelli, Saweda Liverpool-Tasie and Thomas Reardon

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Authors

Carolina Trivelli. Instituto de Estudios Peruanos (IEP). trivelli@iep.org.pe

Saweda Liverpool-Tasie. Professor, Department of Agricultural, Food, and Resource Economics, Michigan State University. lliverp@msu.edu

Thomas Reardon. Professor, Department of Agricultural, Food, and Resource Economics, Michigan State University. reardon@msu.edu

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Abstract

Rapid urbanization and changing diets in Africa and South Asia are raising demand for horticultural products, creating opportunities for agrifood transformation. This report synthesizes evidence from the INCATA project (Linked Farms and Enterprises for Inclusive Agricultural Transformation in Africa and Asia). It finds that small-scale producers are highly commercial and often embedded in mutually beneficial relationships with micro, small, and medium enterprises (MSMEs) in the "hidden middle" of input supply, trading, logistics, and related services. Drawing on case studies of Kenya's tomato value chain and Odisha's vegetable value chains, plus analyses from six African countries, we identify common dynamics. Many small-scale producers sell crops, buy modern inputs, and frequently operate or work in MSMEs. The hidden middle has expanded quickly and is central to value chain performance. We document the emergence of farm and MSME clusters, longer supply chains, technology and input intensification, and job creation on and off farm. Wholesale markets act as hubs that move growing volumes, coordinate exchanges, and support livelihoods for traders and service providers. However, markets often face deficits in basic infrastructure and services, especially water, sanitation, and electricity, which constrain efficiency and heighten food safety risks. Inclusion outcomes are mixed and context-specific. Kenya's tomato wholesale and retail segments show high and rising participation by women. In contrast, Odisha's vegetable wholesale remains male-dominated, with very low participation by women and marginalized castes, even as retail is more inclusive. These shifts generate "growing pains" as rapid expansion intensifies competition, raises quality and safety pressures, and exposes governance gaps. INCATA shows inclusiveness is possible, but not always automatic. Policy priorities include investing in wholesale market infrastructure and connective logistics; strengthening inclusive market institutions and targeted programs that lower entry barriers; and supporting applied research and practical technologies that improve water and chemical use while preserving MSME-led innovation.

Keywords

Small-scale producers, horticulture value chains, hidden middle MSMEs, wholesale markets, clusters, commercialization, gender inclusion, logistics, public investments

Introduction

Across Africa and South Asia, rapidly expanding cities and income growth have spurred demand for horticultural products as diets shift away from starchy staples. Much of this demand is met by domestic supply rather than imports, positioning horticulture as a powerful engine of agricultural and food systems transformation. Yet increased demand does not guarantee broad-based prosperity. Whether horticultural growth is inclusive depends on how value chains evolve, who can participate, how markets are structured, and how risks and rewards are distributed along the chain. This report presents new evidence on the inclusive nature of rapidly expanding horticultural value chains from the INCATA project, with a focus on the tomato value chain in Kenya and vegetable value chains in Odisha, India.

We find that over the past 1-2 decades, there has been a rapid development of spontaneous clusters of vegetable farms & Hidden-Middle micro, small, and medium enterprises (MSMEs), such as input suppliers, third-party logistics providers, processors, traders, loaders, etc. Mutually beneficial relationships between farms and these hidden-middle actors have underpinned the dynamism and expansion observed (in both Kenya and Odisha), but with tensions caused by what we call **growing pains**. The same forces that create opportunities also create these tensions within the system. Rapid expansion intensifies cost pressures and competition, creating tensions for farmers and firms that struggle to keep pace with rising input requirements, evolving market standards, shifting production zones, or heightened competition. Social frictions may also emerge as women, youth, and marginalized groups enter new nodes of the chain and challenge traditional expectations. These growing pains are part of the dynamics of development and shape who benefits and who is left behind. Thus, efforts are needed by multiple stakeholders (including government (at multiple levels), the private sector, donors, and researchers) to support the dynamic transformation already underway, while ensuring it is inclusive and resilient.

Horticulture is often treated as a minor activity occurring on small patches of land or in small home gardens, characterized by limited technological investment. In contrast, our findings reveal that horticulture is a highly commercialized subsector that attracts substantial investments in land and other on-farm technologies, as well as numerous allied activities supporting the production and distribution of horticultural products. Horticulture expands where production and exchange are feasible: in zones with a suitable climate, sufficient water, and road connections that enable supply chains to reach towns and cities and, over time, to lengthen and differentiate by product type and attributes. Our evidence reveals a "silent revolution" in the horticulture sector, built on thousands of small investments and daily transactions. We find that horticulture value chains are characterized by labor-intensive production and relatively low barriers to entry compared to many high-value export crops. The value chain creates space for a wide range of actors, including small-scale commercial producers and a broad range of micro and small businesses. It also creates large spillovers in rural labor markets, since horticulture requires many services beyond farming, such as grading, packing, loading, retailing, and short and long-haul transport.

Our findings reveal that two sets of critical factors have facilitated the observed transformation. First are the enabling conditions that make horticulture production and exchange feasible. These include access to land (including active rental markets), water and irrigation, passable roads, communications, market infrastructure (adequate trading and storage space, water and sanitation), and practical technologies such as improved seeds, pumps, and mobile phones. These conditions lower costs and reduce risk, enabling and incentivizing small producers to invest and firms to provide services at scale. The second critical but often less recognized factor is the role of the dense web of MSMEs operating along input and output value chains. These firms, mostly micro and small, supply inputs and advice,

purchase crops, process crops, move products through third-party logistics, and connect production areas to wholesale markets and consumers. These MSMEs are important sources of livelihood for many who own or work for them. In addition, their relationship with small-scale producers (selling inputs or buying and moving outputs) is typically mutually beneficial and plays a key role in facilitating the rapid transformation observed. Therefore, our analysis treats the hidden middle as a core part of the agricultural transformation, rather than a peripheral concern. We argue that the mutually beneficial relationship between small-scale producers and MSMEs in the hidden middle of horticultural value chains has positive inclusion outcomes with growing opportunities for marginalized groups (e.g., women, youth, scheduled castes and tribes) as well as improved employment, empowerment, increased income, diversified food consumption, and poverty reduction.

The research design for this project was twofold and comparative across multiple levels. First, we drew on evidence from six African countries, using secondary nationally representative data, to situate small-scale producer commercialization in general and within horticulture in particular. This cross-country analysis was complemented by in-depth, country-specific case studies in Kenya and Odisha, based on extensive fieldwork and original survey data collected along the horticulture value chain. In each country, we adopted a three-pronged methodology. First, we conducted an initial Rapid Reconnaissance (RR) to map key value-chain actors and their location and activities. This was followed by market and meso-level studies to examine changes in value-chain structure over time. Our third step was a series of stacked surveys that collected detailed behavioral data from a large sample of actors across selected nodes (input supply, farm, wholesale, and retail) to support rigorous empirical analysis of the drivers of observed behavior. In all phases of the research, we start from observed practices and relationships and build an interpretation of how development dynamics unfold in horticulture value chains. We also use a diachronic lens to analyze what the value chain looks like today, how it has evolved, and how actors perceive likely future changes.

Though vegetable value chains have expanded rapidly in both countries, we find important distinctions. The tomato value chain in Kenya exhibits key features of a more advanced stage of horticulture-led transformation. The value chain is characterized by high rates of technology adoption (on and off farms), significant product differentiation, and disintermediation among traders. In contrast, Odisha is at an earlier stage of transformation, with many actors entering the chain and building expectations of upward mobility. The Kenyan case also presents a more advanced, inclusive transformation (with high participation of women and youth at all nodes of the value chain) compared to Odisha, where the participation of women and scheduled tribes and castes was often extremely low. The south-south comparison between Kenya and Odisha helps identify common mechanisms, context-specific pathways, and policy lessons that can be shared among countries and, potentially, with other regions such as Latin America and the Caribbean. In both study countries, the hidden middle is not a single institution nor a small group of large firms. On the contrary, it is a complex but dense web of actors and relationships. Producers need irrigation services, inputs, credit-like arrangements, market information, and transport. MSMEs engaged in input supply, output trade, and processing need a market for their inputs or a reliable flow of produce to sustain their businesses and serve wholesale and retail markets. When these needs align, repeated interactions can generate a positive-sum system that supports growth and inclusion. Our evidence points to many long-running yet voluntary relationships, meaning they can be ended or reshaped when conditions change.

Many of these interactions take place within local clusters and markets. We find that wholesale markets are a centerpiece of this system. They are hubs where food, information, labor, logistics, and numerous allied services converge. They are also public spaces where consumers, retailers, wholesalers, and other

MSMEs interact. These markets feed and employ millions in rural and urban areas, including women and youth. Markets and clusters are key to linking demand (in rural and urban areas) to supply from production areas, while also enabling value chains to extend into more distant but suitable zones as production grows. However, WMs are often significantly constrained by poor infrastructure (including water and sanitation) that has not kept up with the rapid growth in the number of actors (traders and allied services) and volumes of product moving through them.

As noted earlier, while our two case studies reveal a dynamic system that challenges conventional wisdom about small-scale producers and local businesses in domestic food markets, they also show that growth is rarely smooth or linear. Growing pains are evident and part of the developmental process. Growing pains are already evident, including competition pushing some actors out of one activity/node into other activities within and beyond the value chains studied, and rising concerns about food safety as these MSMEs proliferate. Others are likely to manifest and intensify. At this transitional phase of the agricultural transformation, the main constraints often relate to costs and basic logistics: water availability, road quality, transport reliability, market congestion, and the ability to coordinate large volumes with limited infrastructure. Looking ahead, quality differentiation is likely to matter more, creating pressure to improve varieties, enhance handling, and strengthen standards. In the absence of such adjustments, the expectations that motivate investment may unravel, hampering further growth or the subsector's inclusiveness.

These growing pains highlight the key role for certain stakeholders, such as the public sector (national, regional, and local), the private sector, civil society organizations, donors, and technology developers, even in value chains that operate largely through informal arrangements. Public investments in irrigation, roads (main and secondary across rural and urban areas), communications, and market infrastructure can reduce risks for private investment by lowering costs and stabilizing access. Support for applied research can further reduce production and trading risk, increase productivity, or enable the wide distribution of horticultural products across the study countries. Such support is becoming increasingly important with new pests, climate stresses, and shifting quality requirements. The development and dissemination of affordable, improved varieties is particularly important as production expands into new environments and markets demand better shelf life and handling. Regulation and enforcement matter for issues such as agrochemical use, quality and safety, and the governance of wholesale markets. More broadly, credible and predictable public action can strengthen the institutional conditions that sustain trust and regular exchange, supporting inclusion while preserving the flexibility that allows actors to innovate and adapt.

The remainder of this report is organized around five main messages that document the growth, dynamism, and inclusiveness of horticulture value chains, as well as the growing pains that accompany them (see box 1). We then translate these findings into recommendations, first at a general level and then with more specific guidance for key nodes of the value chain, including farmers and input suppliers, wholesale markets, logistics, and public investments that can sustain an inclusive trajectory.

Finally, we would like to acknowledge the support that made this work possible. The Gates Foundation funded the project, and the research was carried out through collaboration among RIMISP (Latin American Center for Rural Development), Michigan State University, the Tegemeo Institute (Egerton University, Kenya), and IFPRI-Asia.

Box 1

Incata Main Messages

#1: Small-scale producers (SSPs) are highly commercialized and engaged with MSMEs.

#2: The horticulture value chain is providing employment, growth, inclusion, and diversification.

#3: Wholesale markets are engines of value chains, feeding and employing millions, yet are challenged.

#4: In the past decade, there has been a rapid development of spontaneous clusters of farms & Hidden-Middle MSMEs.

#5: Mutually beneficial relationships between cSSPs and MSMEs are enabling the inclusive transformation of horticultural value chains.

Box 2: About INCATA

INCATA's objective is to study the relationship between commercial small-scale producers (cSSPs) and micro, small, and medium-sized enterprises (MSMEs) in the "Hidden Middle" of agrifood value chains, explaining how this relationship underpins and contributes to an inclusive agricultural transformation**.**

Questions to answer:

1) cSSPs: What are the prevailing patterns of commercialization among small-scale producers and the key policy- and non-policy-related factors that shape their engagement with "hidden-middle" MSMEs?

2) **cSSPs and MSMEs:** Which cSSPs and MSMEs succeed in raising incomes, investing, adopting new technologies, and accessing larger or higher-value markets during the transformation process?

3) **Inclusion:** To what extent does greater commercialization of SSPs and the expansion of MSMEs translate into poverty reduction and advances in women's economic empowerment (WEE)?

4) **Policies and interventions:** Which investments and policies have the greatest potential to accelerate the symbiotic co-development of cSSPs and MSMEs?

INCATA answered these questions through two workstreams (see Annex 1 for details): 1) LSMS-ISA data analyses for six African countries, and Horticulture and aquaculture value chain extensive surveys in Kenya, led by Tegemeo Institute, and in Odisha, India, led by IFPRI-Asia.

Methods

A document containing the methodology used for field surveys in Odisha, India and Kenya can be found in our Annex 1.

Ethics and informed consent

The INCATA Odisha study received ethical approval from the Institutional Review Boards (IRBs) of the International Food Policy Research Institute (IFPRI) (DSG-25-0511, IRB #00007490, approved May 1, 2025) and an approved modification (DSG-25-0511M, IRB #00007490, approved September 29, 2025), Global AgriSystem Pvt. Ltd. (GAPL/IRB/2025/001, approved May 1, 2025), and AMS (AMS/IRB/2025-26/02, approved December 1, 2025).

Informed consent was obtained from all participants prior to participation. Consent was obtained verbally, as approved by the IRBs, and was documented by the study team at the time of data collection. Participation was voluntary, participants could decline to answer any question or stop at any time, and all data were handled confidentially and analyzed in de-identified form.

Ethical approval for the Tegemeo (Kenya) study was obtained from the Egerton University Institutional Scientific and Ethics Review Committee (EUISERC) (Approval No. EUISERC/APP/379/2025, dated 16 January 2025; application approval number EUISERC/APP/379/2024). In addition, a national research license was issued by Kenya's National Commission for Science, Technology and Innovation (NACOSTI) (License No. NACOSTI/P/25/416061; Ref No. 413802; date of issue 14 February 2025), authorizing Egerton University to conduct the research in the approved counties through 14 February 2026.

Informed consent was obtained from all participants prior to participation. Consent was obtained verbally, as approved by the ethics committee, and was documented by the study team at the time of data collection. Participation was voluntary, participants could decline to answer any question or stop at any time, and all data were handled confidentially and analyzed in de-identified form.

Key message 1: Small Scale Producers (SSPs) are highly commercial and engaged with MSEs for input procurement and crop sales

Finding 1.1: SSPs are highly commercial.

A common starting point in policy debates is that small-scale producers (SSPs) are mostly subsistence-oriented and only weakly connected to markets. Based on a sound analysis of national survey data from six African countries at different stages of development (Ethiopia, Malawi, Tanzania, Uganda, Ghana, and Nigeria), and two in-depth value chain studies (in Kenya and Odisha, India), the evidence shows the contrary. SSPs are highly engaged in commercial activities.

Evidence from National representative surveys on how commercial SSPs are

Country contexts

Before turning to the household survey evidence on market engagement, Table 1 provides a brief snapshot of the macroeconomic and demographic context of the six study countries. The countries are

ordered from poorest to least poor based on GDP per capita, highlighting Malawi and Ethiopia as the lowest-income settings in the sample, alongside Uganda and Tanzania. The poverty headcount and rural population share highlights that several of these economies combine widespread poverty with predominantly rural livelihoods and a sizeable role for agriculture, which is important for interpreting patterns of commercialization and MSME linkages. The variables shown are averages from 2010 to 2023 to smooth out volatile fluctuations over time and show the performance of these countries during the periods under study.

Table 1. Macroeconomic and demographic indicators for the chosen countries. (2010-2023 average)

Country (rank)	GDP per capita (US$)	Agriculture's share of GDP (%)	Poverty headcount at US$ 3/day (%)	Total population (millions)	Rural population (%)
Malawi (1)	≈575.5	≈24.4	≈73.3	≈17.9 M	≈83.3
Ethiopia (2)	≈663.7	≈37.3	≈36.3	≈108.8 M	≈79.9
Uganda (3)	≈846.9	≈25.1	≈58.7	≈39.9 M	≈77
Tanzania (4)	≈1 002.5	≈26.1	≈51.4	≈55.0 M	≈67.3
Ghana (5)	≈1 988.8	≈20.6	≈40.4	≈29.6 M	≈45
Nigeria (6)	≈2 274.6	≈22.0	≈36.5	≈197.5 M	≈51

Source: World Bank Data accessed through their API.

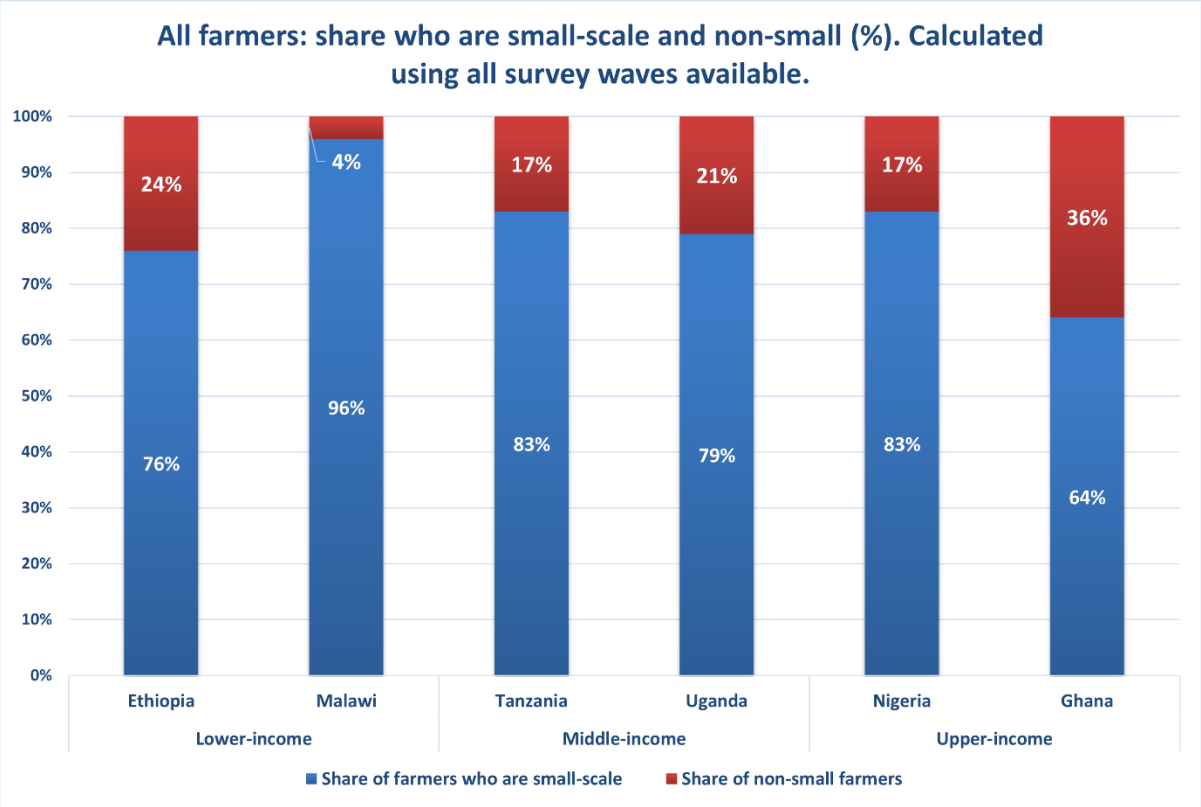
What is an SSP, and how large are SSPs' farms in these countries?

In this report, an SSP (small-scale producer) is defined for each country based on its cultivated land area. Specifically, we classify a household as an SSP if its cultivated area (hectares) falls in the bottom 90% of the national distribution, meaning it is among all farmers except the top 10% with the largest cultivated areas. This relative definition makes "small-scale" comparable across countries with very different land distributions.

Using this definition, the average cultivated area among SSPs ranges from 0.56 ha in Malawi to 2.09 ha in Ghana, with intermediate values in Nigeria (0.68 ha), Uganda (1.02 ha), Ethiopia (1.05 ha), and Tanzania (1.32 ha). There is also meaningful variation within the SSP group: the upper bound of SSPs' cultivated area (the largest farm size still included within the bottom 90%) reaches 1.44 ha in Malawi, 2.68 ha in Nigeria, 3.29 ha in Ethiopia, 3.62 ha in Uganda, 4.45 ha in Tanzania, and 6.39 ha in Ghana. In short, "small-scale" is country-specific and spans a range of farm sizes, but it consistently excludes the largest landholders in each country.

With this definition, SSPs account for most crop producers (see Figure 1), with significant differences among countries. SSPs represent 64% and 96% of all farmers sampled in all the waves of the analyzed nationally representative surveys.

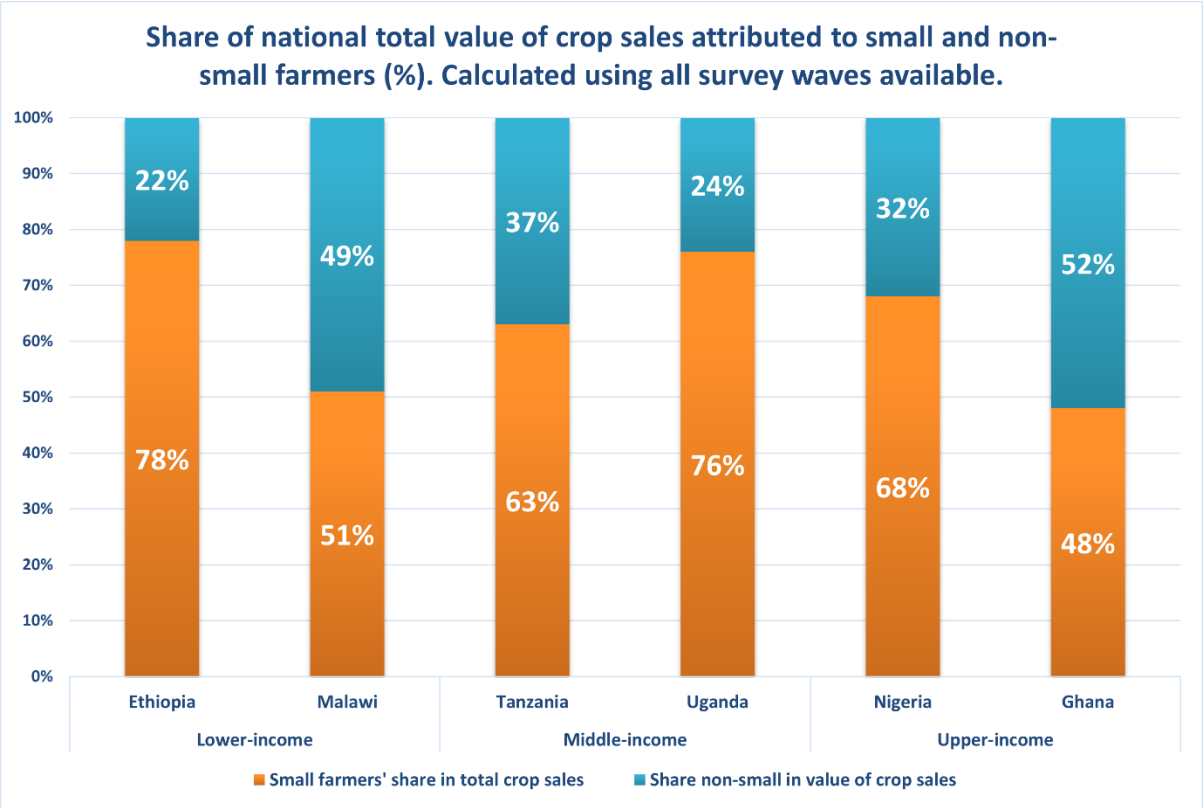
Figure 1. Share of SSPs among all farmers surveyed.



Source: LSMS-ISA

The vast majority of small-scale producers account for more than half of the total crop value in the six analyzed countries, as shown in Figure 2. Only in Ghana, coinciding with the lowest share of SSPs among crop producers, the crop value of SSPs is slightly below (48%). Thus, SSPs are relevant in both number and contribution to total crop production.

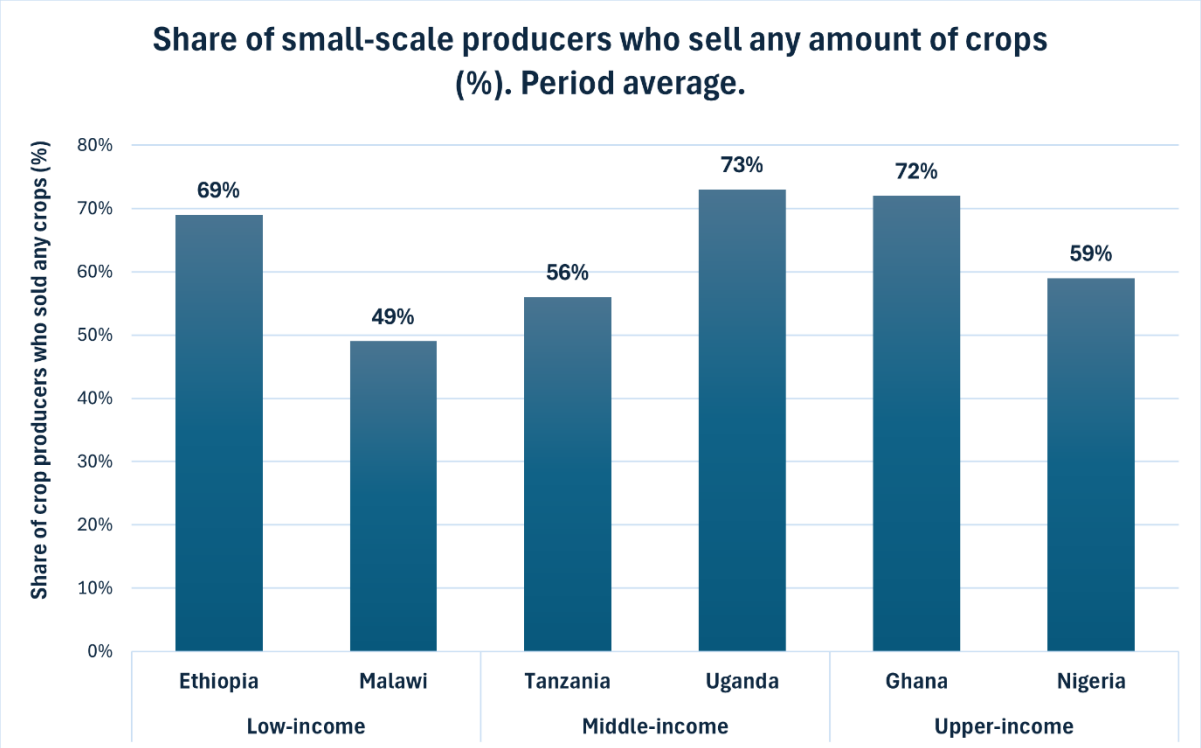
Figure 2. Share of total crop value production attributable to SSPs and non-SSPs



Source: LSMS-ISA

Figure 3 shows that, across all analyzed countries, market participation among SSPs is substantial. Even in settings where poverty is widespread and agricultural systems remain largely rainfed. Selling different shares of their crop production is a regular feature of smallholder livelihoods, not an exception limited to a small group of "commercial farmers".

Figure 3. Share of all SSPs that sell any amount of crops, by country (%).

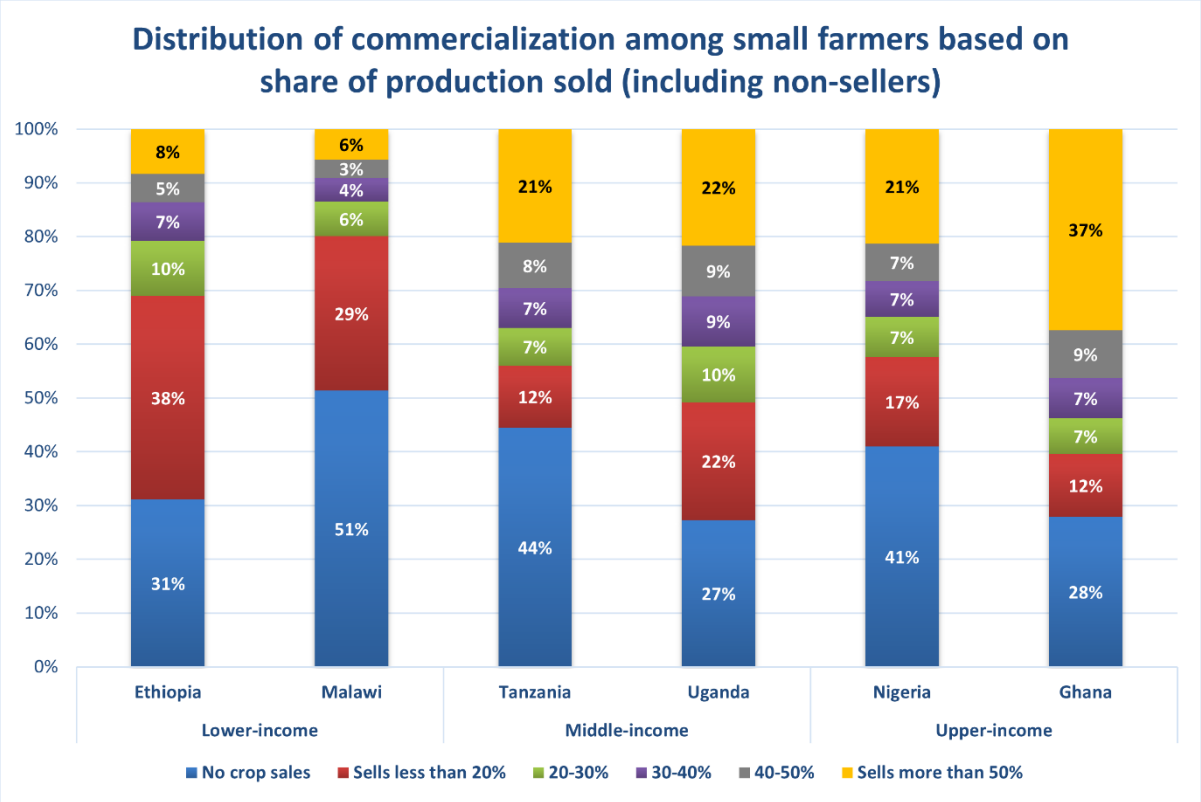


Source: LSMS-ISA

The cross-country differences are meaningful, but they do not overturn the overall message. The share of SSPs that sell any amount of crops ranges from 49% in Malawi to 73% in Uganda. In Ethiopia, Ghana, and Uganda, the selling rate is very similar at about 71%, while in Nigeria it is 59%. This distribution does not reveal a simple gradient by income level: Malawi is low, but Ethiopia is high; Ghana is high, but Nigeria sits in the middle. Instead of an income-strata story, the data suggest that output-market engagement is widespread across varied country contexts.

Participation, however, is only one piece of commercialization. A second question is how intensively SSPs participate in markets, meaning how much of total production is sold. Figure 4 makes clear that the depth of commercialization varies considerably. In Ethiopia and Malawi, SSPs sell about 43% and 50% of production value, respectively. This indicates that many selling households still retain a sizeable share of output for home consumption, seed, or other non-market uses, even as they remain active market participants. In Tanzania and Uganda, SSPs sell around 61% of total production value, suggesting a stronger orientation toward market channels and cash generation. In Nigeria and Ghana, more diversified economies, SSPs sell about 62% and 67% of output value, respectively. These higher figures imply that, in those contexts, smallholders more often treat farming as a source of marketed surplus rather than mainly as a subsistence base.

Figure 4. Share of all crops produced that are sold (in value terms), by country (%).



Source: LSMS-ISA

As shown in Figure 4, in the middle and upper-income countries, more than 20% of SSPs sell more than 50% of their crop production. In the lower-income countries, a significant share of cSSPs sell less than 20% of their production (38% in Ethiopia and 29% in Malawi).

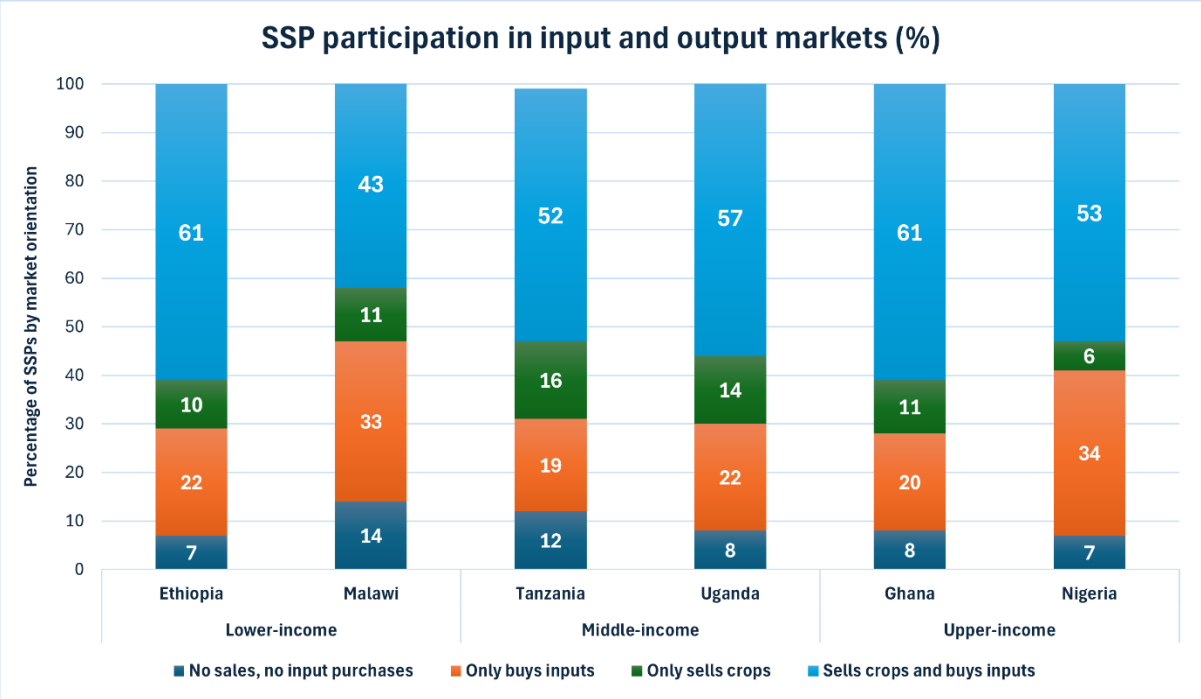
Putting these results together helps reconcile two observations that can otherwise seem contradictory: most SSPs sell something, yet many keep a share for household consumption (or as inputs for other activities, such as livestock). In lower-income settings, this pattern is consistent with households balancing food needs and cash needs under risk and price volatility. In higher-selling environments, the balance shifts toward selling larger portions, which can reflect better market access, stronger demand from traders and processors, or higher shares of cash crops and horticulture. In all cases, the data challenge a binary view of "subsistence versus commercial." Many SSPs sit somewhere in between, combining sales with retention, and adapting their sales intensity to seasonal needs and constraints.

The trend over time reinforces this picture of gradual market deepening, especially in lower-income contexts. Using the LSMS-ISA panels, we see that the share of crop production sold increases from one survey round to the next in every country, and the magnitude of that increase is substantial. On average, the survey-to-survey rise in sales intensity is largest in Ethiopia (about +9.4 percentage points), followed by Uganda (+5.3 pp), Nigeria (+4.7 pp), and Malawi (+4.1 pp), with more moderate gains in Tanzania (+2.0 pp) and near-stability in Ghana (+0.3 pp). Importantly, these upward shifts are not just noise: the change over time is statistically significant across all countries (F-tests with p-values $\approx$ 0.000), consistent with a broad-based increase in commercialization. Taken together, the pattern points to an

expansion of market opportunities and a gradual catching-up process, with countries starting from lower sales intensity also showing the sharpest increases in the share of their output reaching markets. This does not mean every household becomes fully commercial, but it does suggest that the center of gravity is moving toward more frequent and larger market transactions. For food system development, increasing commercialization typically implies higher volumes flowing through the midstream and downstream segments, strengthening linkages between farms and MSMEs engaged in aggregation, transport, storage, processing, and retailing.

Market connection also goes beyond output sales. Figure 5 highlights an important dimension often overlooked in discussions that focus solely on selling: the degree to which SSPs are connected to markets on both sides, as both buyers of agricultural inputs and services and sellers of crops. About 56% of SSPs both purchase agricultural inputs and sell crops, forming a "fully connected" group that interacts with markets upstream and downstream. These households not only supply output to market actors but also purchase modern inputs such as seed, fertilizers, and pesticides, typically through agro-dealers and local input suppliers. At the other end of the value chain, fewer than 14% of SSPs (9% in average) neither purchase inputs nor sell output, representing a more subsistence-like segment with almost no market exchange associated with their farm production.

Figure 5. Distribution of SSPs based on input purchases and crop sales, by country (%).



Source: LSMS-ISA

Figure 5 also presents two additional relevant categories because they show that partial market integration is common. Some households buy inputs but do not sell crops, while others sell crops but do not report input purchases. The former can reflect farmers investing in production while relying on home consumption, selling through informal channels not captured in the data, or facing limited access to output markets at harvest. The latter can reflect households selling surplus but relying on traditional

inputs, saved seed, or low-input systems. In other words, market engagement is multi-dimensional, and households can be integrated in one way while constrained in another.

These categories are not only descriptive, but they also align with welfare differences. The subsistence-like SSPs tend to have smaller farms and are more likely to be poor. In Malawi, for example, subsistence SSPs are about 20 percentage points more likely to be poor than their fully connected counterparts. This gap is consistent with a broader pattern in which market participation and input adoption correlate with higher cash incomes and better capacity to smooth consumption, even if the direction of causality can run in both directions.

Box 3 shows that small-scale producers' market engagement is strongly shaped by what nearby farmers do, not only on the input side but also for crop sales and sales intensity. Across several countries, especially Ghana, Ethiopia, and Malawi, higher peer commercialization is closely linked to higher own commercialization, and the link is often strongest for how much households sell rather than whether they sell at all.[1] This highlights the value of "neighboring" dynamics for scaling commercialization: well-targeted peer and group-based strategies can help SSPs sell more, particularly in places where market participation is still spreading, while complementary investments in market access and coordination are key once participation becomes more widespread (Box 3).

BOX 3 **Social Learning and Peer Influence in Smallholder Commercialization**

Dzanku et al., (2025) analyses whether small-scale producers' (SSPs) input purchases and crop sales are partly "socially embedded", meaning that what other farmers do in the same community helps predict what an individual farmer does. Using harmonized survey data across six countries, it documents where peer influence is strong, where it is weak, and when it becomes nonlinear (strong at early diffusion stages but fading, or even reversing, as participation becomes widespread).

The study answers if SSPs are more likely to buy modern inputs when a larger share of other SSPs in their community buys them? SSPs are more likely to sell crops, and to sell a larger share, when their peers commercialize more? and if these relationships do change once peer participation becomes "high" (nonlinear or threshold effects), and do they differ across countries?

Peer influence measures: what is captured

The paper builds peer measures at the village level, and it always excludes the household itself from the peer calculation.

Peer input behavior (seeds, fertilizer, pesticides): for each input, the peer variable is the share of other SSP households in the same community that purchased the input, computed using survey

[1] Espinoza et al., (2026) also found that this kind of peer effects has a positive effect on total factor productivity of SSPs in SSA.

weights. In plain terms: “among your neighboring SSPs (not counting you), what fraction bought fertilizer (or seed, or pesticide) this season?”

Peer commercialization behavior: the peer variable is the average share of harvest sold (in value terms) by other SSPs in the same community, again weighted and excluding self.

Outcomes: how commercialization is measured

On the input side, the outcomes are whether the SSP purchased: (i) improved seed, (ii) chemical fertilizer, (iii) pesticides; on the output side, the paper tracks three margins: (i) whether the SSP sold any crop at all, (ii) the value of crop sales (constant PPP dollars), and (iii) the share of harvest sold (sales intensity).

Data and approach in brief

Six countries are studied: Ghana (GLSS) plus Ethiopia, Malawi, Nigeria, Tanzania, and Uganda (LSMS-ISA), covering roughly 2006–2020 depending on country and panel structure. The econometric strategy uses correlated random effects methods suited for panel data, and separates “whether you sell” from “how much you sell” using a hurdle approach for sales outcomes. The estimates are interpreted as conditional associations, with careful caveats about non-causal interpretation.

Core results: where peer effects are strongest…

The headline pattern is strong positive peer effects for input purchases in Ghana, Nigeria, and Ethiopia, but weaker or sometimes negative peer associations in Tanzania, Uganda, and Malawi. For output markets, peer commercialization is most consistently linked to how much farmers commercialize (sales intensity) in Ghana, Ethiopia, and Malawi, with more mixed patterns elsewhere (Table 2).

Interpretation and robustness notes

The study emphasizes that these are strong, policy-relevant associations consistent with social learning, imitation, and coordination, but they may also reflect shared shocks or local conditions that move peers together. The main takeaway is practical: peer dynamics can be leveraged to accelerate adoption and commercialization, but designs should be context-specific and timing-sensitive, especially where saturation points imply diminishing returns to peer-based approaches.

Table 2. Direction and strength of peer effects (stylized from main results)

Country	Peer effects on inputs	Peer effects on commercialization
Ghana	Seed (+) Fertilizer (+) Pesticides (+)	Sell any (+) Value sold (+) Share sold (+)
Nigeria	Seed (+) Fertilizer (+) Pesticides (+)	Sell any (n.s.) Value sold (+) Share sold (+)
Tanzania	Seed (n.s.) Fertilizer (n.s.) Pesticides (+)	Sell any (−) Value sold (n.s.) Share sold (n.s.)
Uganda	Seed (n.s.) Fertilizer (−) Pesticides (−)	Sell any (n.s.) Value sold (n.s.) Share sold (n.s.)

Ethiopia	Seed (+) Fertilizer (+) Pesticides (+)	Sell any (+) Value sold (+) Share sold (+)
Malawi	Seed (n.s.) Fertilizer (+) Pesticides (+)	Sell any (+) Value sold (+) Share sold (+)

Source: Dzanku, F., et al. (2025)

Finding 1.2: SSPs are diversified.

Other than buying inputs or selling crops, SSPs are highly connected with markets through at least two channels: diversifying income sources through wage labor (within or outside the agrifood sector) and through food consumption markets.

As mentioned earlier, there is a group of SSPs that neither purchase inputs nor sell crops. Despite a lack of agricultural market connections among subsistence small-scale producers, as shown in Table 3. The share reporting any wage income varies sharply across countries, from about 13% in Ethiopia to 65% in Malawi, with intermediate levels in Uganda (37%), Tanzania (38%), Nigeria (42%), and Ghana (45%). At the same time, a large portion of their food consumption is purchased rather than self-produced: roughly 42% in Uganda and 46% in Ethiopia, rising to 53% in Malawi and 60% in Tanzania, and reaching about two-thirds in Nigeria and Ghana. Taken together, this suggests that "subsistence" in production decisions does not mean economic isolation: many of these small-scale farmers rely on off-farm wage work and routinely purchase food, reflecting regular participation in local labor and food markets despite limited engagement in input and output markets.

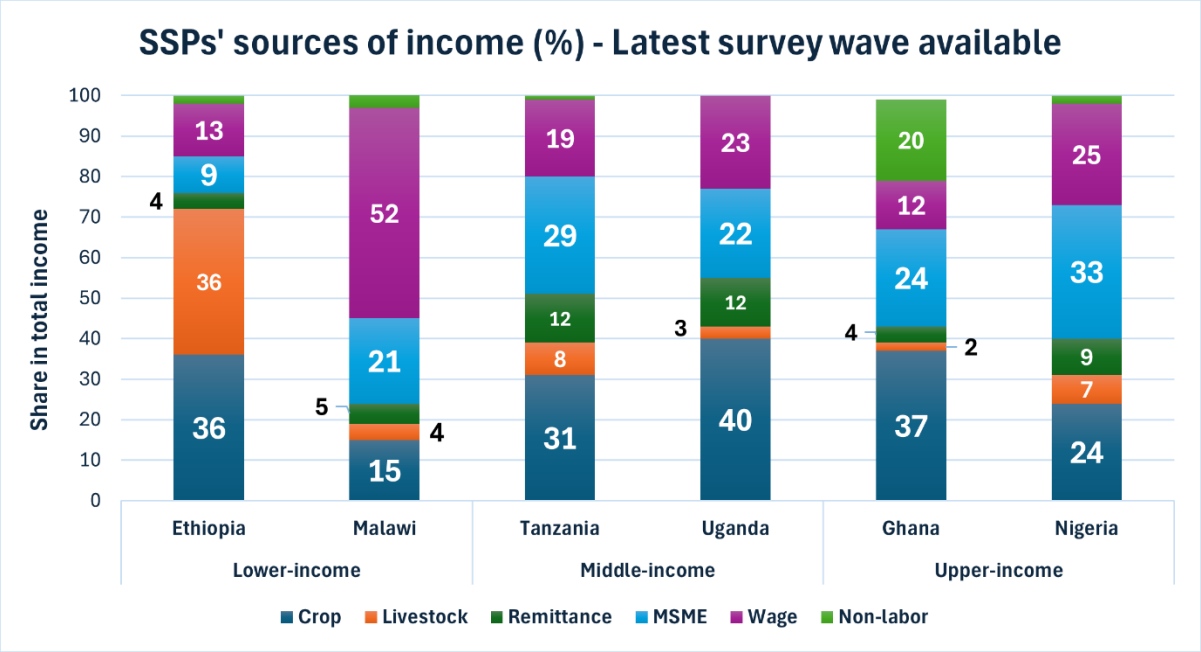
Table 3. Share of subsistence SSPs with wage income and their share of food purchased

Country	Share of subsistence SSP households with wage income (%)	Share of food consumed that is purchased (%)
Ethiopia	12.5%	46.1%
Malawi	65.0%	52.5%
Uganda	37.3%	42.3%
Tanzania	38.4%	60.2%
Nigeria	42.3%	66.4%
Ghana	44.9%	66.4%

Source: LSMS-ISA

The income data shows why diversification matters. Figure 6 shows that, on average across the six countries, combined crop and livestock production contributes about 41% of total household income, but this average masks strong cross-country differences. In Ethiopia, farming remains the dominant income source, with the farm share at 72%. In Uganda, the farm share is 43%, and in Tanzania and Ghana, it is about 39%. Nigeria has a lower farm share at 31%, while Malawi stands out at only 19%, indicating a much heavier reliance on non-farm income sources and labor markets.

Figure 6. SSPs' income distribution, by country (%).



Source: LSMS-ISA

Wage income is a non-trivial source of livelihood for SSPs, ranging from 12% in Ghana to 52% in Malawi (with more than 80% of this being ganyu[2] work) and intermediate values of 13% in Ethiopia, 19% in Tanzania, 23% in Uganda, and 25% in Nigeria.

Finding 1.3: SSPs operate across Micro, Small, and Medium Enterprises in the Agrifood Value Chains.

In many developing-country settings, micro-, small-, and medium-sized enterprises (MSMEs) in food systems are often described by their position along the value chain. Reardon and colleagues (2021) define midstream MSMEs as mainly business-to-business (B2B) firms, such as processors and wholesalers, that buy crops or livestock products from producers and sell to other firms (although in practice they may also sell to consumers). Downstream MSMEs are mainly business-to-consumer (B2C) actors, such as traditional market vendors, street-food sellers, and small retailers that sell food directly to final consumers.

These categories can overlap. Midstream firms may also retail, and downstream firms can carry out light processing, for example, preparing food before sale. The Africa Agriculture Status Report further notes that value chains also include lateral segments, such as logistics, packaging, and equipment repair, which support both midstream and downstream activities (AGRA, 2024).

This framing is especially relevant for SSP households, because many small-scale farmers in Africa also operate non-farm MSMEs, mostly micro and small enterprises (MSEs). These enterprises can serve

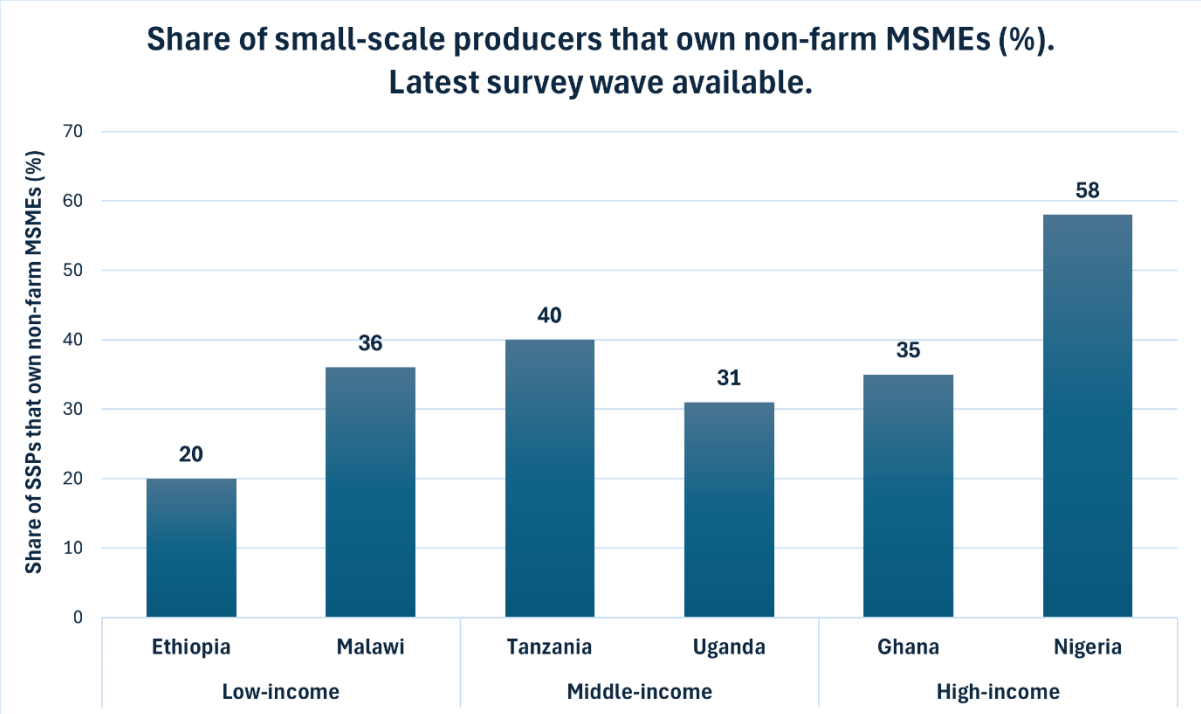
[2] In Malawi, ganyu means short-term, casual work (often day labor or "piecework"), usually on someone else's farm (like weeding, ridging, harvesting), paid in cash or in kind (often food) (Whiteside, 2000).

different purposes, including processing and marketing their own produce or diversifying income beyond farming.

SSPs leading MSMEs

The LSMS-ISA evidence indicates that non-farm entrepreneurship is a major component of rural livelihood strategies for SSP households, although the degree of engagement varies widely by country. Figure 7 shows that 20% of SSPs in Ethiopia, 36% in Malawi, 40% in Tanzania, 31% in Uganda, 35% in Ghana, and 58% in Nigeria operate at least one non-farm MSME. Across the six countries, roughly one-third of small-scale producers own a non-farm enterprise, and SSP-owned MSMEs represent around half of all agrifood MSMEs captured in the LSMS-ISA surveys. This means it is a common feature of household economic portfolios, often used to complement farming, manage risk, and address seasonal income gaps.

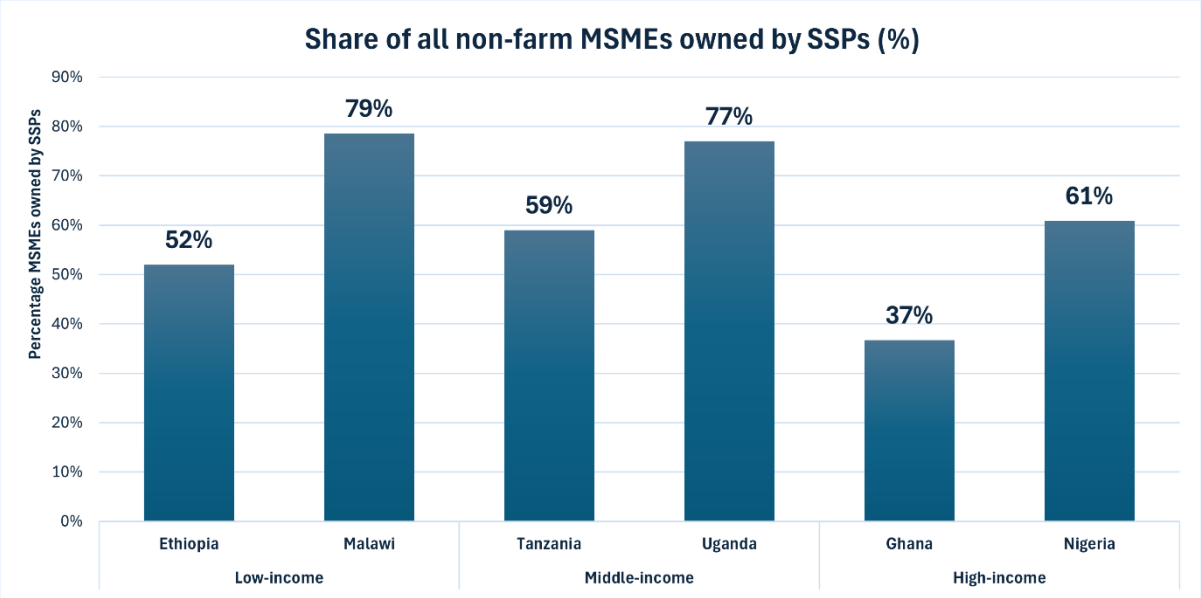
Figure 7. Share of SSPs that operate non-farm MSMEs, by country (%).



Source: LSMS-ISA

As noted earlier, SSP households also account for a large share of the rural non-farm enterprise sector. Figure 8 illustrates that the proportion of all non-farm MSMEs operated by SSP households is 52% in Ethiopia, 79% in Malawi, 59% in Tanzania, 77% in Uganda, 37% in Ghana, and 61% in Nigeria. Except in Ghana, the majority of rural non-farm MSMEs are owned by smallholders who produce crops. This is a significant point for food system policy because it implies that interventions aimed at strengthening rural enterprises will often reach farm households directly. It also means that changes in agriculture can spill over into rural enterprise performance, and vice versa, because ownership overlaps within the same households.

Figure 8. Share of all non-farm MSMEs operated by SSP households, by country (%).

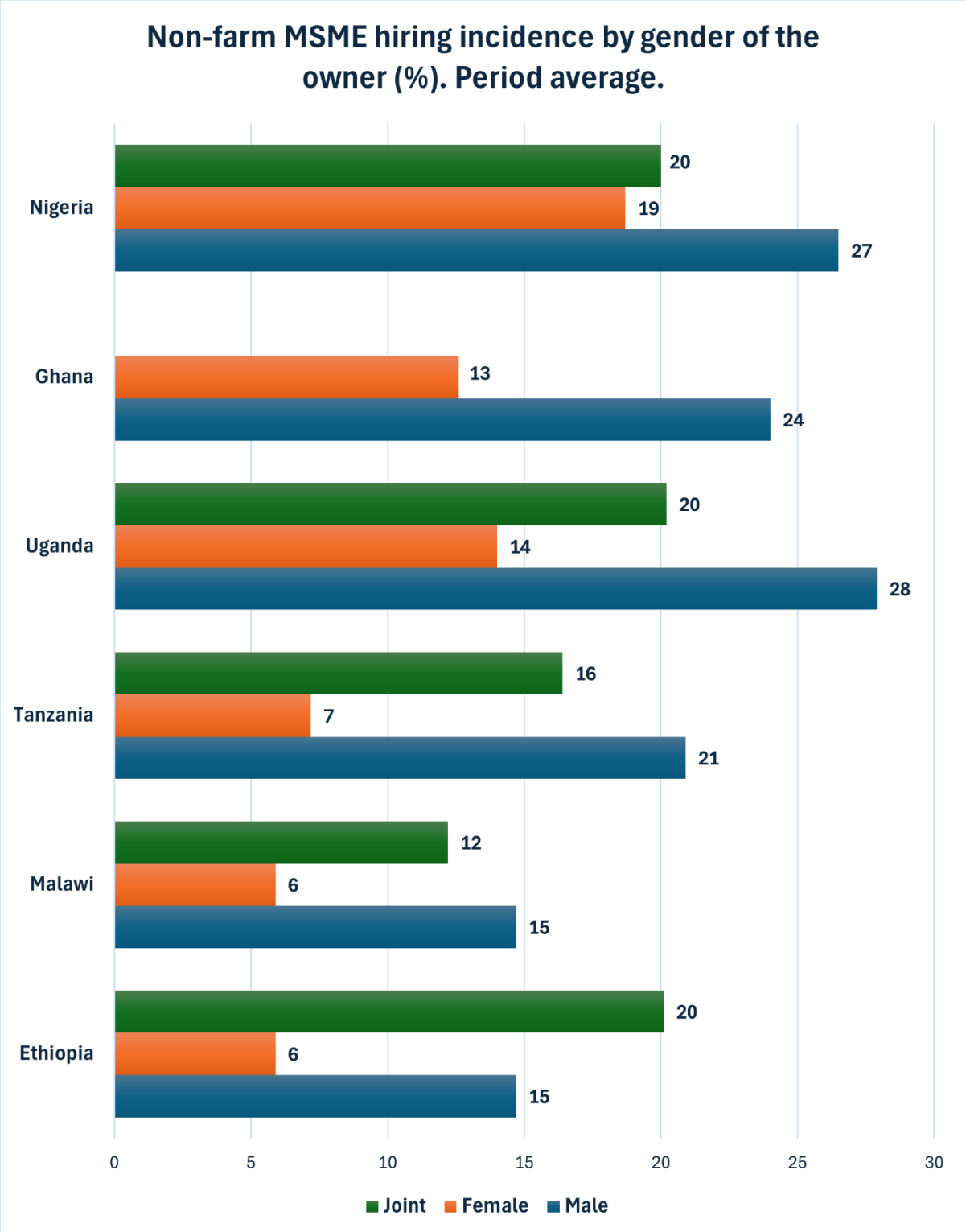


Source: LSMS-ISA

Non-farm MSMEs contribute a substantial share of household income across all countries, with significant variation among them (Figure 6): 9% in Ethiopia, 21% in Malawi, 29% in Tanzania, 22% in Uganda, 24% in Ghana, and 33% in Nigeria.

Enterprise dynamics also have a strong gender dimension, particularly when considering employment creation. Figure 9 shows that male-owned MSMEs are more likely to hire paid workers than female-owned MSMEs in every country. Among male-owned firms, the hiring rate ranges from 15% in Ethiopia and Malawi to 21% in Tanzania, 24% in Ghana, 27% in Nigeria, and 28% in Uganda. Hiring among female-owned firms is consistently lower: 6% in Ethiopia and Malawi, 7% in Tanzania, 13% in Ghana, 14% in Uganda, and 19% in Nigeria. Jointly owned enterprises sit between these two patterns, with hiring rates of 20% in Ethiopia, 12% in Malawi, 16% in Tanzania, 20% in Uganda, and 20% in Nigeria. These differences likely reflect disparities in access to capital, networks, and growth opportunities, as well as sectoral concentration in smaller-scale activities.

Figure 9. Non-farm MSMEs that hire any external labor based on the gender of the owner (%).



Source: LSMS-ISA

At the same time, lower hiring incidence among female-owned enterprises does not imply a negligible role in job creation. In Nigeria and Ethiopia, female-owned firms that do hire workers account for a sizeable share of all MSME wage employment, with around 18% and 35% of all MSME workers, respectively. This suggests a "thin but important" segment of women-owned firms that scale up enough to employ labor and can have outsized employment effects relative to their share of firms. It also highlights why focusing only on the average female-owned enterprise can miss the employment contribution of the subset that expands.

When the lens shifts to food system segments, the centrality of women becomes even clearer. Across the six countries, women own around 68% of food-retail MSMEs and about 75% of agri-midstream MSMEs. Female-owned enterprises generate approximately 52% of all food-retail wage jobs and 47% of agri-midstream jobs.

There is, however, substantial cross-country variation in how this plays out. In Ghana and Nigeria, female-owned businesses dominate employment in both segments. They provide about 62% of food-retail jobs and around 69% (Ghana) and 60% (Nigeria) of midstream jobs. Malawi also shows a strong female presence in midstream employment, with women owners generating roughly 59% of agri-midstream jobs, although their share in food retail is lower at about 37%. In contrast, Ethiopia and Uganda exhibit a more male-dominated ownership and employment structure in these segments: female-owned firms account for only about 28% and 32% of food-retail jobs, and roughly 20% of agri-midstream jobs, respectively.

The gender patterns indicate that women's enterprise ownership is central in food retail and in some midstream activities, and that women-owned firms make a substantial contribution to wage employment even where average hiring rates are lower. In practical terms, strengthening food system MSMEs often means strengthening the enterprise activities of farm households themselves, and improving the conditions under which both men and women entrepreneurs can invest, expand, and employ labor.

Finding 1.4: Clusters are key for dynamic commercial SSPs and MSMEs development and inclusiveness.

Territorial "clusters" in our work refer to places where commercial small-scale producers and agrifood MSMEs are more concentrated and economically active, creating denser local value-chain linkages. We capture this idea with a territorial Cluster Index of agrifood dynamism, built from indicators that jointly describe commercialization and MSME activity: (i) the share of land dedicated to commercial production by smallholders, (ii) the volume and monthly revenue of downstream agro-related enterprises (for example, retailers and processors), (iii) the density of agriculture-oriented MSMEs, and (iv) the number of output traders. These components are combined via principal component analysis (PCA) and normalized to the 0–1 scale, so higher values indicate territories with stronger agrifood ecosystems and more intense interactions among commercial farmers, enterprises, and traders.

Because the underlying indicators in the Cluster Index move together (they load onto the same "dynamism" factor), a higher Cluster Index can be interpreted as a setting where MSME presence and local economic activity co-occur with stronger agricultural commercialization. In practical terms, territories with higher MSME density, higher downstream enterprise revenues, and more traders are

also the territories where a larger share of land is oriented toward commercial production, and where output-market engagement (selling any amount of crop) is more common.

As shown in Box 4, households that are commercially engaged (selling crops) and/or operate MSMEs tend to achieve better well-being outcomes, and these gains are often larger in territories with higher densities of commercial producers and agrifood MSMEs, that is, in more dynamic clusters. In practical terms, the combination of market engagement and a strong local economic ecosystem is associated with higher values of our Inclusion Index and improvements across its core components, including empowerment[3], resilience, food security, off-farm income opportunities, and poverty reduction (see Box 4 that explains the Inclusion Index and its components).

BOX 4 **Welfare, MSMEs, and Inclusion in Rural Africa (Cluster and Inclusion Indices)**

Trivelli et al., (2025) analyses the links among participation in commercial agriculture (selling any crop) and/or operating a household MSME to a broad, multi-dimensional, measure of inclusion. It also tests whether households benefit more when they operate in dynamic "agrifood cluster" territories where commercial farmers and agrifood MSMEs are dense and active.

The study answers: Is SSP participation in commercial agriculture and/or a household-run MSME associated with better inclusion outcomes? Do territorial conditions amplify these gains, especially in places with dense and active agrifood systems (clusters)? And, if the patterns differ by country income level and by farm size?

Inclusion Index how it is built

Composed inclusion index is build based on five household-level indicators: (i) women's empowerment score (adapted A-WEAI), (ii) resilience index (RIMA-II aligned), (iii) food consumption score (WFP method), (iv) per capita non-farm cash income, and (v) per capita consumption expenditures (for Malawi, an asset-based wealth index is used where consumption data are unavailable).

Cluster Index: what does it capture?

A territorial measure of agrifood dynamism and interconnection, combining information on commercial small-scale producers (cSSPs), agrifood MSMEs, and traders. Built using PCA on indicators such as share of land in commercial production, number and crop sales of commercial SSPs, number and revenue of downstream agrifood enterprises, density of agriculture-oriented MSMEs, and trader presence (all in per capita terms).

[3] Fuica & Li (2026) provide complementary LSMS-ISA panel evidence (Ethiopia, Malawi, Tanzania, Uganda, Nigeria; 2010–2020) on how agricultural commercialization relates to women's empowerment using a modified A-WEAI, two-way fixed effects, Double Machine Learning, and matched difference-in-differences. They find the strongest empowerment gains at market entry (first sale), with smaller gains as sales portfolios become more dominated by non-staple (high-value) crops, but still positive, and greater among SSPs who are diversified in production.

Calculated for "territories" (aggregations of districts; Nigeria uses states; Ghana uses regions) and normalized to a 0 to 1 scale for tracking over time.

Core result: participation in commercial agriculture (selling crops and/or running an MSME) is associated with higher Inclusion Index (standard deviations), all statistically significant (Table 4).

Key findings

- When analyzing each component of the Inclusion Index, SSPs participating in commercial activities is most consistently linked to higher empowerment and higher non-farm income. Food security and resilience gains are present but smaller in several countries (Figure B1).
- Inclusion gains are not limited to large farms: positive associations appear across all farm-size categories, including very small landholdings in several countries.
- Territorial context matters: the cluster-participation (being commercial) interaction is strongest in Ethiopia, suggesting households gain more from participation when they are located in more dynamic agrifood territories.
- In Nigeria and Malawi, the Cluster Index itself is positively associated with inclusion outcomes, suggesting spillovers that benefit even non-participants.

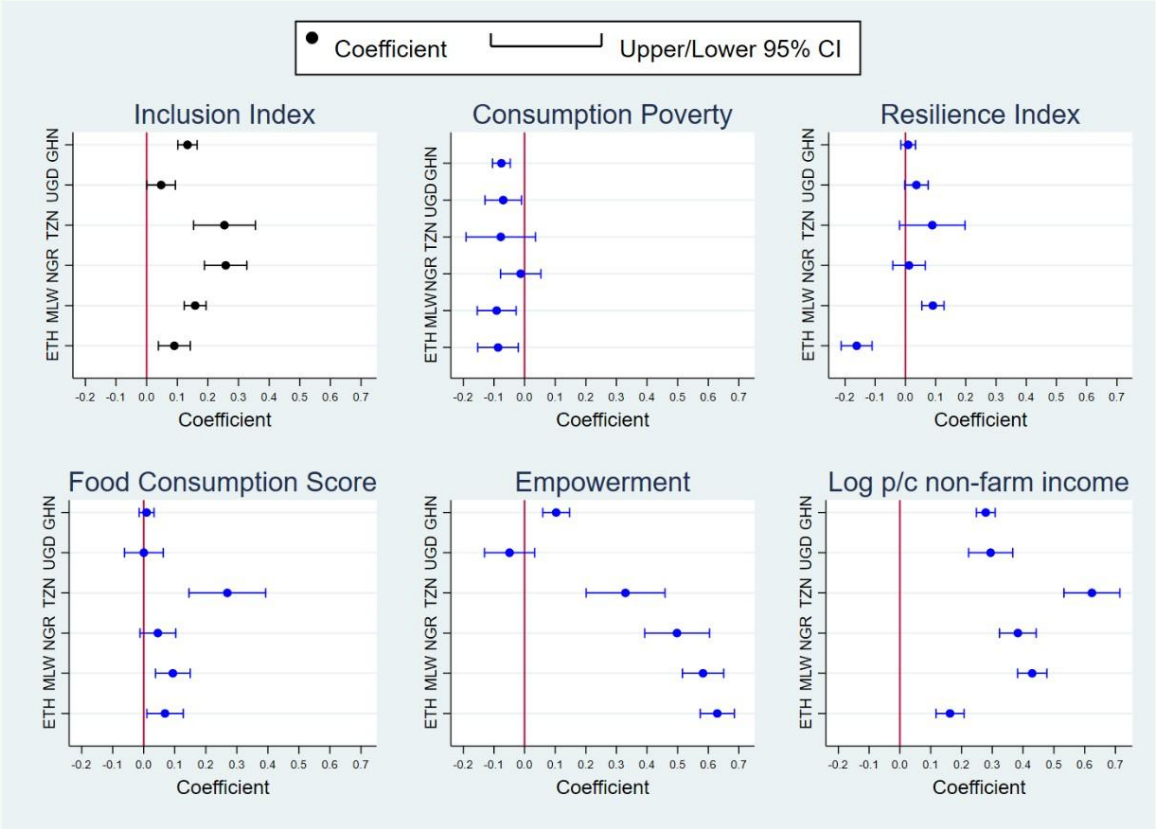
Robustness and interpretation notes

Alternative participation definitions (commercial agriculture only, MSME only, share of crops sold) show similar positive patterns in most countries. Overall, the paper's main message is about strong, consistent associations; causal interpretation should be made carefully.

Table 4. Estimated association for participation on Inclusion Index

Country	Estimated association with Inclusion Index
Nigeria	+0.31 s.d. (strongest)
Tanzania	+0.19 s.d.
Malawi	+0.16 s.d.
Ghana	+0.14 s.d.
Ethiopia	+0.08 s.d.
Uganda	+0.06 s.d. (smallest)

Figure B1. Two-way fixed effect regressions, inclusion dimensions on participation, household controls, by country.

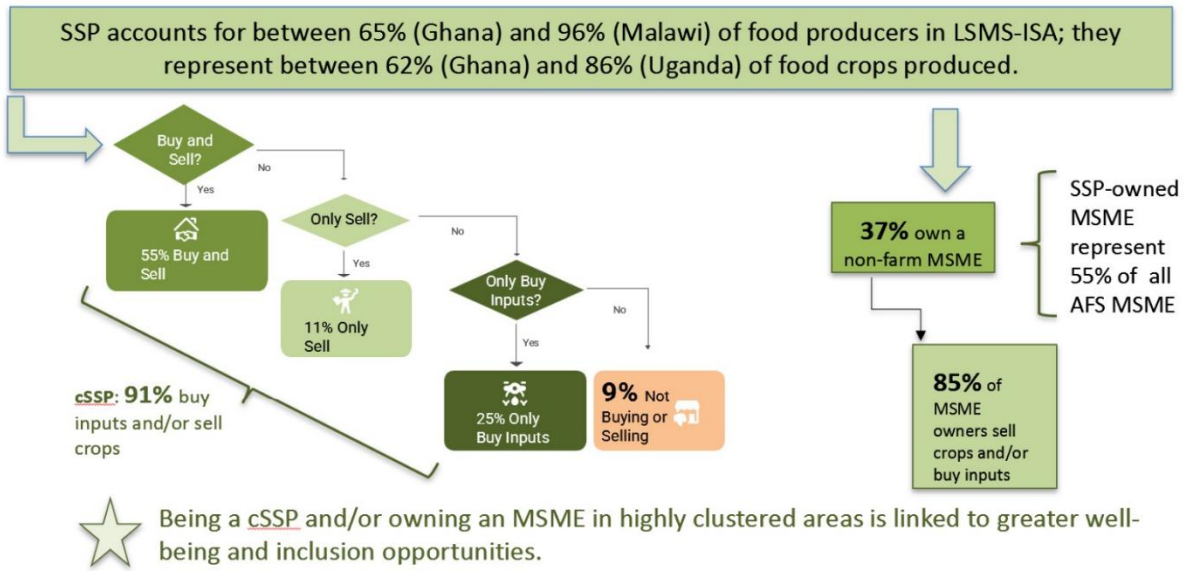


Source: Trivelli et al. (2025)

In summary, the results in Figures 6 to 9, taken together, reinforce our broader interpretation of SSPs as deeply embedded in the rural economy. SSPs are not only selling crops and purchasing inputs, but they are also major owners of non-farm enterprises that constitute much of the rural MSME landscape. The household income profiles show why these enterprises matter, especially where agriculture accounts for a smaller share of total income or where wage labor is a major source of income.

In Figure 10, we present a summary representation of the commercial SSPs in these six African countries, based on their participation in the agrifood markets as crop sellers, input buyers, and MSME owners and workers. However, as stated before, they are also connected to labor markets (as part of the income diversification strategies) and to consumption markets, including food markets.

Figure 10. Summary of SSP presence and market engagement.



SSPs and Commercialization in Odisha, India, and Kenya

From our case studies -analyzed in detail in messages 3, 4, and 5 of this working document, and in the case studies reports (Kirimi et al., 2026, for the tomato value chain in Kenya, and Belton et al., 2026, for Odisha)- we corroborate that SSPs dominate the horticulture value chain and that they are highly commercial.

Survey data from the Kenyan tomato value chain show that most of the first tomato harvest is sold rather than used at home. In the latest production cycle, the median quantity picked in the first harvest was about 0.81 t per plot. Out of that, growers reported selling roughly 0.68 t, equivalent to about 85% of the harvest. The share of crop sold does not vary significantly by land size. Small farmers sell, on average, 83% of the harvested tomatoes, while medium-sized farmers sell 88%, and large farmers 86% of their tomato production. There is also very little variation throughout the three main production zones.

Home consumption was minimal, with a median of only 35 kg (≈4.3% of the harvest) being kept for household use. Almost every farmer who reported harvesting tomatoes sold some, and 67% kept some for home consumption.

On the input side, the picture is one of intensive buying. More than four-fifths of growers purchase seedlings rather than producing their own, and they spend substantial sums on planting material (mean spending ≈KES 67,000 per plot). Virtually every farmer applies inorganic fertilizer (averaging about 180 kg per plot) and nearly all plots are treated with pesticides; herbicides are used much less frequently. These figures highlight that tomato production in this sample is highly commercialized: farmers invest heavily in purchased inputs and rely on the crop as a cash generator rather than a subsistence food source.

Compared to Kenyan tomato small scale producers, with a median of 1.2 ha of land, Odisha farmers growing vegetables are smaller in scale: the average area of land operated by vegetable farmers (0.9 ha)

is 29% larger than that operated by non-vegetable farmers (0.7 ha), but small in relative terms: the average area of land operated by vegetable farms in land tercile 3 (i.e. the largest third) is 1.8 ha.

Our Odisha horticulture study reveals that 74% of vegetables produced were sold in the market. The share of market surplus varies depending on production conditions; for example, farmers with irrigated land sold on average 77% of their production, while farmers depending on rain sold only 60% of their crops. By caste and tribe, non-scheduled caste farmers sold on average 70% of their crops. By comparison, scheduled Tribe farmers sold 77%. But all vegetable producers sell a significant portion of their production. The horticultural commercialization rate is much higher than that found in rice cultivation in the same production zones: non-vegetable farmers sold 47 percent of their rice crop.

All horticultural producers purchased inputs in the market, but most farmers are in a transitional stage of the agricultural transformation. Hybrid vegetable seed, inorganic fertilizers, pesticides, and mechanized land preparation are widely adopted. Still, adoption of more advanced technologies that could lead to greater commoditization (e.g., seed trays, seedlings purchased from nurseries, plastic mulch, drip irrigation, and drones) remains low. Adoption of environmentally friendly inputs such as vermicompost, organic pesticides, and insect traps is limited.

As with tomato producers in Kenya, input suppliers in Odisha are key as providers of training and advice.

Commercialization of horticultural production does not affect home consumption of vegetables; on the contrary, vegetable-farming households consume a greater diversity of vegetables more frequently and have significantly higher household diet diversity scores than non-vegetable farmers.

In general terms, vegetable farmers have significantly higher agricultural incomes than non-vegetable farmers. The average annual agricultural income earned by vegetable farming households is ₹46,188 ($530) - 24 percent higher than that earned by non-vegetable farmers. However, the average household incomes of rice and vegetable farmers, excluding government transfers, are not significantly different, suggesting that non-vegetable farming households may specialize more in non-farm employment. In contrast, the labor-intensive nature of vegetable cultivation may limit opportunities for such work.

Key message 2: Horticulture value chains represent a growing and attractive option for SSP

Horticulture production, trade, and domestic supply (2010-2023)

Based on FAOSTAT Food Balance quantities (production, imports, exports, and food supply quantity, as a proxy for domestic consumption) for Ethiopia, Ghana, Kenya, Malawi, Nigeria, Tanzania, and

Uganda, a clear pattern emerges: domestic horticultural[4] supply is expanding. At the same time, international trade remains small, relative to the scale of national production.

Across the seven countries analyzed (Ethiopia, Malawi, Tanzania, Uganda, Ghana, Nigeria, and Kenya), combined horticultural production rises from about 9.8 million tons in 2010 to about 15.8 million tons in 2023 (+61%). Over the same period, the food-supply quantity (used here as a proxy for domestic consumption) rises from about 8.4 million tons to about 13.9 million tons (+66%). In 2023, the country's total horticultural exports were about 262 thousand tons (1.7% of total horticultural production), which is small compared to total production. Total food supply follows a similar trend to production, highlighting the small share that trade (imports and exports) has on total consumption in the countries.

Trade volumes are comparatively small relative to domestic production and food supply, and are concentrated in a few countries. In 2023, Uganda (~103.8 thousand tons), Ghana (~29.6 thousand tons), and Ethiopia (~31.8 thousand tons) accounted for the majority of horticultural imports in this sample. On the export side, Kenya (~111.0 thousand tons) is the largest exporter, followed by Ethiopia (~70.5 thousand tons) and Tanzania (~29.3 thousand tons).

Using net trade (imports minus exports), Uganda (~+78.7 thousand tons) and Ghana (~+24.9 thousand tons) are net importers in 2023. Kenya (~-110.8 thousand tons), Ethiopia (~-38.6 thousand tons), and Tanzania (~-20.6 thousand tons) are net exporters in this sample year.

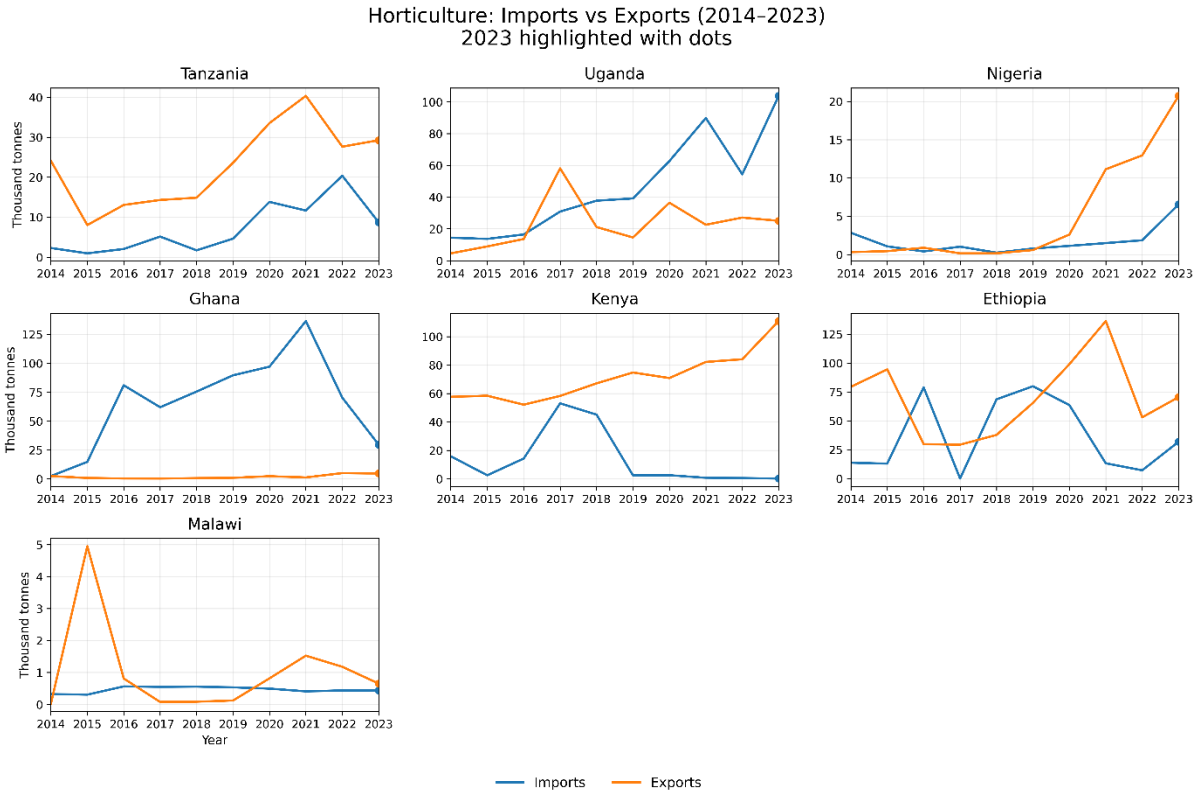
Using FAOSTAT's supply-utilization accounts for 2023, the largest imported vegetables in the two net-importing countries, Uganda and Ghana, were identified. In Uganda, onions and shallots (dry) accounted for about 40% of all horticultural imports by volume, tomatoes made up roughly 31%, and carrots and turnips around 26%. These three crops, therefore, capture almost the entire horticultural import flow into Uganda. Ghana's imports were even more concentrated: onions and shallots accounted for more than four-fifths (around 82%) of its total horticultural imports, with carrots and turnips contributing about 10% and other green beans about 6%.

Finding 2.1: growing vegetable production and consumption in SSA

In the FAO's Supply–Utilization Accounts, the element "food supply quantity" is defined as the amount of a commodity available for human consumption after subtracting exports, feed, seed, industrial processing, and other non-food uses from the total supply (production plus imports). Because of this accounting identity, food supply quantity effectively acts as a proxy for consumption: it measures the physical tonnage of vegetables reaching consumers' plates. By plotting "food supply quantity" alongside production for each country, Figure 11 illustrates both the output of horticultural vegetables and the portion of that output remaining after non-food uses; the gap between the two lines mainly reflects exports and minor losses. In most cases, the lines closely follow each other because imports are small and non-food uses of vegetables are limited; therefore, the food supply curve can be interpreted as a consumption trend.

[4] Horticulture products are as follows: tomatoes, onions (green and dry), carrots/turnips, cabbages, pumpkins/squash/gourds, cucumbers/gherkins, eggplants (aubergines), okra, spinach, lettuce/chicory, chillies/peppers (green), other green beans, broad beans (green) and peas (green).

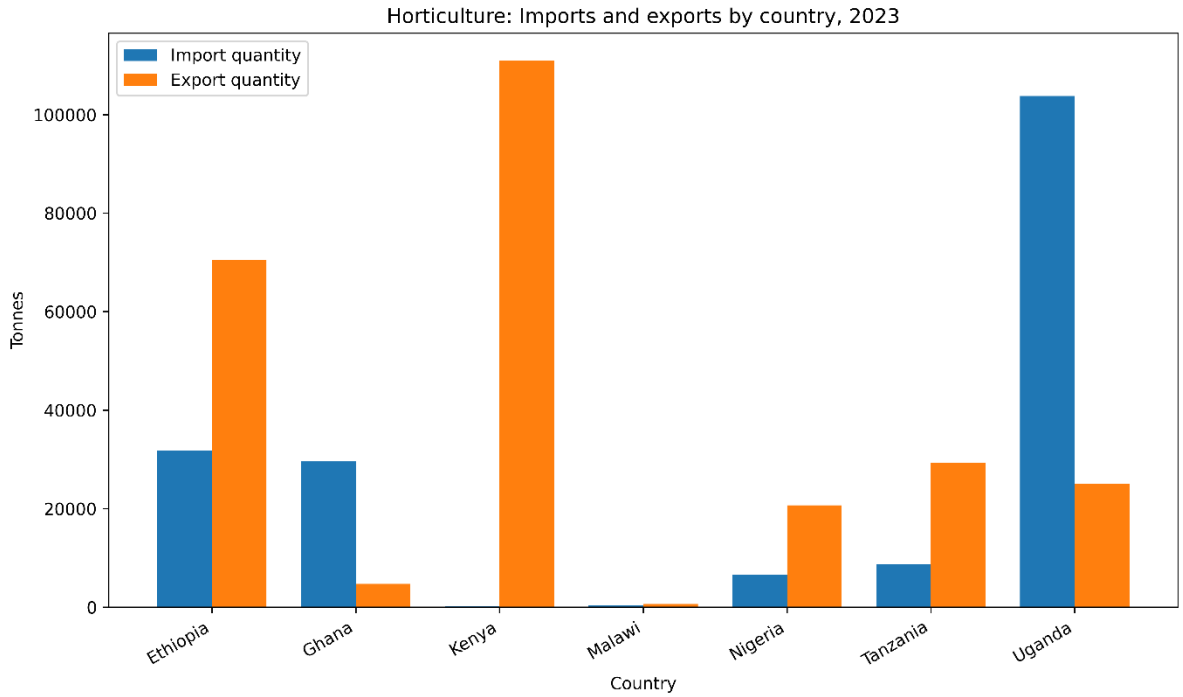
Figure 11. Horticulture total production and food supply, 2010-2023.



Source: FAOSTAT

The panels also reveal divergent consumption trajectories between 2010 and 2023. Nigeria's food-supply curve rises sharply—from about 4.45 million tons in 2010 to more than 7.4 million tons in 2023—an increase of roughly 67 %, reflecting both population growth and rising horticultural output. Kenya's consumption grew by about 27% over the period, while Ghana's rose by 20%, each showing a steady upward trend. Tanzania's food supply more than doubled (up 123 %), and Malawi's surged nearly sixfold (up 581 %), the steepest increase among the seven countries, albeit from a low base. Uganda's consumption rose by around 39 %, especially after 2015, whereas Ethiopia's food-supply curve dipped slightly (about −1 %), largely due to higher exports rather than declining output. These patterns illustrate that, despite small trade volumes (Figure 12), domestic consumption of horticultural vegetables has expanded markedly in most countries over the past decade.

Figure 12. Horticulture imports and exports by country, 2023.



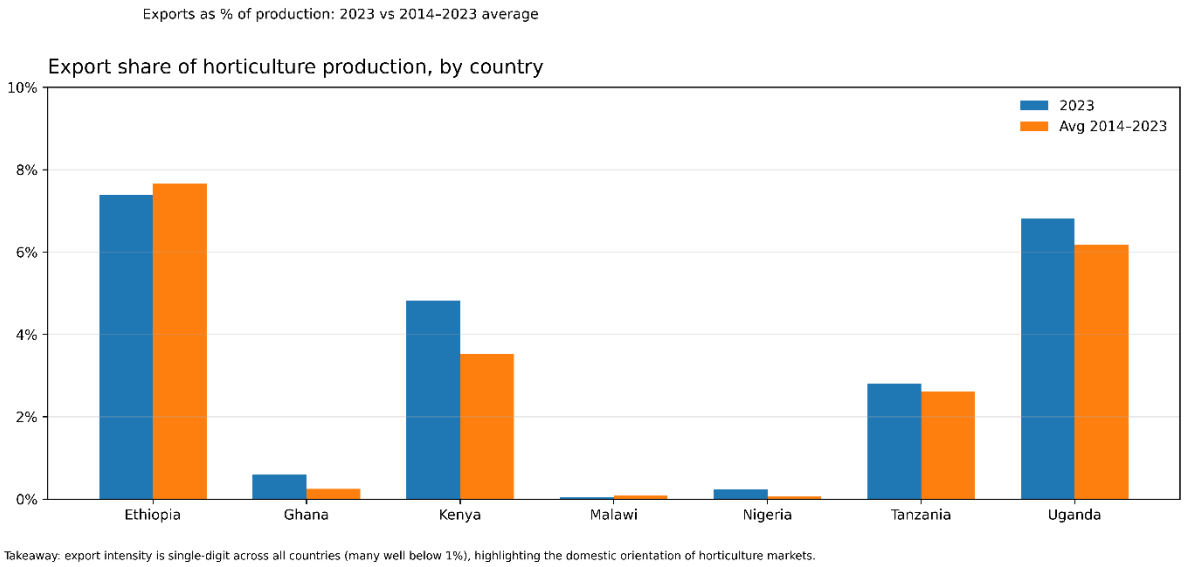
Source: FAOSTAT

Horticultural vegetables imports and exports

As shown in Figure 12, the import share in total consumption is even lower than the export share (except in Uganda), highlighting the overwhelming importance of domestic markets in these countries.

Exports as a share of total production remain limited for most countries. In 2023, export shares are below 1% in Ghana (0.6%), Malawi (0.04%), and Nigeria (0.24%). Tanzania is about 2.8%, Kenya about 4.8%, while Uganda (6.8%) and Ethiopia (7.4%) are the highest in this sample. Even over the last decade (2014-2023), average export shares remain in single digits across all countries (see figure 13).

Figure 13. Horticulture exports as a share of production by country (2023 and average 2014-2023).



Source: FAOSTAT

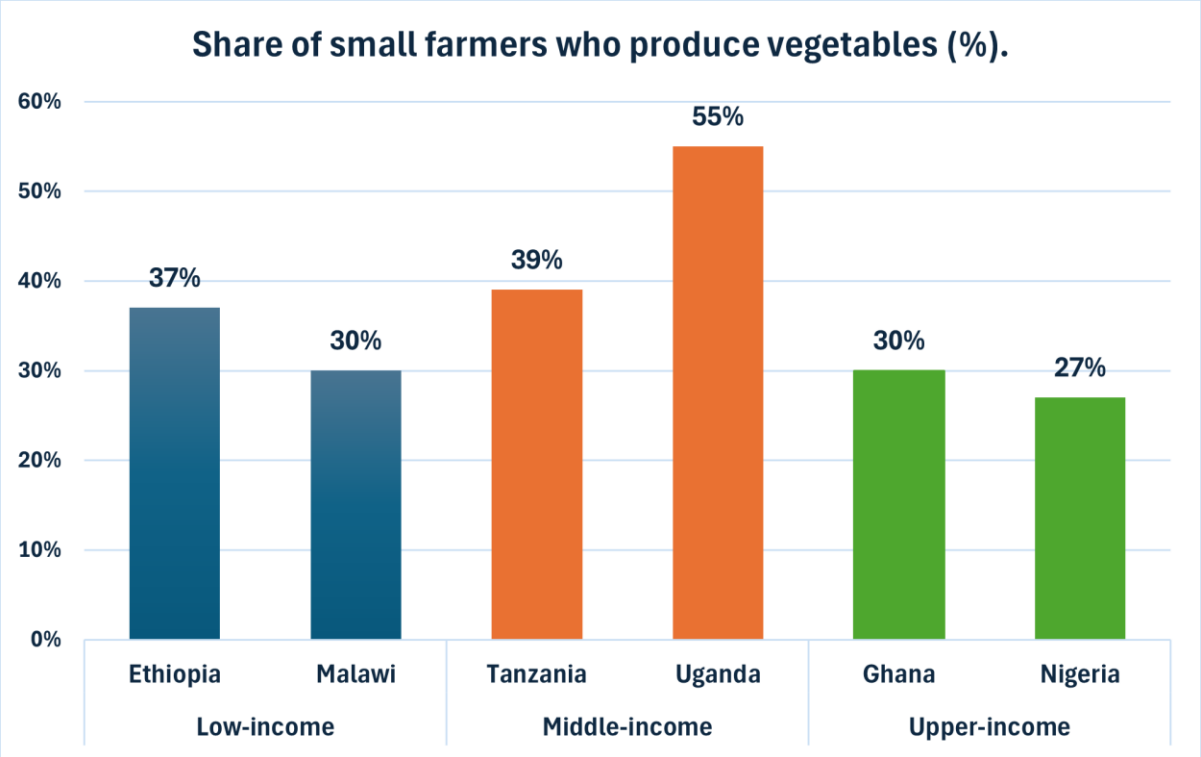
Thus, most horticulture crops are produced for domestic consumption.

Finding 2.2: SSPs are producing vegetables (based on LSMS-ISA)

Household survey evidence from LSMS-ISA complements the FAOSTAT supply story by providing a micro view of who produces vegetables[5] and how those households engage with markets. Across the five LSMS-ISA countries (Ethiopia, Malawi, Tanzania, Uganda, and Nigeria) and Ghana (GLSS), vegetable production is common: roughly 27-55% of households report producing any vegetables (with higher participation in rural areas) (Figure 14)

[5] Note: "Vegetables (horticulture)" includes common fresh and leafy vegetables and related horticultural crops captured across country questionnaires, such as cabbage, onions, tomatoes, carrots, peppers (sweet and hot), pumpkins, eggplant (including garden egg), okra, cucumbers, lettuce and other leafy greens (for example spinach, amaranth, dodo), plus selected items recorded in some countries (for example garlic, ginger, moringa, beetroot, cauliflower, green beans, and locally named vegetables).

Figure 14. Share of SSPs producing any amount of vegetables (LSMS-ISA).

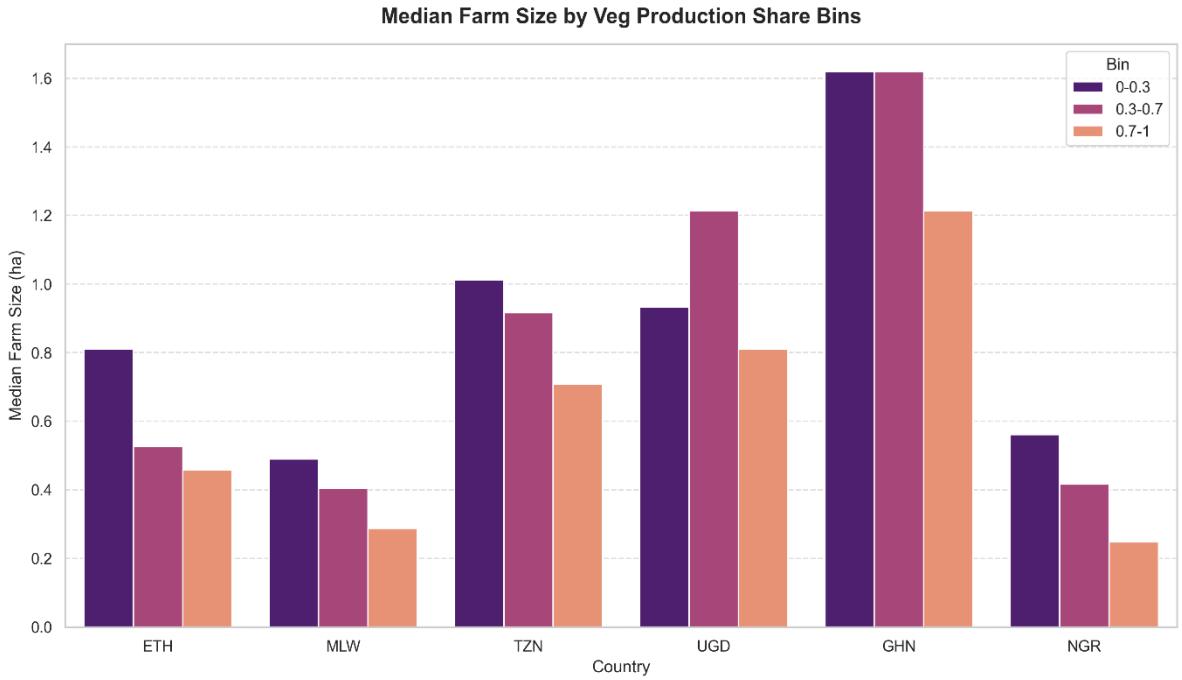


Source: LSMS-ISA

Vegetable production is closely linked to domestic markets. The share of vegetable producers who sell any vegetables ranges from about 18-28% in Malawi and Ethiopia to about 53% in Tanzania 63% in Nigeria. It is nearly universal among vegetable producers in Uganda.

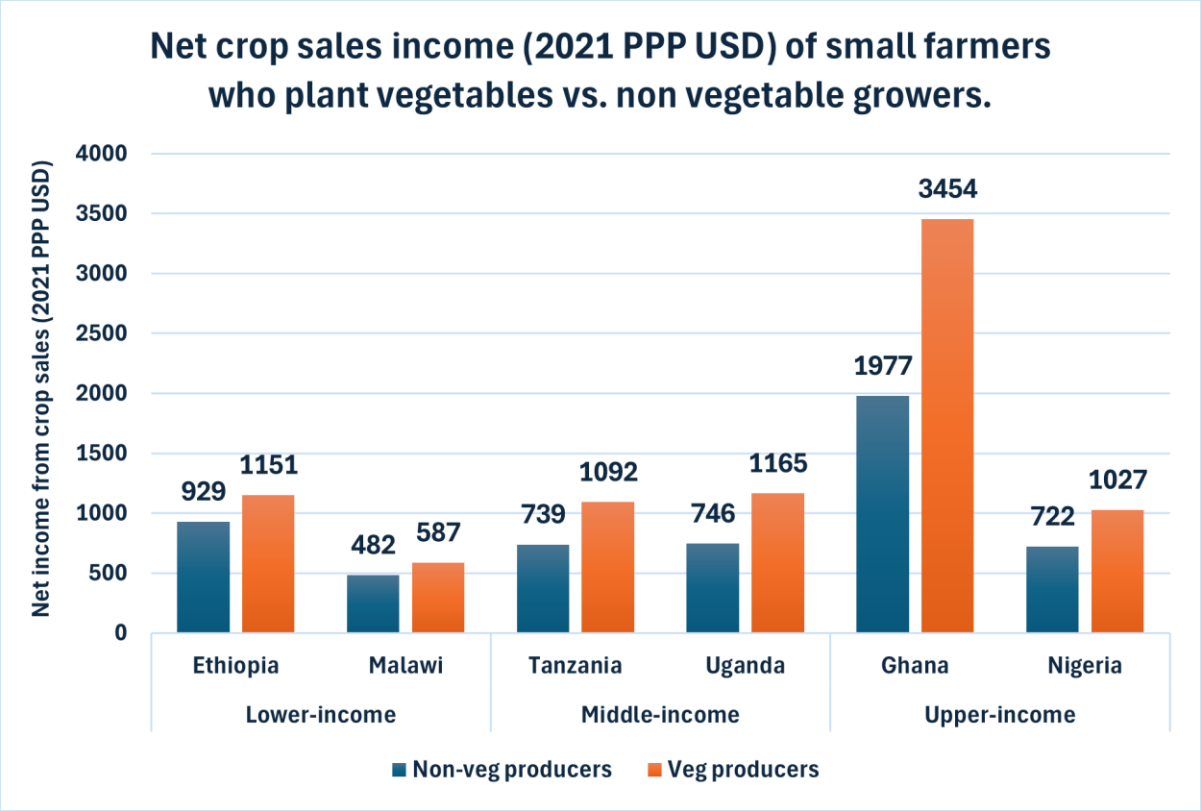
Beyond market participation, the LSMS-ISA results consistently support the idea that vegetables provide a high-value pathway on small areas of land. To capture production intensity, we classify households by the **vegetable share of total crop production value** (0–30%, 30–70%, 70–100%). Households that dedicate a larger share of crop production value to vegetables tend to operate smaller farms (Figure 15). In Ethiopia, for example, the median cultivated area falls from about 0.8 ha among households with low vegetable shares to about 0.46 ha among households where vegetables dominate production. Small farmers who produce any amount of vegetables earn greater net income (2021 PPP USD) from crop sales compared to non-vegetable producers (Figure 16)

Figure 15. Median farm size by vegetable production share bins (LSMS-ISA).



Source: LSMS-ISA

Figure 16. Comparison of net crop sales income (2021 PPP USD) between veg. and non-veg producers.

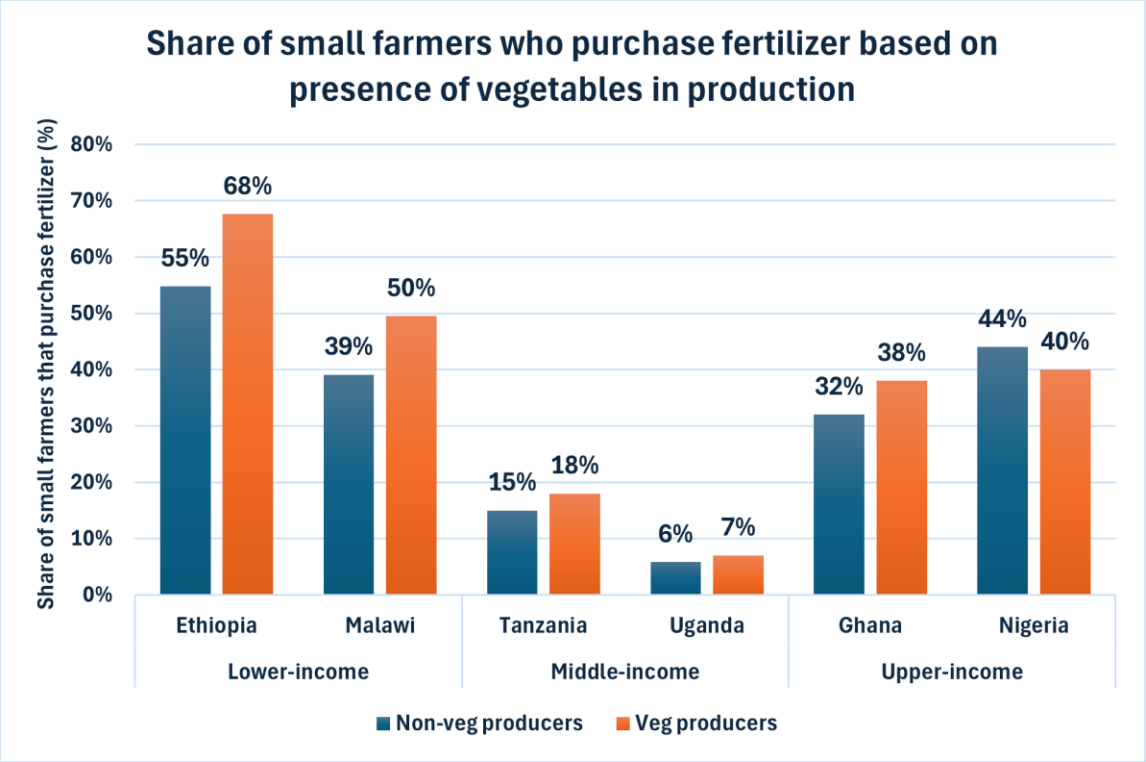


Source: LSMS-ISA. Differences in medians are all statistically significant.

Finding 2.3: Vegetable producers use more intensive agricultural inputs

Vegetable producers purchase fertilizer and seeds at rates much higher than those of non-vegetable producers in most countries (with some exceptions for Tanzania, Uganda, and Nigeria). For example, in Malawi, 39% of non-vegetable producers purchase fertilizer, compared to 50% of vegetable producers (Figure 17).

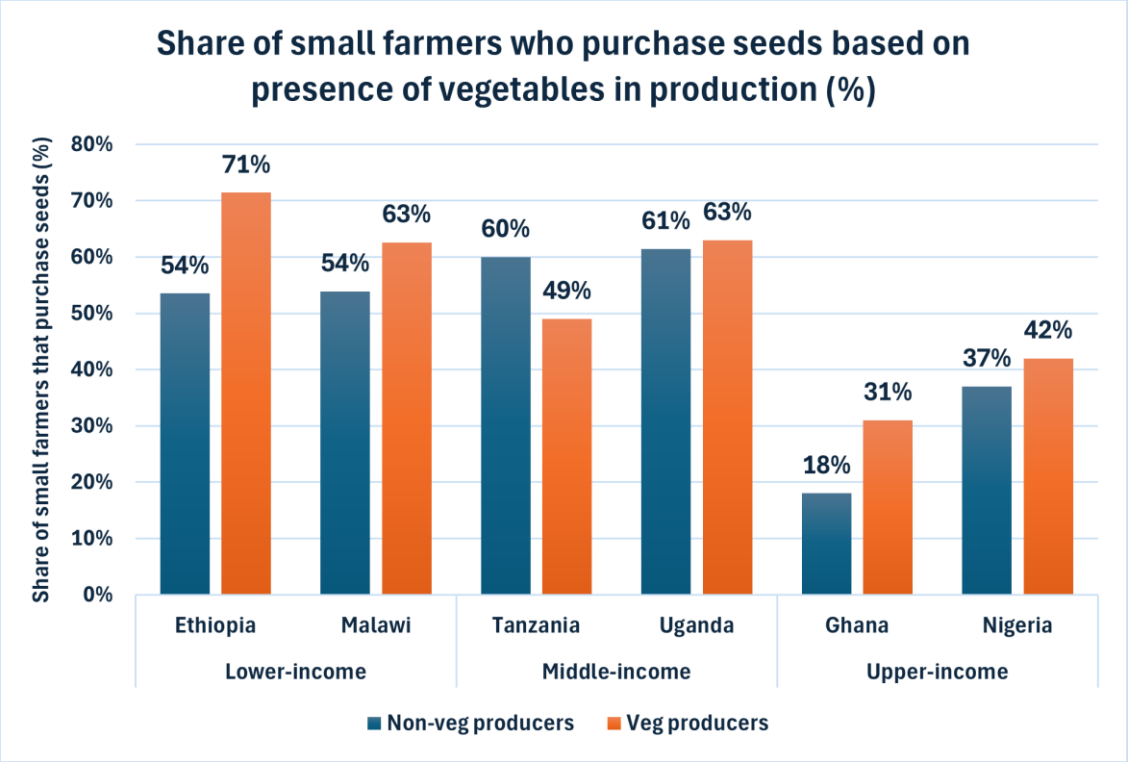
Figure 17. Percentage of SSPs that purchase fertilizers, veg. versus non-veg. producers.



Source: LSMS-ISA. Differences in averages are all statistically significant.

Vegetable producers also purchase seeds at higher rates across all countries except for Tanzania and Uganda (Figure 18).

Figure 18. Percentage of SSPs that purchase seeds, veg. versus non-veg. producers.



Source: LSMS-ISA. Differences in averages are all statistically significant except for Uganda.

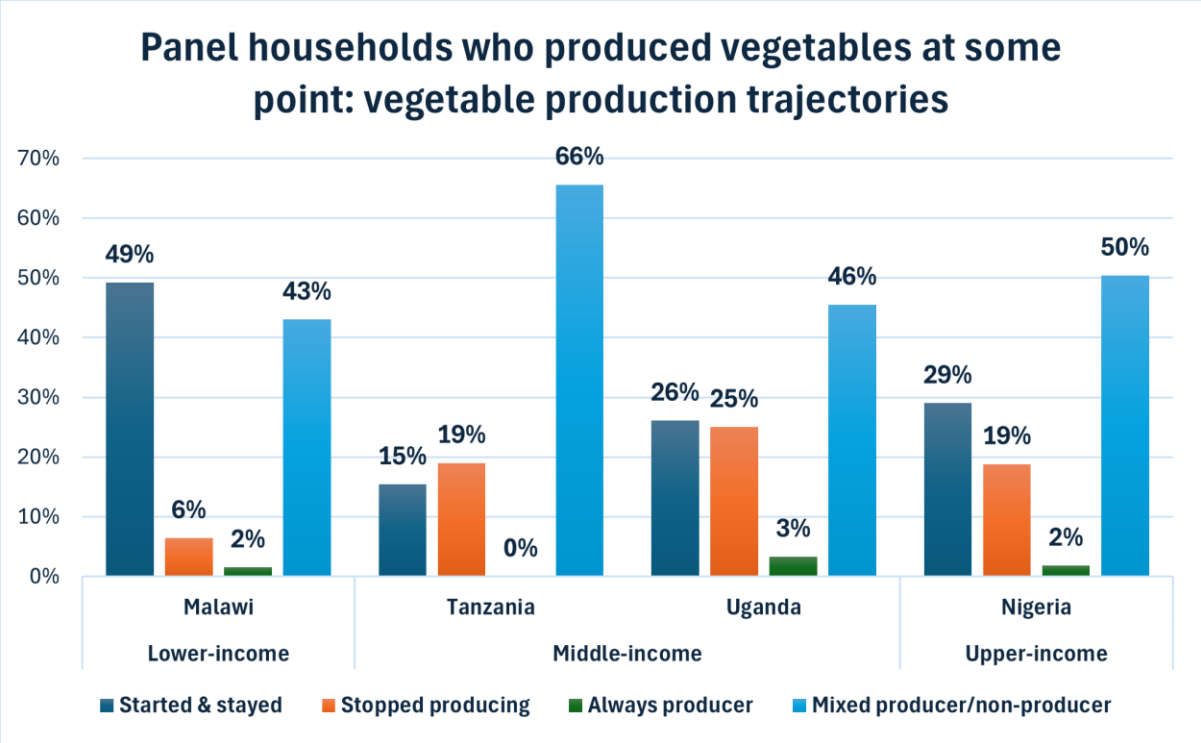
Finding 2.4: Vegetable producers also grow other crops

Based on the panel data available (LSMS-ISA), the households' vegetable production trajectory was analyzed. Using Malawi, Tanzania, Uganda, and Nigeria, which have at least four rounds of surveys, we analyze five groups:

1. Those who began the survey as non-vegetable producers and eventually became consistent producers (for example, not producing in rounds 1 & 2 and then producing vegetables in rounds 3 & 4).
2. The opposite case (stopped producing vegetables)
3. Those who always produced vegetables in the four rounds
4. Those who never produced vegetables
5. Mixed producers (produced inconsistently, for example, in round 1, then nothing in round 2, then again in round 3)

Among those who ever produced vegetables in any survey round, we find that the most common case is being a mixed producer of vegetables, except in Malawi, where most started as non-vegetable growers, and eventually became so (Figure 19). Showing that farmers enter and quit vegetable production at their convenience.

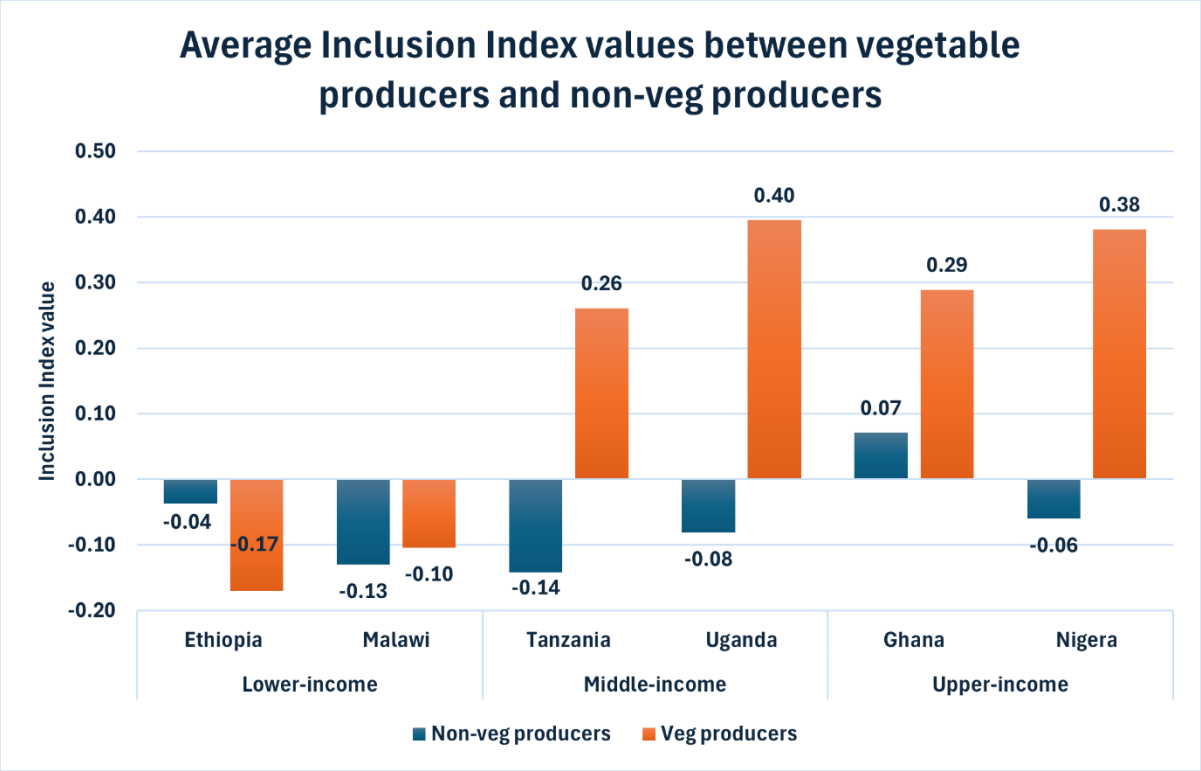
Figure 19. Panel households' analysis based on consistency of vegetable production among ever producers.



Finding 2.5: Vegetable producers are better off than those producing other crops

Vegetable producers also tend to register noticeably higher inclusion index scores in several countries, including Tanzania, Uganda, Ghana, and Nigeria (Figure 20). The inclusion index is a composite that summarizes multiple dimensions including the food consumption score, FAO's resilience index RIMA-II, IFPRI's Abbreviated Women's Economic Empowerment in Agriculture, and per-capita off-farm income and consumption expenditures. Importantly, food consumption scores, which measure dietary diversity and frequency, do not show a systematic disadvantage for vegetable producers: scores are similar or slightly higher in Malawi, Tanzania, and Uganda, and essentially unchanged in Nigeria, with Ethiopia the main exception.

Figure 20. Inclusion index: vegetable producers vs non-vegetable producers (LSMS-ISA).



Source: LSMS-ISA. Differences are statistically significant

Taken together, household evidence reinforces the macro story: vegetables are widely produced, often commercial, and associated with higher inclusion outcomes on smaller farms, without clear evidence of worsening household diets. Thus, horticulture value chains are key and valuable for the inclusive agricultural transformation.

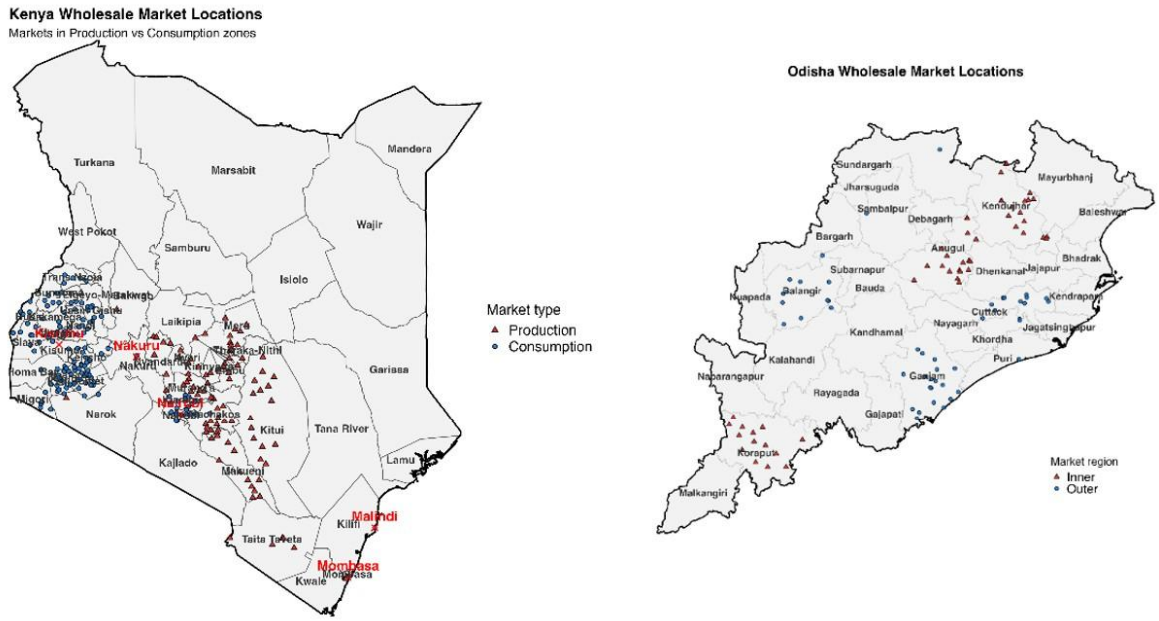
Key message 3: Wholesale markets in Kenya and Odisha are critical to value chain and cluster performance and growth. They feed and employ many, but face challenges

Food wholesale markets (WMs) in developing regions are important spaces through which massive amounts of food move every day. They feed and employ millions of people in both rural and urban areas linking directly to millions of farmers upstream and millions of consumers via hundreds of thousands of midstream and downstream value chain actors such as wholesalers, processors, retailers and food service providers. Despite their importance, WMs are scarcely considered in research and policy debates on food security. WMs are less studied within the growing but limited evidence base on the "Hidden Middle" that Reardon (2015) calls the midstream sectors because though often dynamic and rapidly changing; are often hidden from policy debates.

We draw on our unique dataset generated in a primary survey of 234 WMs in 36 counties of Kenya and 100 WMs across four blocks within six districts in Odisha, India (see Figure 21). A WM is defined as a recognized space where two or more wholesalers of any of our study products trade. A wholesaler is an intermediary who procures produce from farmers or other wholesalers and typically sells majorly to

retailers and other wholesalers, though can also sell directly to consumers. Our survey focused on WMs trading tomatoes (in Kenya) and those trading > 30 different vegetables (including tomatoes, pointed gourd, okra and cauliflower) in Odisha. Data was collected via structured interviews with groups in each market constituted of leaders of market associations and product associations, traders (women and longstanding traders and tomato or vegetable association heads concerning the origins of the markets, volumes moved in the markets, the numbers of wholesalers, retailers, transporters and allied enterprises supporting vegetable trading such as packaging materials, input supply shops, hired labor and transporters. We also collected information on the kind of infrastructure and services available in the market (e.g. functional toilets, water, electricity and security supplied to traders and other WM clients), market governance (who does the day-to-day running of the market and what functions they perform and services they provide).

Figure 21: Map of tomato WMs in Kenya and vegetable WMs in Odisha



Using the data, we address four questions: (1) What are the contributions of WMs to feeding residents of Kenya and India (2) What employment opportunities are created by WMs in trading tomatoes (vegetables) and providing allied services that support food trade (e.g. transportation, packaging etc.) (3) How inclusive is any observed contributions in terms of engagement of women and marginalized groups? (4) What services are available in WMs in terms of infrastructure and public services? We present five key highlights about horticulture WMs in Kenya and Odisha.

Finding 3.1: Horticulture WMs in Kenya and Odisha handle large and rapidly growing volumes

Tomato WMs in Kenya handle large and growing volumes, with clear differences between the main tomato production and consumption zones of the country and across seasons. During the high season, an average market in production zones sells about 30 tons per day, while markets in consumption zones sell roughly 45 tons per day, or 50% more. Though volumes traded fall in the low season (more in

production zones), they remain substantial and growing. On an annual basis, a typical WM sells about 5,800 tons of tomatoes (~3,300 and 7,240 tons in production and consumption zones respectively), underscoring the central role of WMs in moving tomatoes from surplus to deficit areas. According to the Kenya National Bureau of Statistics (KNBS) Economic survey, the average per capita consumption of tomatoes in Kenya is 8.1 kg per year. Thus, a single WM supplies the annual tomato consumption of approximately 692,000 people (KNBS Economic Survey 2024).

Similar to Kenya, vegetable markets in Odisha move massive amounts of food. A typical vegetable WM handles about 90 tons per day, with substantial variation across regions. Markets in the more developed outer coastal districts, which are more developed and exposed to inter-state trade, move around 140 tons daily, while those in the less developed interior districts handle about 40 tons per day. On average, an Odisha WM sells approximately 20,900 tons annually (Table 5). Given average vegetable consumption of 210 grams per person per day (about 77 kg per year), a single WM supplies the annual vegetable consumption of roughly 271,000 people (India Household Consumption Expenditure Survey, 2024).

Table 5: Volumes and growth of tomato delivered on a typical day

	Production zones	**Consumption zones**	**All**	**Inner**	**Outer**	**All**
Number of markets	**93**	**141**	**234**	**50**	**50**	**100**
Average quantity (tons) delivered in a typical day in tons (tomato, high season)	29 (1)	45 (1)	39 (1)	41 (0.2)	140 (0.6)	90 (0.3)
Average quantity (tons) delivered in a typical day in tons (tomato, low season)	11 (1)	20 (2)	16 (2)	25 (0.2)	79(0.5)	52(0.4)
Average quantity (tons moved through the market in a year)	3,826 (2)	7,239 (2)	5,883 (2)	3,274(0.2)	3,8526 (0.5)	20,900 (0.5)
Average percentage growth in daily quantity delivered (tomato, high season, 10 years) %	553	367	443	131	38	53
Average percentage growth in daily quantity delivered (tomato,	470	226	332	98	58	60

low season, 10 years) %						
Average percentage growth in quantity (tons moved through the market in a year, 10 years) %	570	561	565	101	51	54

Source: INCATA market surveys. Note: (N) means (cv).

WM volumes have grown rapidly in both Kenya and Odisha over the past decade, though with distinct patterns across and within both countries. In Kenya, tomato WMs have expanded dramatically, with the average percentage growth in total annual volumes of more than 500% over the last 10 years, and strong average growth in both production and consumption zones at 550% and 370% respectively. Even in the low season, growth remained substantial (330%) and particularly in the production zones with 470% compared to about 225% in consumption zones. In Odisha, WM volumes have also increased markedly, but at slower rates than Kenya and more uneven growth across regions. Total annual volumes traded have increased by about 50% compared to >500% in Kenya. In the less developed inner districts, volumes on a typical day have more than doubled in the high season and nearly doubled in the low season, reflecting rapid market deepening from a lower base. By contrast, in the more developed outer districts, where volumes are already much higher, growth has been slower on average at 51 % (for the average growth in the total annual volume traded) varying across seasons between 38% in the high season and 58% in the low season. Together, these patterns show that WMs are dynamic across diverse contexts, with the fastest growth occurring either along major trade corridors (Kenya) or in the less developed inner regions catching up (Odisha).

Finding 3.2: Horticulture WMs serve as key employment hubs

WMs generate substantial direct and indirect employment in both Kenya and Odisha, though at different scales and with distinct spatial patterns. For direct employment in Kenya, tomato WMs in the production zone has an average of 40 wholesalers and 50 retailers, amounting to 8,370 wholesale and retail enterprises across 93 markets (Table 6). In consumption zones, each WM averages 24 wholesalers and 40 retailers, totaling 9,024 traders across 141 markets. Taken together, tomato WMs in Kenya directly support 17,394 wholesale and retail enterprises. Beyond traders, allied businesses (such as transporters, loaders, packaging suppliers, and other service providers) form a major source of employment. An average WM in production zones hosts 71 allied businesses, while one in consumption zones has 133. This translates to 6,603 allied enterprises in production zones and 18,753 in consumption zones, for a total of 25,356 allied enterprises across 234 markets. Combined, tomato trading and allied activities in Kenyan WMs provide livelihoods for approximately 42,750 small enterprises, the vast majority of which are MSMEs.

Table 6: Many are employed in horticulture WMs in Kenya and Odisha

	Kenya	**Odisha (India)**

	Production zones	Consumption zones	All	Inner	Outer	All
Number of markets	**93**	**141**	**234**	**50**	**50**	**100**
Average number of tomato wholesalers in 2025	40 (2)	24 (1)	30 (2)	8 (0.2)	18** (0.2)	13 (0.2)
Average number of tomato retailers in market in 2025	245 (2)	177 (1)	204 (2)	194 (0.1)	127** (0.2)	160 (0.1)
Average number of allied businesses in the market	71 (1)	133 (2)	108 (2)	23 (0.1)	30 (0.1)	27 (0.1)
Average percentage growth in number of tomato (vegetable) wholesalers over the past 10 years %	197	245	227 (1)	-6.5	149	67
Average percentage growth in number of tomato (vegetable) retailers over the past 10 years %	582	262	387 (2)	1.2	53	17
Average percentage growth in number of allied businesses over the past 10 years %	408	627	540 (2)	29	63	46

Source: INCATA market surveys. Note: (N) means (cv).

Second, Kenyan WMs also generate substantial indirect employment through their demand for farm produce. An average tomato WM handles about 5,882 tons of tomatoes annually, sourced from roughly 190 farms, based on average farm production of 31 tons per hectare per production cycle and one cycle per year since farmers typically only produce in one season a year (done by more than 80% of our sample of tomato farmers). Supplying the 234 tomato WMs in the study therefore requires production from approximately 44,400 tomato farms, each relying on both family labor and hired workers to meet market demand. WMs thus play a critical role in sustaining farm level employment well beyond the market boundaries.

A similar pattern emerges in Odisha, though at a smaller scale and with some spatial contrasts. In the inner districts, an average vegetable WM has 8 wholesalers and 194 retailers, yielding about 7,400 wholesale and retail enterprises across 50 markets. In the more developed outer districts, each WM averages 18 wholesalers and 127 retailers, totaling 7,250 traders across 50 markets. Taken together, vegetable WMs in Odisha generate about 14,650 jobs in direct trading activities (wholesale and retail). Allied businesses further expand WM contribution to livelihoods. An average WM hosts 23 allied enterprises in inner districts and 30 in outer districts, amounting to 1,150 and 1,500 allied enterprises. Together, trading and allied activities across 100 markets support approximately 17,300 small enterprises (1150+1500+14,650).

As in Kenya, WMs in Odisha also generate significant indirect employment through agriculture. An average vegetable WM handles about 20,900 tons of vegetables annually, sourced from hundreds to thousands of farms, each relying on family and hired labor. These linkages underscore the role of WMs as major drivers of both on farm and off farm employment across diverse regional contexts.

Finally, employment growth in WMs has been rapid in both Kenya and Odisha over the past decade, though with contrasting patterns. In Kenya's tomato WMs, employment has expanded sharply across production and consumption zones. The number of wholesalers per market increased by 200% in production zones and 250% in consumption zones, while retail activity grew even faster; by 580% in production zones and 260% in consumption zones. Growth in allied businesses (such as transport, packaging, and services) has been similarly dramatic, rising by 408% in production zones and 627% in consumption zones. In Odisha, by contrast, employment growth in vegetable WMs has been highly uneven across regions. In the more developed outer districts, the number of wholesalers per market grew by 149% between 2015 and 2025, with retailers increasing by 53% and allied businesses by 80%. This stands in sharp contrast to the inner districts, where average wholesale employment stagnated or declined, with average growth rate for wholesalers falling by 7%, retailers growing by only 1%, and allied businesses increasing by 34%. Together, these patterns highlight that while WMs are generating substantial employment across diverse contexts, growth is fastest either along major trade corridors (as in Kenya) or in more connected, higher-volume regions (as in Odisha's outer districts).

Finding 3.3: While Kenyan tomato WMs are inclusive (and increasingly so) of women entrepreneurs, Odisha vegetable WMs are less inclusive

Contrary to conventional wisdom that women are largely confined to low-barrier trading activities such as retail, the evidence from Kenya shows that women dominate both tomato wholesale and retail (see Table 7). On average, 67% of tomato wholesalers in Kenya are women; 58% in production zones and 73% in consumption zones. As expected, women also dominate retailing, accounting for 79% of tomato retailers in production areas and 82% in consumption areas. In Odisha, by contrast, women's participation in vegetable trade is markedly lower. Women are almost entirely absent from vegetable wholesaling, representing only 2% of wholesalers in inner districts and 3% in outer districts. While women are more visible at the retail level, vegetable retailing remains male-dominated overall, with women accounting for about 28% of retailers. Participation is higher in the more traditional inner districts (35%) than in the outer districts (21%), where commercial expansion appears to have disproportionately favored male traders.

Table 7: Women are highly engaged in Kenyan tomato WMs, but less so in Odisha vegetable WMs

	Production zones	**Consumption zones**	**All**	**Inner**	**Outer**	**All**
Number of markets	**93**	**141**	**234**	**50**	**50**	**100**
Average percentage of female wholesalers in the market	58 (0)	72 (0)	67 (0)	2.4 (0.6)	3.3 (0.5)	2.9 (0.4)
Average percentage of female retailers in the market	79 (0)	82 (0)	81 (0)	35 (0.1)	21 (0.2)	28 (0.1)

Average percentage change in share of female wholesalers (10 years)	10 (2)	3 (5)	0.7 (86)	0.8 (1)	0.8 (0.6)	0.7 (0.9)
Average percentage change in share of female retailers (10 years)	2 (7)	1 (12)	33.2 (11)	18.6*** (0.2)	26.4 (0.1)	33.2 (0.1)

Source: INCATA market surveys. Note: (N) means (cv).

Second, women's engagement in tomato wholesale and retail in Kenya is not a recent phenomenon though it continues to grow, particularly in production zones. Between 2015 and 2025, the share of female wholesalers increased by 10 percentage points in production zones and 3 percentage points in consumption zones. In comparison, women's participation in retail grew at a slower pace (2 percentage points in production zones and 1 percentage point in consumption zones) over the same period. This contrasts with Odisha where the share of female wholesalers has largely remained the same over the last decade, growing less than 1 percentage point. However, among retailers, female engagement appears to be on the increase, particularly in the inner districts where the percentage change in share of women retailers increased by 33 percentage points compared to slower growth in the outer districts of 19 percentage points. Odisha WMs also exhibit very low participation of marginalized caste groups. Scheduled Castes (SCs) accounted for only 1% of wholesalers and 10% of retailers in the study markets, while Scheduled Tribes (STs) represented less than 1% of wholesalers and only 6% of retailers. These figures stand in contrast to their demographic significance in Odisha, where SCs and STs constitute approximately 17% and 23% of the state population, respectively (Belton, Narayan et al., 2026).

Finding 3.4: Both Kenyan and Odisha horticulture WMs face infrastructure challenges

Five key findings highlight major infrastructure and service gaps in wholesale markets (WMs) in both Kenya and Odisha, with important cross country and within country differences (Table 8).

Table 8: Market infrastructure in Odisha and Kenyan horticulture WMs

	Production zones	**Consumption zones**	**All**	**Inner**	**Outer**	**All**
Number of markets	**93**	**136**	**234**	**50**	**50**	**100**
Percentage of markets with improved flush or pour-flush toilets/any toilet* (%)	53	64	59	22	38*	30
Average number of traders per toilet in the market (conditional)	133 (1)	150 (1)	143 (1)	110 (0.3)	97 (0.4)	102 (0.2)
Percentage of markets with security (%)	58	55	56	86	98**	92

Percentage of markets with electricity from the grid (%)	82	78	79	20	56***	38
Average number of hours per day (conditional on having grid electricity)	22 (0)	23 (0)	22 (0)	18 (0.1)	21* (0)	20 (0.1)
Percentage of markets with electricity from solar (1/0)	50 (1.0)	20 (2.1)	30 (1.5)	N/A	N/A	N/A
Water sources in the market						
Percentage of markets with no water (1/0)	27	30	29	18	18	18
Percentage of markets with pipe borne water (1/0)	70	56	62	20	50***	35
Percentage of markets with a borehole (1/0)	59	48	52			
Percentage of markets with a tubewell				66	66	66
Percentage of markets with a drinking water point				22	46**	34

Source: INCATA market surveys. Note: (N) means (cv). * in Odisha the numbers are for any toilet

First, access to sanitation is substantially better in Kenya than in Odisha, though gaps remain in both. About 60% of Kenyan tomato WMs have improved flush toilets (87% have at least a toilet of any kind), with coverage lower in production zones (53%) than in consumption zones (64%). Where toilets exist, trader to toilet ratios average about 135 traders per toilet in production zones and 150 in consumption zones. In Odisha, sanitation coverage is far more limited: only 30% of WMs have any toilet at all, with stark differences across districts. Toilets are present in 40% of markets in the more developed outer districts, but in only about 20% of markets in the inner districts. Conditional on having a toilet, trader to toilet ratios in Odisha average around 100, ranging from 100 in outer districts to 110 in inner districts.

Second, while more than half of WMs in both Kenyan and Odisha have security services, the presence is much higher in Odisha (ranging between 86% in markets in the inner districts and 98% of those in the outer districts) compared to 55% and 58% in WMs in Kenya's consumption and production zones respectively.

Third, access to electricity is far more common in Kenya than in Odisha. In Kenya, about 80% of WMs (in both production and consumption zones) are connected to the national grid and enjoy nearly continuous supply, averaging 22 hours per day in production zones and 23 hours per day in consumption zones. In contrast, only 38% of WMs in Odisha have access to electricity, with stark spatial inequality. Only 20% of WMs in the inner districts have electricity from the grid compared to 56% in the outer

districts. However, conditional on having electricity from the grid, electricity supply is quite constant; available for about 20 hours a day, on average.

Fourth, lack of water access is a significant challenge in WMs in Kenya and Odisha. In Kenya, about 30% of tomato WMs have no access to water, a problem common to both production and consumption zones. In Odisha, water access is a bit more widespread, with 18% of markets lacking any water source.

Fifth, the sources of water differ markedly across and within the two countries. Among the 70% of Kenyan tomato WMs with water, the main sources are piped water (available in 70% of production zone markets and 60% of consumption zone markets) and boreholes (used by 60% and 50% of markets, respectively), with many markets relying on both. In Odisha, tube wells are the dominant water source, present in 66% of markets across both inner and outer districts. Piped water is available in 50% of markets with water in outer districts, but only 20% in inner districts. Drinking water points are also much more common in the outer districts (46%) than in the inner districts (22%).

Finding 3.5: Horticulture WMs in Kenya and Odisha are regular spaces for multiple trading activities, serving supply chains that span districts and zones.

Four key patterns highlight how and where WMs in Kenya and Odisha trade and are governed, with important contrasts across contexts (Table 9).

Table 9: Market governance and activities

	Production zones	**Consumption zones**	**All**	**Inner**	**Outer**	**All**
	93	**141**	**234**	**50**	**50**	**50**
Percentage of markets run by both govt and the market authority/private committee (%)	58	53	55	2	12	7
Percentage of markets run by only the market authority or committee (1%)	24	13	18	4	12	8
Percentage of markets run by only the government (%)	9	23	17	76	52	64
Average number of days a week market operates now	6 (0)	6 (0)	6 0)	2	5	4
Average number of days markets were open in 2025	6 (0)	6 (0)	6 0)	2.4 (0)	5.4 (0)	3.9 (0)
Average number of days markets were open in 2015	6 (0)	6 (0)	6(0)	2.3 (0)	5.0 (0)	3.6 (0)
Percentage of markets that operate all year 2025 (%)	99	96	97	22	72	47

Percentage of markets that operated all year in 2015 (%)	99	98	98	21	58	39
Percentage of markets where retail activity occurs in the market (%)	99	97	98	96	98	97
Percentage of markets where grains are sold (%)	96	99	97	90	50	70
Percentage of markets where non-grain staples (Tubers or pulses) are sold (%)	99	98	98	94	66	80
Percentage of markets where fruits are sold (%)	100	100	100	84	88	86
Percentage of markets where other vegetables are sold (%)	100	100	100	N/A	N/A	N/A
Percentage of markets where fish products are sold (%)	19	89	61	88	62	75
Percentage of markets where livestock products are sold (%)	85	91	89	60	46	53

Source INCATA market survey. Note: (N) means (cv).

First, tomato WMs in Kenya are predominantly permanent, daily markets. They typically operate year-round, six days per week, a pattern that has remained stable over the past decade (Table 9). In contrast, vegetable WMs in Odisha are more often periodic. Markets in the more developed outer districts operate on average five days per week, while those in the inner districts operate only for about two days per week. Over time, expansion of market activity in Odisha has been driven not only by growth in traded volumes, but also by an increase in the number of markets operating all year (not seasonal), trading days for some markets and the establishment of more vegetable WMs.

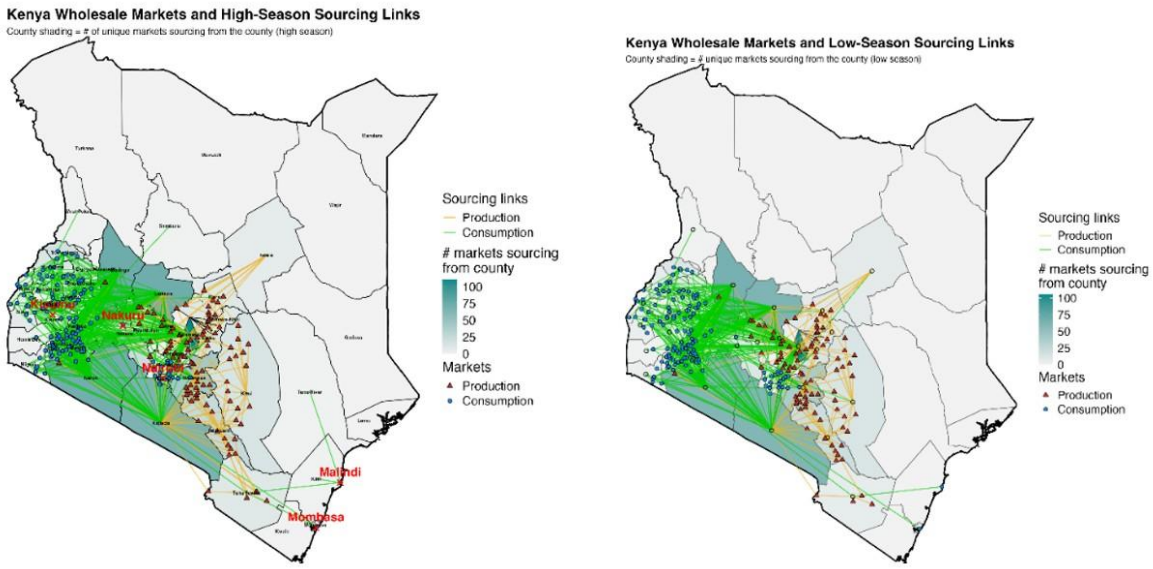
Second, WMs in both settings are highly diversified and commonly combine wholesale and retail functions. In Kenya, tomato WMs are always mixed markets, trading multiple products alongside tomatoes, and 100% also hosting retail activity. A similar pattern is observed in Odisha, where 85–95% of vegetable WMs sell products beyond the focal vegetable, and 97% of markets combine wholesale and retail trading. This highlights the multifunctional role of WMs as aggregation, redistribution, and retail nodes within local food systems.

Third, governance structures differ markedly between Kenya and Odisha. In Kenya, most tomato WMs are managed by market committees, accounting for about 80% in production zones and 70% in consumption zones, but with government oversight also widespread. Approximately 70% of markets in production zones and 80% in consumption zones report some form of government management. In practice, 55% of markets are jointly overseen by both market committees and government authorities,

while roughly 20% are managed exclusively by committees and another 20% solely by government. This contrasts sharply with Odisha, where WMs are predominantly government run (though with significant growth in privately run markets more recently), accounting for 64% overall, with government management ranging from 52% in WMs in outer districts to 76% in inner districts.

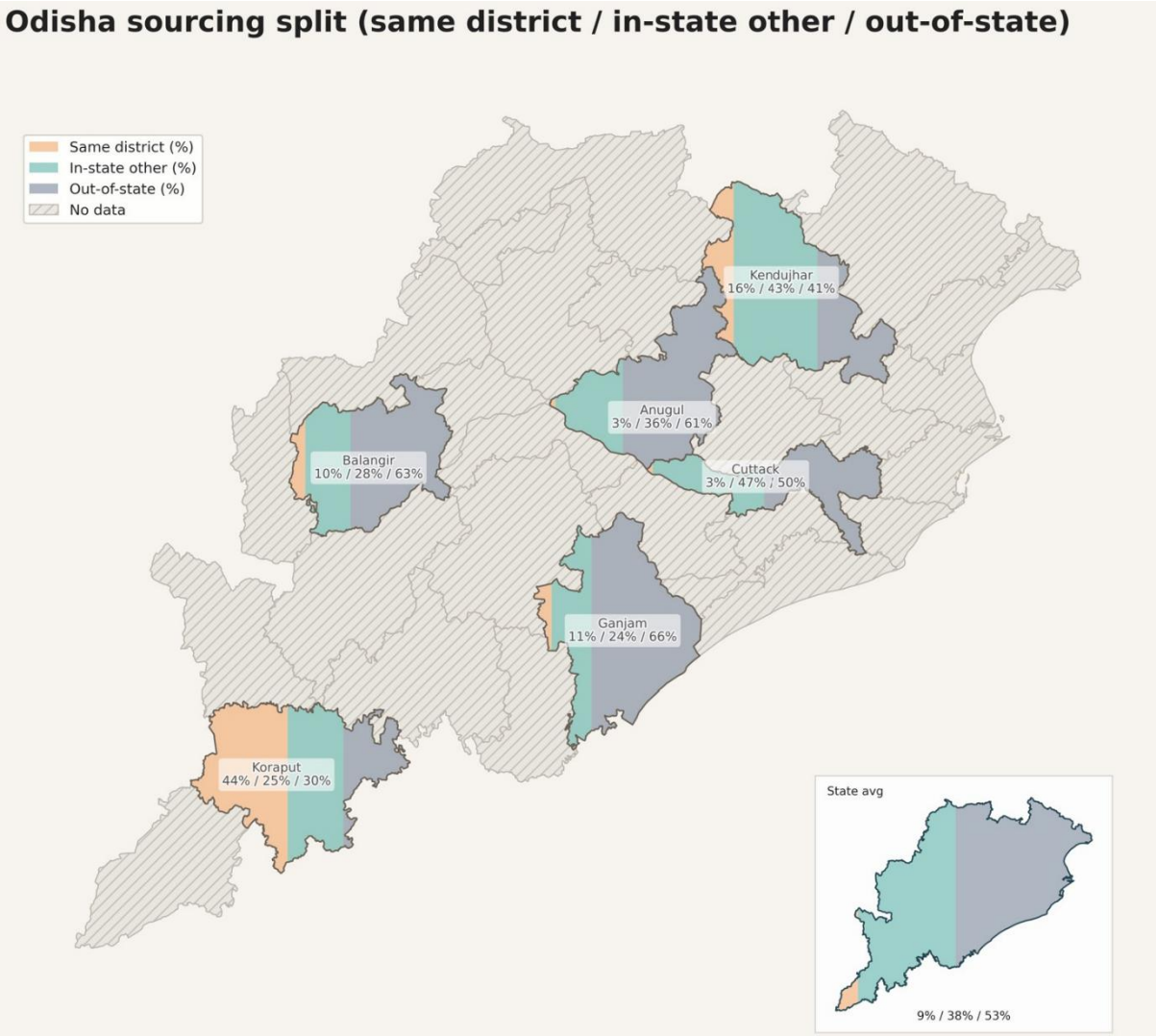
Fourth, WMs in Kenya are embedded in a rapidly lengthening national supply chain, with clear spatial specialization between production and consumption areas (MESO study). As Kenya's tomato supply chain has expanded, WMs increasingly source from major production zones to serve both local and distant consumption markets, in both production and consumption areas (see Figure 22A). In contrast, Odisha functions primarily as a consumption zone within India: it absorbs nearly all of the vegetables it produces locally and supplements this supply with inflows from other regions, rather than acting as a major supplier to external markets (see Figure 22B).

Figure 22A: Main sourcing locations for tomato wholesale markets in Kenya



Source: INCATA WM data

Figure 22B: Main sourcing locations for vegetable wholesale markets in Odisha



Source: INCATA WM data

Policy implications

This study highlights the centrality of horticulture wholesale markets (WMs) in both Kenya and Odisha as rapidly expanding nodes within horticultural value chains. These WMs handle large and growing volumes of food reflecting growing consumer demand and the high commercialization rate of small-scale vegetable producers. Beyond their trading function, WMs serve as major employment hubs, supporting a diverse ecosystem of traders, brokers, loaders, transporters, packaging suppliers and other ancillary service providers. Their role in job creation highlights their importance not only for food system efficiency but also for livelihoods. The comparison reveals important contrasts in social inclusion. Kenyan tomato WMs demonstrate relatively high and increasing participation of women suggesting that market entry barriers are surmountable under certain institutional and social conditions. In contrast, women and minority tribe participation in Odisha's vegetable WMs remains extremely limited, pointing to persistent gendered and caste constraints.

These differences illustrate that inclusivity is not an automatic outcome of market growth, but rather the result of context-specific factors and institutional arrangements. At the same time, both Kenyan and Odisha WMs face significant infrastructure deficits, including access to water, electricity and adequate toilets and poor sanitation. These constraints undermine market efficiency and exacerbate occupational health and safety risks.

We highlight three specific policy recommendations, given these findings:

1. **Invest in market infrastructure as critical food system public goods.** Targeted public investment is needed to upgrade WM infrastructure, including storage, drainage, sanitation, waste management, and road networks. Such investments would improve food safety and enhance labor productivity and consumer experiences in markets. Given the scale of volumes handled, these investments should be treated as high-return public goods within national and subnational food system strategies.

2. **Strengthen inclusive market institutions and programs.** The relative inclusivity of Kenyan tomato WMs offers lessons for Odisha. Policies should address caste and gender-specific constraints and formalizing trader associations in ways that lower entry barriers for women and marginalized castes. Targeted programs (e.g. lower participation fees in vegetable markets for marginalized groups) and minority-responsive market governance can help ensure that market growth translates into equitable participation.

3. **Context-specific reforms are needed rather than one-size-fits-all models.** The contrast between Kenya and Odisha (and within zones and districts in both countries) highlights the need for locally grounded policy design. While shared challenges such as infrastructure deficits call for common solutions, differences in gender and minority caste inclusion require tailored interventions that reflect social norms, administrative capacity, market history and market governance.

Taken together, our results point to WMs as strategic leverage points for advancing efficiency, inclusion, and resilience in horticultural value chains. Policies that simultaneously address infrastructure, governance, and social inclusion can significantly enhance the developmental impact of tomato WMs in Kenya and vegetable WMs in Odisha.

Key message 4: In the past 1-2 decades there has been a rapid development of spontaneous clusters of farms & Hidden-Middle MSMEs.

This section reviews the key findings presented as punchlines from the Kenya and Odisha case studies and cross-comparison. The findings concern determinants and patterns of cluster formation, growth, composition in terms of numbers and volumes of all segments, and effects of farmers participation in clusters on technology use and growth of clusters on inclusion/employment of actors in all segments including women and youth.

The findings are synthesized and compared from Kirimi et al. (2026) and Belton and Narayanan (2026), the two country reports for INCATA for Kenya and India respectively. The data sources in those reports and thus here are as follows: (1) review/analysis of secondary data on where production zones are and in them how vegetable (India) and tomatoes (Kenya) production and farm density differ over counties

or districts; (2) rapid reconnaissance in rural and urban areas in the production zones and in key consumption areas in particular primary and secondary cities in the country (Kenya) and state (Odisha, India); (3) "meso inventory/survey" in rural and urban counties in production zones in Kenya with recall over 1 decade (2014, 2019, 2024); (4) case studies of selected clusters, spontaneous and government-established (APC) in Odisha.

Finding 4.1: ***The nature of the clusters***

a) There are two types of clusters: spontaneous and government-organized. The spontaneous is most common in both places. The government-organized clusters are also present in vegetables in Odisha but not Kenya.

Government-established vegetable clusters have been established in some districts in Odisha. They are called APC (Agricultural Production Cluster). There are none in the Kenya tomato case. The APC were set up to spur commercial vegetable cultivation in economically deprived areas of Odisha in 2018. The APCs were built on Self-Help Groups (SHGs) with formation of Farmer Producer Companies (FPC). The focus has been on tribal areas, marginalized castes, and women. The program trains farmers in cultivation of vegetables, synchronization of planting, collective input purchase, and market linkages.

"Spontaneous clusters" are the most common cluster type in Kenya & Odisha. They are also the main concentrations of production of vegetables in the country/state. Spontaneous means that the cluster was not directly set up by government, or a large company, or an NGO.

b) There is, however, not a sharp division between the two types of clusters because government investments have facilitated spontaneous clusters, while private MSMEs have flocked to both types of clusters.

First, spontaneous clusters have often been partly catalyzed by some form of state intervention. In Odisha, examples are lift irrigation investments and Geographic Indication (GI) for a local eggplant variety that brought it attention in the market. An example from Kenya is the establishment of a road network in the southern production zone opening up areas there and linking those areas to the Tanzania border.

In both spontaneous and state-started clusters, public investments in wholesale markets (Message 3) have played an important role in catalyzing the local cluster, and in turn the cluster emergence has fed the growth of the local wholesale market.

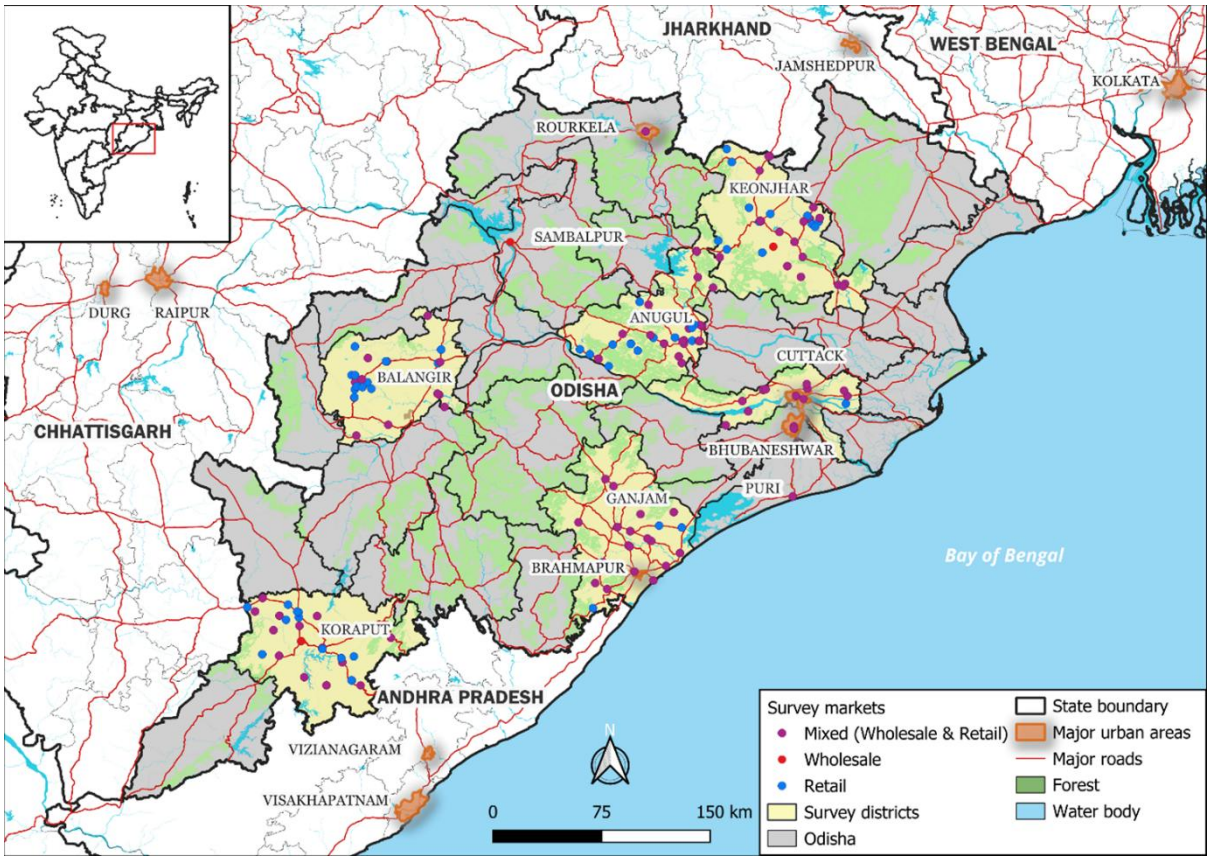
Second, Hidden Middle actors come to and service and sometimes base in the local government-organized cluster (just as they do in spontaneous clusters). An example is in APCs in Odisha, women at first retailed their produce to local markets and subsequently traders from outside came to procure their produce.

c) The size of the clusters varies widely but feature diffuse agglomeration in zones or districts.

In Odisha (Figure 23), the clusters vary in size sometimes widely over space within a given zone or district. An example is given via qualitative case studies of three clusters in Odisha; we cite the farmer numbers they note, while in addition in the clusters are (and in situ and mobile traders, input suppliers, and logistics MSMEs. They studied an eggplant cluster of 120 farmers that has functioned for more than 100 years. A second example is a cauliflower cluster of 400 farmers that has functioned since 1978.

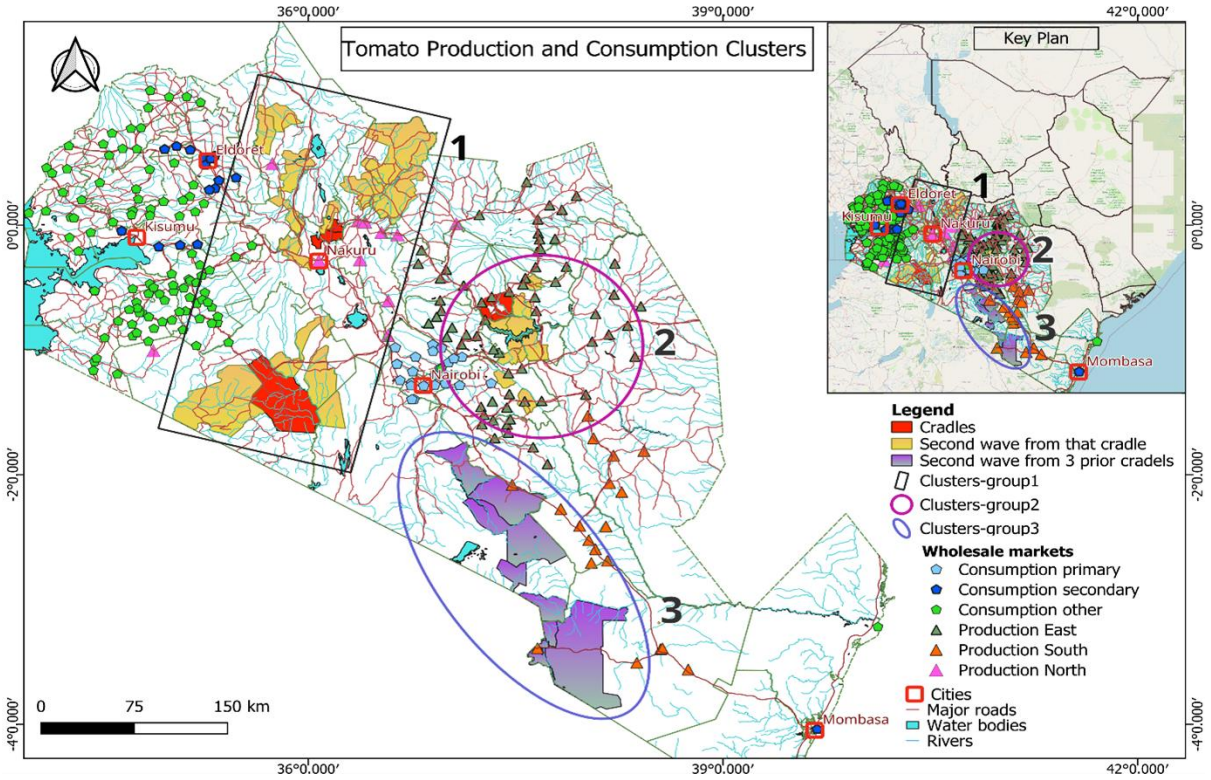
A third is a pointed gourd cluster of more than 130 farmers founded in 2017. There are many of these modest sized clusters spread over the districts of the state (Odisha). However, they tend to be in zones and districts that are nodes of concentration of vegetable production in the state. Our study chose those concentrations based on secondary information and rapid reconnaissance as discussed in another chapter. Those concentrations can be thought of as meta clusters and are discussed immediately below.

Figure 23. Odisha cluster map



In Kenya (Figure 24), no one county makes up a cluster; for instance, the Northern production zone (cluster 1) comprises 5 counties, while the southern production zone (cluster 3) has 2 counties. In the counties, there are pockets that are key tomato production areas. The study identified sub-counties that are key production areas that could be sub-counties or even smaller administrative areas (e.g., location) within a sub-county where tomato is a key crop. Thus, the three zones indicated on the map are the three clusters, and within each, there are scattered areas that are the key tomato growing areas.

Figure 24. Kenya cluster map



(d) The cluster concentrations or zones have diffused over space and time in waves in a dynamic way.

First, in Kenya the geographic concentrations (with presence of a diffusion of clusters) are shown as three zones with lines drawn around their approximate de facto borders on the map below (Figure 24). The map shows that tomato production (with accompanying hidden middle MSME spontaneous agglomerations as well as public and private wholesale markets) spread in three main zones.

The first zone is shown as a rectangle in the center-west of Kenya, which we call production zone 1 or cluster group 1 in the map. This zone started production earliest, centered around Nakuru city (which as a city of only a few hundred thousand 20-30 years ago and is now a city of 1 million) several decades ago. Within the zone we show in red the cradle/s where tomato farming first started; the yellow areas are local clusters that formed after the cradle, as a "second wave." The second wave clusters were sometimes formed by the pioneer farmers in the cradle to go seek areas with cheaper land or more water access; the clusters were also formed by farmers and MSMEs incumbents in the area and by in-migrants from other rural areas and urban areas.

The second zone is shown as a near-circle centered to the Northeast of Nairobi, centered approximately on Kirinyaga. This group of clusters emerged 10-15 years ago. These were formerly mainly irrigated rice zones and the tomato production sprang up from water access from the irrigation (such as in pipes stretched from rice farms and rivers) and from dense road access to the Nairobi market. The yellow shows the second wave clusters that emanated from the Kirinyaga cradle.

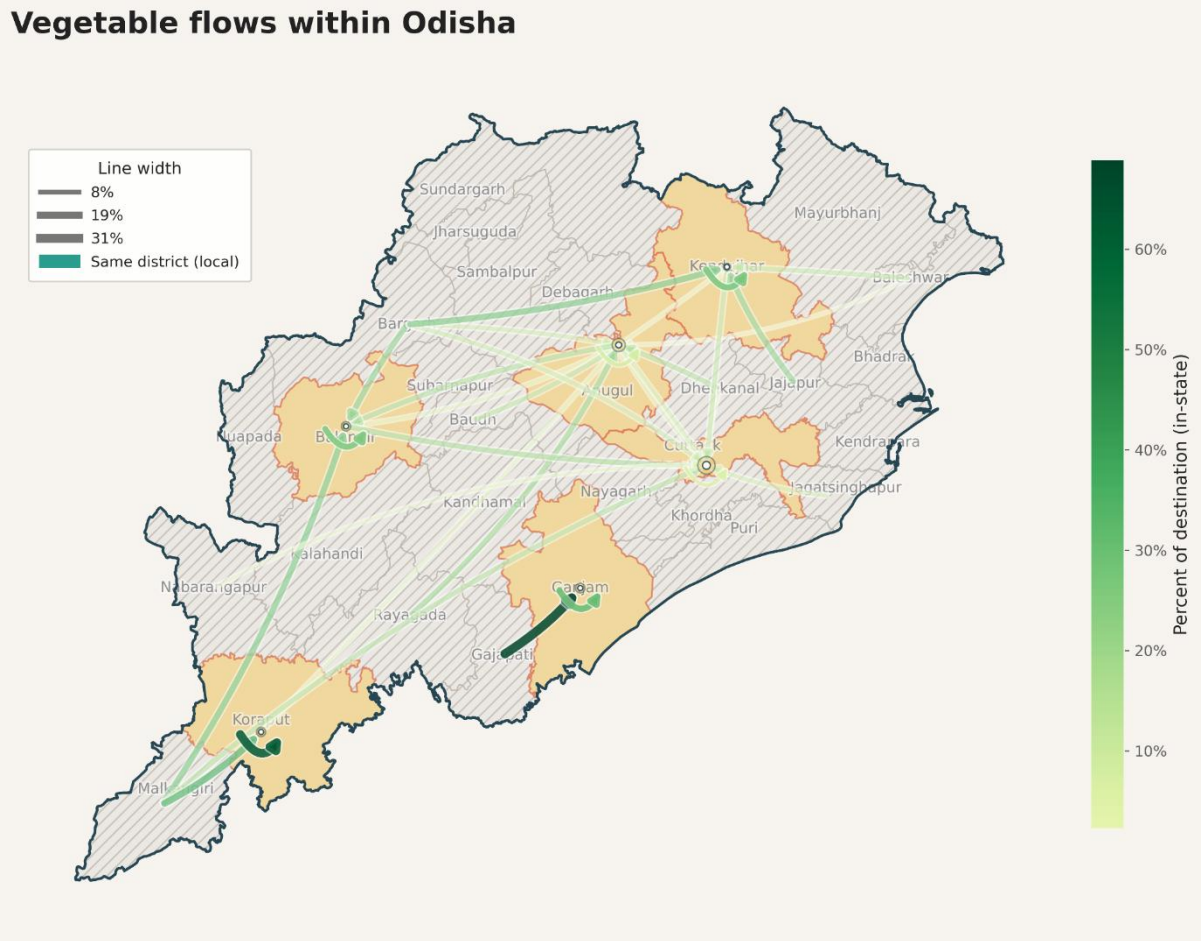
The third is shown as an oblong circle southeast of Nairobi. While the above two zones are mainly in the dense highlands, the southeast zone is in a flatter area further from cities, with easier access to land but further (and thus with much higher transport costs) to urban markets. The Kenya study rapid reconnaissance found that much of this zone is composed of clusters that formed from farmers coming

down from the other two zones as land became tight, as well as new in-migrants and to a lesser extent than in the other zones, local incumbents.

Second, in Odisha the clusters of vegetable production have developed alongside rivers (irrespective of region) and close to urban centers. Vegetable production is dense in the coastal areas serving the large cities. The interior "spine" of the state is the area of most rapidly emerging vegetable zones. In those broad areas of concentration of vegetable production, there are many micro-clusters of vegetable production (and concomitant presence of Hidden-Middle MSMEs); even in a low-stratum (of vegetable farming presence) district or block one encounters a small cluster.

Below we will show that while the zones in the maps that encase the diffuse clusters are more or less anchored by a city, the clusters in these zones do not just sell to the local consumption areas but rather also sell vegetables at a rather long distance across the state or country to other cities and rural areas (Figure 25).

Figure 25. Vegetable flows within Odisha



(e) The rapid growth of the clusters (from meso survey findings)

For Kenya, Tables 10 and 11 show the change in farm numbers and tomato output over 10 years as well as the number of Hidden Middle MSMEs in the three production zones. There are three sets of main points for this synthesis.

Table 10: Structural change in tomato clusters over 10 years: farmers

Cluster	Farmers											
	Total number			Share of small in total number			Share of medium in total number			Share of large in total number		
Production North	**2024**	**2019**	**2014**	**2024**	**2019**	**2014**	**2024**	**2019**	**2014**	**2024**	**2019**	**2014**
First cradle (Nakuru-Subukia/Kabazi)	**260**	**340**	**850**	**100 %**	**82 %**	**76 %**	**0 %**	**3 %**	**6 %**	**0 %**	**15 %**	**18 %**
Second wave around first cradle												
Narok (Township)	374	198	109	75 %	73 %	54 %	23 %	26 %	46 %	2 %	1 %	0 %
Laikipia (Marmanet)	329	2,606	9,292	95 %	92 %	97 %	5 %	7 %	2 %	1 %	1 %	1 %
Narok (Mosiro)	310	420	200	97 %	95 %	75 %	3 %	5 %	25 %	0 %	0 %	0 %
Nakuru (Solai & Rongai)	285	107	57	86 %	92 %	88 %	10 %	8 %	5 %	7 %	9 %	7 %
Baringo (Marigat)	220	135	51	100 %	99 %	100 %	0 %	0 %	0 %	0 %	1 %	0 %
Laikipia (Salama)	184	79	225	54 %	63 %	58 %	25 %	23 %	33 %	21 %	14 %	9 %
Narok (Siana)	134	42	-	100 %	100 %	100 %	0 %	0 %	0 %	0 %	0 %	0 %
Narok (Melili)	122	163	216	60 %	54 %	50 %	30 %	31 %	30 %	10 %	15 %	20 %
Laikipia (Sosian)	113	74	39	77 %	95 %	87 %	20 %	5 %	8 %	3 %	0 %	5 %
Elgeyo Marakwet	69	47	38	99 %	100 %	100 %	0 %	0 %	0 %	1 %	0 %	0 %
Laikipia (Rumuruti)	37	108	40	89 %	64 %	75 %	5 %	28 %	25 %	5 %	8 %	0 %
Baringo (Barwessa)	31	8	-	100 %	100 %	100 %	0 %	0 %	0 %	0 %	0 %	0 %
Baringo (Mogotio)	24	7	-	88 %	86 %	0 %	0 %	0 %	0 %	13 %	14 %	0 %
Total- Second wave around first cradle	**2,232**	**3,994**	**10,267**	**85 %**	**89 %**	**94 %**	**11 %**	**9 %**	**5 %**	**4 %**	**2 %**	**1 %**
Total- Production North	**2,492**	**4,334**	**11,117**	**87 %**	**89 %**	**93 %**	**10 %**	**9 %**	**5 %**	**4 %**	**3 %**	**3 %**
Production East Second cradle (Kirinyaga-Mwea)	**741**	**988**	**1639**	**92 %**	**91 %**	**90 %**	**8 %**	**8 %**	**8 %**	**0 %**	**2 %**	**3 %**
Second wave around second cradle												
Embu (Mwea)	430	191	172	78 %	60 %	65 %	13 %	27 %	28 %	9 %	13 %	7 %

Machakos (Ekalakala)	252	130	13	60%	62%	54%	28%	27%	31%	12%	12%	15%
Embu (Kagaari)	100	100	61	100%	100%	100%	0%	0%	0%	0%	0%	0%
Machakos (Ndalani)	67	10	0	61%	90%	0%	30%	10%	0%	9%	0%	0%
Embu (Kyeni South)	53	46	41	100%	100%	100%	0%	0%	0%	0%	0%	0%
Machakos (Mbiuni)	43	28	33	67%	100%	100%	16%	0%	0%	16%	0%	0%
Embu (Makima)	41	40	105	100%	75%	62%	0%	25%	29%	0%	0%	10%
Machakos (Wamunyu)	40	25	28	33%	100%	93%	55%	0%	7%	13%	0%	0%
Machakos (Masinga)	32	37	31	100%	100%	100%	0%	0%	0%	0%	0%	0%
Embu (Mbeti South)	8	8	8	100%	100%	100%	0%	0%	0%	0%	0%	0%
Total -Second wave around second cradle	**1,066**	**615**	**492**	**76%**	**78%**	**78%**	**16%**	**16%**	**17%**	**8%**	**7%**	**5%**
Total- Production East	**1,807**	**1,603**	**2,131**	**82%**	**86%**	**87%**	**13%**	**11%**	**10%**	**5%**	**3%**	**3%**
Production South Second wave around second cradle in Southeast of Nairobi												
Kajiado												
Imbirikani/Eselekei	4,900	8,170	13,490	67%	67%	54%	23%	21%	31%	9%	11%	15%
Rombo	1,055	1,450	1,941	82%	93%	97%	13%	6%	3%	4%	1%	0%
Imaroro	230	220	243	64%	61%	60%	26%	30%	34%	10%	9%	7%
Kimana	105	145	100	67%	90%	100%	5%	0%	0%	29%	10%	0%
Kenyewa-poka	55	41	27	18%	24%	19%	36%	39%	44%	45%	37%	37%
Total	**6,345**	**10,026**	**15,801**	**69%**	**71%**	**60%**	**22%**	**19%**	**27%**	**9%**	**10%**	**13%**
Taita Taveta												
Chala	360	338	470	92%	91%	87%	5%	7%	13%	3%	2%	0%
Bomeni	99	186	320	98%	99%	100%	2%	1%	0%	0%	0%	0%

Mboghoni	63	66	66	78%	94%	100%	22%	6%	0%	0%	0%	0%
Mata	56	292	670	71%	98%	100%	27%	2%	0%	2%	0%	0%
Mahoo	41	135	295	100%	100%	100%	0%	0%	0%	0%	0%	0%
Total	**619**	**1,017**	**1,821**	**90%**	**96%**	**97%**	**8%**	**4%**	**3%**	**2%**	**1%**	**0%**
Total - Production South	**6,964**	**11,043**	**17,622**	**71%**	**73%**	**64%**	**20%**	**18%**	**25%**	**8%**	**9%**	**12%**
ALL	**11,263**	**16,980**	**30,870**	**76%**	**78%**	**76%**	**17%**	**15%**	**16%**	**7%**	**7%**	**8%**

Table 11: Structural change in tomato clusters over 10 years: Production Volumes

Cluster	Production volume											
	Total volume (metric tons)			Share of small in total volume			Share of medium in total volume			Share of large in total volume		
	2024	2019	2014	2024	2019	2014	2024	2019	2014	2024%	2019	2014
First cradle (Subukia/Kabazi)	**23,858**	**21,280**	**35,400**	**26%**	**21%**	**22%**	**0%**	**11%**	**17%**	**74%**	**68%**	**61%**
Second wave around first cradle												
Laikipia (Salama)	35,968	11,490	31,080	17%	26%	25%	37%	42%	58%	46%	32%	17%
Narok (Township)	25,600	14,580	9,232	44%	48%	31%	48%	49%	69%	8%	3%	0%
Nakuru (Solai & Rongai)	21,254	11,312	1,536	28%	55%	39%	35%	19%	23%	37%	25%	38%
Narok (Mosiro)	13,440	22,000	13,600	89%	87%	53%	11%	13%	47%	0%	0%	0%
Baringo (Marigat)	12,150	3,480	460	97%	92%	100%	0%	0%	0%	3%	8%	0%
Narok (Melili)	11,128	17,124	23,312	26%	25%	22%	48%	42%	36%	26%	34%	42%
Laikipia (Marmanet)	8,436	46,190	26,472	30%	21%	48%	39%	56%	30%	31%	24%	22%
Laikipia (Sosian)	8,422	1,540	1,372	15%	45%	25%	69%	55%	37%	16%	0%	38%
Elgeyo Marakwet	3,996	1,128	342	92%	100%	100%	0%	0%	0%	8%	0%	0%
Baringo (Mogotio)	2,106	288	0	54%	50%		0%	0%		46%	50%	
Laikipia (Rumuruti)	1,880	9,960	1,980	26%	7%	15%	27%	63%	85%	47%	30%	0%
Baringo (Barwessa)	1,674	192	0	100%	100%		0%	0%		0%	0%	
Total - Second wave around first cradle	**146,054**	**139,284**	**109,386**	**42%**	**40%**	**34%**	**34%**	**41%**	**45%**	**25%**	**20%**	**20%**
Total - Production North	**169,912**	**160,564**	**144,786**	**39%**	**37%**	**31%**	**29%**	**37%**	**38%**	**31%**	**26%**	**30%**
Second cradle (Kirinyaga - Mwea)	**39,636**	**49,056**	**85,350**	**62%**	**55%**	**52%**	**38%**	**33%**	**31%**	**0%**	**36%**	**58%**
Second wave around second cradle												

Embu (Mwea)	40,532	21,404	15,018	30%	16%	22%	33%	47%	55%	38%	37%	23%
Machakos (Ekalakala)	40,272	16,160	0	14%	15%		42%	55%		45%	30%	
Embu (Kagaari)	3,600	3,000	1,220	100%	100%	100%	0%	0%	0%	0%	0%	0%
Machakos (Ndalani)	9,876	526	0	15%	51%		49%	49%		36%	0%	
Embu (Kyeni South)	1,908	1,380	820	100%	100%	100%	0%	0%	0%	0%	0%	0%
Machakos (Mbiuni)	6,924	840	330	15%	100%	100%	24%	0%	0%	61%	0%	0%
Embu (Makima)	1,476	2,820	8,740	100%	32%	15%	0%	68%	58%	0%	0%	27%
Machakos (Wamunyu)	8,748	750	644	5%	100%	40%	60%	0%	60%	34%	0%	0%
Machakos (Masinga)	1,152	1,110	310	100%	100%	100%	0%	0%	0%	0%	0%	0%
Narok (Siana)	5,360	2,016	0	100%	100%		0%	0%		0%	0%	
Embu (Mbeti South)	288	240	160	100%	100%	100%	0%	0%	0%	0%	0%	0%
Total- Second wave around second cradle	**120,136**	**50,246**	**27,242**	**29%**	**33%**	**28%**	**35%**	**42%**	**50%**	**37%**	**25%**	**21%**
Total - Production East	**159,772**	**99,302**	**112,592**	**37%**	**44%**	**46%**	**36%**	**38%**	**36%**	**28%**	**19%**	**19%**
Production South Second wave around second cradle in Southeast of Nairobi												
Kajiado												
Imbirikani/Eselenkei	184,820	164,340	169,120	39%	39%	36%	41%	42%	40%	19%	19%	24%
Rombo	77,460	62,380	63,296	60%	76%	88%	26%	17%	11%	14%	7%	1%
Imaroro	21,420	19,900	20,080	35%	30%	30%	40%	46%	52%	25%	24%	18%
Kimana	12,920	9,840	2,400	39%	63%	100%	6%	0%	0%	56%	37%	0%
Kenyewa-poka	9,380	6,320	4,016	5%	8%	6%	31%	35%	38%	64%	57%	56%
Total	**306,000**	**262,780**	**258,912**	**43%**	**47%**	**48%**	**35%**	**35%**	**33%**	**21%**	**18%**	**18%**
Taita Taveta												
Chala	15,856	24,136	16,802	42%	61%	44%	17%	17%	56%	41%	22%	0%
Bomeni	2,228	9,152	5,760	87%	97%	100%	13%	3%	0%	0%	0%	0%
Mboghoni	2,996	3,616	1,188	33%	82%	100%	67%	18%	0%	0%	0%	0%
Mata	3,680	15,176	12,060	22%	91%	100%	59%	5%	0%	20%	4%	0%
Mahoo	820	6,480	5,310	100%	100%	100%	0%	0%	0%	0%	0%	0%
Total	**25,580**	**58,560**	**41,120**	**44%**	**80%**	**77%**	**28%**	**10%**	**23%**	**28%**	**10%**	**0%**
Total - Production South	**331,580**	**321,340**	**300,032**	**43%**	**53%**	**52%**	**35%**	**30%**	**32%**	**22%**	**17%**	**16%**
ALL	**661,264**	**581,206**	**557,410**	**41%**	**47%**	**46%**	**34%**	**33%**	**34%**	**26%**	**20%**	**20%**

First, for farms, there has been rapid growth of tomato output of the clusters in a decade, but a decline in farm numbers, and a process of concentration over farms. The details of the table show that the fastest growth in volume came in the Southern zone clusters which coincided with increased average farm size due to more accessible land, and the slowest growth in output and decline in numbers in the zone 1 cradle areas which had pressures of land access and crop disease. Overall farmer numbers declined over the three zones from around 31,000 to 11,000.

By sharp contrast, the volume increased a stunning 100,000 tons from 557,000 to 661,000 (Table 11) for the set of clusters. The share of small farmers in the total numbers of farms stayed at around 76%, but their share of total farm output declined from 46% to 41%, and the share of medium and larger farms (averaging 4 and 7 hectares, respectively) climbed from 54 to 59%.

Yield growth was a stunning and important part of the rise of overall volumes (of 100,000 tons) despite the reduction of total land under tomatoes from 16,000 ha to 10,000 ha (in the meso table annex). The yield in tons per ha for the overall sample rose from 16 to 32 tons per ha (Table 12). This can be compared with 5-10 tons on average in Nigeria. All strata yields grew fast, but large farms grew to larger yields: small, from 14 to 28 tons, medium from 20 to 35, and large, from 19 to 37.

Table 12. Land size and yields, by production and consumption zones.

Cluster		Year	Production Zone North (2024, 2019, 2014)		Production Zone East (2024, 2019, 2014)		Production Zone South (2024, 2019, 2014)	ALL
			First cradle (Subukia/ Kabazi)	Second wave around first cradle	Second cradle (Kirinyaga - Mwea)	Second wave around second cradle	Second wave southeast of 2nd cradle southeast of Nairobi	
Land size (Ha) 1000s ha	Total land (ha)	**'24**	0.3	2.8	0.4	1.6	6.1	10
		'19	0.4	3.5	0.6	1.2	7.3	12
		'14	1.2	4.7	1.4	1.9	8.9	16
	Small scale (ha)	**'24**	0.1	1.4	0.3	0.6	2.9	5
		'19	0.1	1.8	0.4	0.6	4.3	7
		'14	0.3	2.1	0.9	1.1	5.3	9
	Medium scale (ha)	**'24**	0	0.7	0.1	0.6	2	3
		'19	0.004	1	0.2	0.5	2	3
		'14	0.2	1.3	0.4	0.6	2.4	4
	Large scale (ha)	**'24**	0.2	0.7	0	0.4	1.2	2
		'19	0.2	0.7	0.1	0.2	1	2
		'14	0.7	1.2	0.2	0.3	1.2	3
Average land size per farm (Ha)	Average land size (Ha)	**'24**	1	1	1	1	1	1
		'19	1	1	1	1	2	1
		'14	1	1	1	1	2	1
	Average land small scale	**'24**	0	1	0	0	1	1
		'19	0	1	0	0	1	1
		'14	0	1	1	0	1	1
	Average land medium scale	**'24**		3	2	2	2	2
		'19	4	3	2	3	3	3
		'14	4	3	3	3	3	3

	Average land large scale	**'24**		4		5	4	5
		'19	5	5	4	4	5	5
		'14	5	5	5	4	6	5
Yield (tons/ha)	Total yield	**'24**	36	33	47	48	27	32
		'19	27	15	40	39	22	22
		'14	15	11	29	29	17	16
	Small scale farms	**'24**	30	28	44	44	25	28
		'19	20	8	37	37	20	18
		'14	15	7	25	25	15	14
	Medium scale farms	**'24**		36	52	50	30	35
		'19	30	21	44	42	25	26
		'14	15	13	37	34	20	20
	Large scale yield farms	**'24**	40	41		49	30	37
		'19	30	26	44	41	25	27
		'14	15	14	37	35	20	19

Second, the counterpart of the substantial rise in tomato output in the Kenyan clusters, combined with the emergence of fast growth in the southern zone and thus longer supply chains, gave rise to (and was facilitated by a large increase in MSMEs in the Hidden Middle: from 6371 to 11,935 MSMEs, +87% in 10 years! The breakdown by segment was that the numbers of (Tables A1 to A5, annex):

(1) input suppliers rose from 279 to 773, +177%

(2) rural assemblers/village traders: 647 to 746, +15%

(3) wholesalers, 3000 to 5300, +77%

(4) market-based brokers: 805 to 1597, +98%

(5) transporters (3PLS), 1640 to 3519, +115%

Third, services complementary to the Hidden Middle were present in large numbers and developed rapidly in the Kenya tomato clusters. Graders (who worked for farmers and traders) rose from 7733 to 8121 (Table A6, annex). Market based loaders soared from 1808 to 3160 in the decade. This meant an increase in employment of these complementary service workers from 9541 to 11,281.

For Odisha vegetable clusters, there was also substantial growth from 2015 to 2025 in the numbers in the clusters, albeit at a somewhat less spectacular pace than observed in Kenya:

1) Farmer numbers: +23%
2) Vegetable volume delivered in surveyed markets: +72% (1.4 million mt to 2.25 million mt per year)
3) Input suppliers: +56%
4) Wholesalers: +66%
5) 3PLS (trucking logistics firms): +82%
6) Retailers: +19%

Finding 4.2: The drivers of the formation and growth of the clusters

The rapid reconnaissance studies in the two study locations showed the following to be the main drivers of the cluster formation. As we noted above, while state-organized clusters had an additional program component, both those and spontaneous clusters formed from similar causes, thinking from downstream pull to midstream and upstream facilitation.

First, a central driver in both Odisha and Kenya was the rapid growth in the demand for vegetables - driven by increasing populations, cities, and incomes. There was thus a "growth motor" in the words used in the Green Revolution era.

Second, an important driver was the infrastructure for connecting the clusters internally within local zones and between zones and cities. This infrastructure included highways and feeder roads, wholesale markets, and, for some segments, electricity.

Third, in India, a central determinant of cluster formation was access to irrigation water; the figure shows that cluster formation closely tracked increases in irrigation within the clusters. In Kenya, irrigation has been moderately less important than in India. In the North (a zone of high rainfall), 93% of farms are rainfed; in the East, 48%; in the South, 56%; and overall, 63%.

Fourth, land access was a very important driver in Kenya. The share of tomato land rented is 64% in the North, 60% in the East, and 67% in the South! This is a far higher rate of farmland rental than the overall rate in Kenya.

Fifth, in-migration is a driver of the clusters and is linked to access to land via rental. During the rapid reconnaissance, it was emphasized that many people came from outside the cluster and even the zone, from other places in Kenya, to rent land and grow tomatoes, given their profitability. A concomitant driver is thus in-migration to the cluster zones. The in-migration is not just from around Kenya; there is also in-migration from Tanzania, such as into Kajiado in the southern (3rd) zone. Migrants came with experience and skills in tomato growing and marketing. Some of the immigrants were previously farmers, farm managers, farm workers, and traders in other areas.

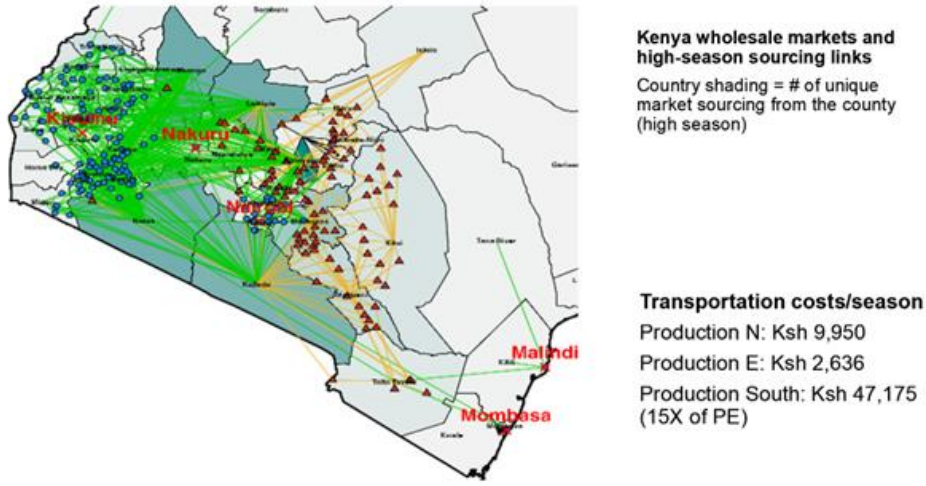
Fifth, various "change agents" played roles in the formation of clusters (outside the government). These included traders and input suppliers bringing capital and new seeds, and spillovers from other clusters (such as the famous flower cluster in Naivasha, Kenya, which gave rise to seedling clusters first for flowers, then for tomatoes).

The impacts of cluster growth on supply chain length, inclusion, and scaling up technology upgrading

(a) The production zone clusters supply vegetables not just to their local markets but also to urban markets across the state (Odisha) and country (Kenya) – driving the rise of long supply chains. This is important because it emphasizes roads and wholesale markets as key elements of cluster development.

A map for Kenya (Figure 26) illustrates the long supply chains that have developed (spontaneously, operated by the MSMEs of the Hidden Middle, especially traders and logistics) from the production area clusters to consumption areas, mainly city markets. The dense sets of green and yellow lines show the supply chain lines from the various clusters in the three zones to the urban consumption areas (but also to rural areas). Green is sourcing by markets in consumption zones, and yellow is sourcing by markets in production zones.

Figure 26. Transportation costs and high-season sourcing links in Kenya's clusters.

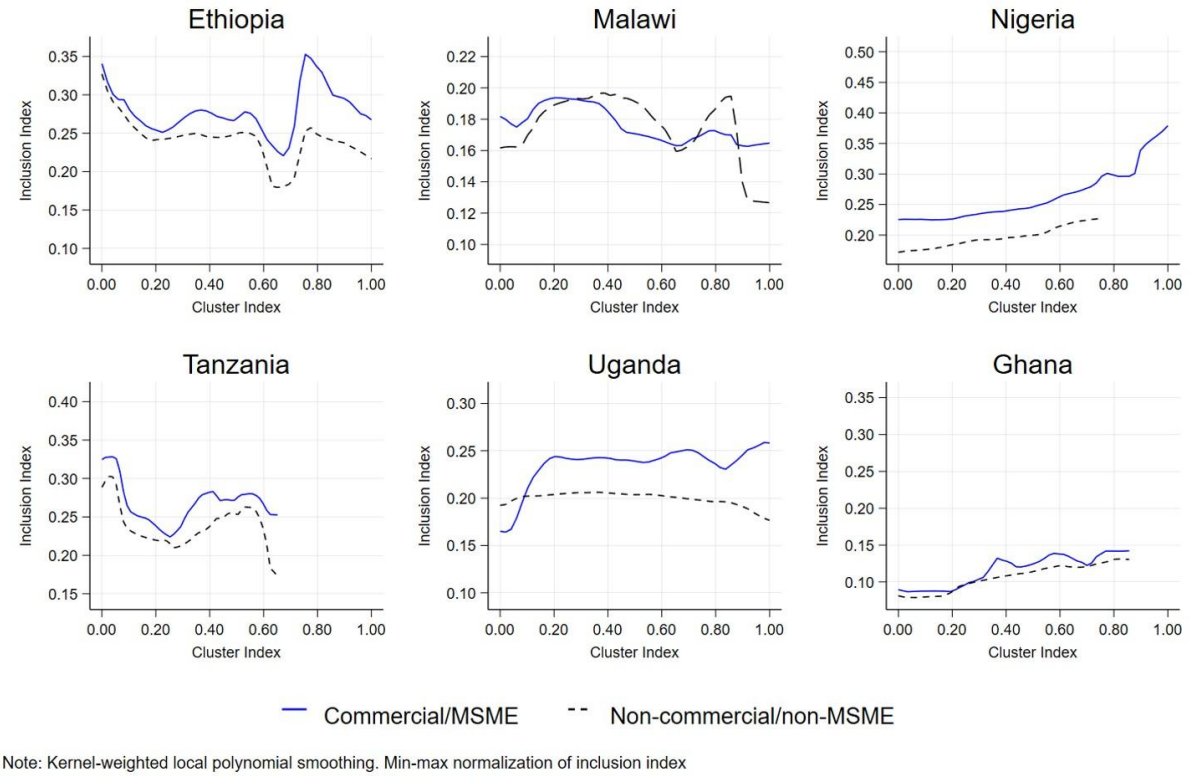


One notes the length of the lines that criss-cross Kenya. This is far from the short supply chains thought usually to characterize vegetable supply chains in Africa; and it also varies from the image of just peri-urban vegetable production around cities that characterized the literature and debate some decades ago.

(b) There is substantial (but mixed) inclusion in terms of small enterprise and job creation by clusters

First, LSMS-ISA data analysis across six African countries shows a correlation between female and youth inclusion and the cluster index, as shown in Figure 27.

Figure 27. Nonlinear relationship between Cluster Index and Inclusion Index.



Note: Kernel-weighted local polynomial smoothing. Min-max normalization of inclusion index

Second, in Kenya, the clusters' inclusion story is mixed, but with a net positive inclusion effect on employment. From the meso survey data, in Kenya, we showed above that the number of farms fell over time in the clusters; the share of small farms stayed steady at 76%, but their numbers went from 24,000 to 8000, so 16,000 small farms exited on the farm side, which is a big exclusion effect.

However, two inclusion forces were at work in the tomato sector in the Kenya clusters. On the one hand, the output rose 100,000 tons overall. The tomato farm sector did not significantly change its mechanization rates over that decade: by our survey year, 81% of the farms used tractors to prepare the soil; yet 73% also hired labor for that; 99% hired for planting, 99% for weeding, 99% for fertilizer and pesticide application, and 69% for staking and pruning. Thus, per ton, there was little to no shedding of labor over time, and the labor employment rose and was very substantial on farms. With 11,000 farms producing 661,000 tons of tomatoes, and supposing labor use of some 10 workers (own and hired) per average farm, this means around 110,000 persons employed on the tomato farms.

We already noted that hidden middle MSMEs increased to 12,000; each roughly employs about 6 persons (own and hired), so that comes to 72,000 as a very conservative estimate. Note that the tables show that the majority of the Hidden Middle MSMEs are small firms. Complementary service for rural workers to 11,000. This means the hidden middle firms employ at least 83,000 people.

The above provides the stunning employment figure of these Kenyan tomato clusters at around 200,000 persons, as a conservative estimate – a strong employment generator.

Women and youth are important in this employment. Women constitute 66% of wholesalers and 81% of retailers; 50% are farmer-wholesalers. Traders employ youth who constitute 60% of their salaried employees and 50% of their casual workers. For input suppliers, youth constitute 71% of their salaried workers and 73% of their casual workers.

In Odisha, by contrast, the vegetable farm sizes average much smaller than in Kenya, with the average vegetable cultivation area 0.2ha, versus 0.6ha for rice. The income effect of growing vegetables is also strong: vegetable income per ha is 305% higher than rice, and there is no trade-off between nutrition (including home consumption of vegetables) and the commercialization of vegetables.

However, the female and marginalized castes have less access to farmland, including through leasing. Among input suppliers, the probability of the owner being a female or a member of a marginalized caste is far lower than that of a non-scheduled caste. For wholesalers, the bias away from women and marginalized castes toward men and non-scheduled castes is even more striking. By contrast, vegetable retail is more inclusive, but still with a minority of women and the marginalized caste. Women have also reported expectations of business improvement in the future at a much higher rate than men.

In Odisha, however, there are other forces at work that are pro-inclusive in clusters. One is the proliferation of markets, growth of the average market, and an increase in ancillary services, so that market access is increasing.

(c) There is a correlation (and two-way causality) among technology upgrading and cluster formation (including farmer entry).

In Kenya, there is widespread use of intensification technologies. We already noted that in production zones 2 and 3, half the farms have irrigation (not just rainfed); 97% use irrigation to complement rainfed sources; 100% use inorganic fertilizer, 97% organic; 97% use hybrid seeds or purchased seedlings; 100% use pesticides; 81% of farmers use tractors for land preparation.

In Odisha, the results are similar, with intensification somewhat higher in clusters versus outside and in slightly larger farms. Overall: 85% use hybrid vegetable seed, 2.6% buy seedlings; 94% use inorganic fertilizer; 24% trellis; 2.9% plastic mulch; 90% use pesticides; 28% herbicides; and 68% use tractors.

Key message 5: Mutually beneficial relationships between SSPs and MSMEs are enabling the inclusive transformation of horticulture value chains.

This section reviews the key findings presented as punchlines from the Kenya and Odisha case studies and cross-comparison. The findings concern the determinants, patterns, and effects, especially on inclusion, of relationships between SSPs (small farmers) and MSMEs.

The findings are synthesized and compared with those of Kirimi et al. (2026) and Belton and Narayanan (2026), the two country reports for INCATA in Kenya and India, respectively. The data sources in those reports and thus here are as follows: (1) rapid reconnaissance in rural and urban areas in the production zones and in key consumption areas in particular primary and secondary cities in the country (Kenya) and state (Odisha, India); (2) "stacked micro surveys" of the farm, trader, and input seller segments.

Findings

We discuss the findings in general as to their departure from the traditional practices or at least the traditional view of how intermediaries and farmers interact, with our findings by category of interaction. Hence, we term the traditional "old" and then our finding, which is different from the traditional view, as "new".

Finding 5.1: OLD: "many hands" or highly intermediated; NEW: "disintermediation."

In the traditional setting and view, wholesalers based in cities sourced vegetables from farmers via brokers, mainly rural brokers and village traders. In contrast, especially in Kenya and emerging in Odisha wholesalers based in cities/towns are buying directly from farmers (cutting out brokers), called "disintermediation" (see Reardon et al. 2012 and 2014 for a review of the emergence of this trend in rice and potato supply chains in Asia and Liverpool-Tasie et al. 2017 for the case of Nigerian maize; there is similar research on this in Latin America such as in tomatoes in Guatemala (Hernandez et al., 2007).

In Kenya, this practice stands at 77% of wholesalers, and 76% in the case of women traders, and in Odisha, 14% of wholesalers buy direct from farmers and 13% from their own farms. In the Odisha case, this results in the farmers receiving higher prices than when selling to brokers.

Triangulation data from farmers in Kenya corroborate the above: farmers reported that 70% of their tomato output is sold to wholesalers and only 20% to rural assemblers/brokers, and a mere 14% directly to retailers.

Finding 5.2: OLD: Traders use their own vehicle; NEW: Emergence of Third-Party Logistics (3PLS) in vegetable value chains

Third-party logistics service MSMEs have been sharply neglected in field research and policy debate in developing regions. Their importance has recently been highlighted, for example, during COVID in Nigeria, when food distributors like wholesalers were declared "essential services" while transport MSMEs were declared non-essential. The result was that the food supply chain was constrained and failed. It had not been realized by the government that traders were relying on 3PLs, for example, in the maize supply chains; research showed that only 4% of urban maize traders own trucks and rely mainly on 3PLS (Liverpool-Tasie et al., 2021)

In the present research on vegetables we found that a similar trend of the rise of a central role for 3PLS in vegetables, especially in Kenya but also emerging in Odisha (lagging the onrush of 3PLS in agricultural supply chains in areas of India where supply chain transformation has advanced further, such as for rice in western and central (Uttar Pradesh; Reardon et al., 2014).

In Kenya, 52% of wholesalers use 3PLS. There is a strong correlation between the use of 3PLS and buying direct from farmers (disintermediation). That is how urban wholesalers can "cut out" traditional rural brokers. Traders gradually get the names and phones of farmers, and then instead of calling the local broker, they phone the farmer, set the order, and send a hired transporter and grader to pick it up.

In Odisha, the use of 3PLS is emerging: 32% of wholesalers use it. The study showed that wholesalers and retailers often provide transport services (via 3PLS or their own vehicles) when sourcing or supplying vegetables. Specifically, 32% of wholesalers used 3PLS in their last transaction, and 18% used their own vehicle. Another 26% of the transport was provided by seller-owned vehicles. The trader-provided transport (hired or own) is usually costed into the price of goods received or sold, but is attractive to time- or mobility-constrained farmers and other trading partners.

The rapid reconnaissance studies indicated that the rapid development of 3PLS, both large and small vehicles, is importantly facilitated by the liberalization of vehicle imports. At the same time, many youths benefit from employment in 3PLS as owners of small vehicles, drivers of small and large, and as loaders and graders.

Finding 5.3: OLD: Traders "tie" farmers by credit advances; NEW: Traders very seldom provide advances to suppliers, including farmers.

The conventional wisdom on the current situation and the traditional practice is that traders undertake "tied output-credit market relations" with farmers. They have been assumed to do this by paying the farmer in advance (in cash or in inputs) and then expecting the farmer to sell to that trader at harvest, and that is used as an exploitative arrangement to underpay the farmer.

Abundant evidence has been building for more than a decade that these arrangements are disappearing in Africa and Asia (for example, in Asia, rice and potatoes see Reardon et al. 2012, and in Nigeria, see Adjognon et al. 2017). The reasons for the demise of this arrangement include: (1) the "thickening" of the market and competition among traders due to denser road systems and spatial clustering such as we discuss in Message 4; (2) reduction of need for finance from traders by farmers as the latter tend to have nonfarm employment providing cash, as well as informal credit means as we show below; (3) the wide diffusion of cell phones allowing farmers to call contacts and check prices at harvest (and even if they had been in tied arrangements this could induce side-selling) (Reardon & Minten, 2021). These reasons also emerged in our rapid reconnaissance studies in Kenya and Odisha.

In Odisha, more than 90% of input suppliers, wholesalers, and retailers provide no credit of any kind to sellers (such as farmers), and fewer than 2% of surveyed enterprises impose exclusive tied-credit obligations on buyers or sellers. The 4-5% of traders who provide trade credit (advances to farmers and other suppliers) do it primarily as short-term working capital, not a means of control. In contrast, traders did tend (in 40% of their transactions) to provide credit to their buyers (such as retailers), but for a cycle of several days, just a rotation of funds.

A key correlated point is the finding in Odisha that farmers are not heavily credit-constrained. A lot of farmers accessed credit: half of vegetable farmers borrowed money to fund agriculture within the past year, and only 5% of non-borrowing vegetable farmers reported that they wished to access agricultural credit but were unable to. Most farmers borrowed from family and friends or self-help groups. Less than 2% of loans came from wholesalers or input suppliers.

In Kenya, the demise of tied output-credit relations has gone even further: only 0.3% of traders provided cash advances to farmers, and only 0.1% provided farm inputs.

Finding 5.4: OLD: traders and farmers are in "edgy", distrustful, intermittent relations. NEW: Traders and farmers are largely in long-term relationships with repeat transactions, apparently "trust-based."

In Odisha, most trader-farmer (and trader-trader) transactions are part of long relationships. Most have lasted 5-9 years. The Odisha study notes that these repeated interactions constitute the main de facto system of market coordination. The most recent supplier is a "regular" for 73% of wholesalers 60% of retailers.

By contrast, it is uncommon for the supplier to be in the commercial equivalent of what traditionally was called debt peonage (continuously on the treadmill of providing underpriced goods or labor to pay off loans); instead, outstanding loans to a recent supplier were the case for only 14% and 8% of wholesalers and retailers. Conditional on having an outstanding loan, only 6% and 19% of the borrowers were required to sell to the trader. That implies that a "tie" via loans affected only 0.8% of suppliers to wholesalers and 1.7% for retailers.

Selling by wholesalers and retailers is also characterized mainly by regular relationships. The most recent sale was to a "regular" customer for 51% of input suppliers, 39% of farmers, 58% of wholesalers, and 32% of retailers.

The Kenya survey found that the most significant reason for choosing a supplier is the high quality of the product, cited by 59% of the overall sample. Beyond quality, traders prioritize availability and interpersonal relationships; availability was cited by 32%, a trusted person by 26%, and being linked by a broker or trader by 26%.

Finding 5.5: OLD: Traders pay farmers late to extract de facto credit. NEW: Traders mainly pay farmers on time.

In Kenya, 87% of traders pay fully upon receipt of the tomatoes. The Kenya study emphasizes that this indicates a highly liquid, immediate transaction model rather than long-term credit-dependent supply relationships.

The Odisha survey shows similar results. Being paid fully at the moment of sale characterized 94% of input sellers, 87% of farmers, 55% of traders, and 92% of retailers. Only traders pay with a delay (39% of cases), but the delay is only the short 6-day transaction cycle.

Finding 5.6: OLD: Farmers are mainly trained by government extension, with private input sellers playing only a minor role. NEW: Input sellers are important trainers of farmers.

In Kenya, 46% of farmers (49% of women, 45% of men) received training; 87% of the training came from input suppliers, 27% from neighbors, relatives, and friends, and only 19% from government extension agents.

In Odisha, input suppliers are by far the main source of free advisory services for farmers. 48% of input suppliers were asked by farmers for advice; 52% of input suppliers gave advice.

The leading subjects of advice in descending order (from 62% to 11%) were about seedling rates, varietal selection, fertilizer selection and use, varietal traits, nursery preparation, pest treatment (23%), weed control (19%), and fungal treatment. The frequencies are interesting because the least cited themes directly relate to agrochemicals, apart from fertilizer. The least frequent (6% down to 0.3%) included soil health, plant health diagnostics, land preparation, irrigation management, and health and safety.

Finding 5.7: OLD: Farmers are left in the dark on market prices; NEW: farmers get price information from traders, friends and neighbors, brokers (but not from apps).

In Kenya, tomato farmers got 46% of their price information from wholesalers, 60% from brokers, 60% from friends and neighbors, and only 2% from digital apps.

Finding 5.8: OLD: No crop grading and other value-adding services provided to farmers; NEW: grading and value addition done by both farmers and traders in different distributions between the two countries.

Buying tomatoes (or other produce) ungraded from farmers is traditionally seen as the norm and a signal that the market does not yet reward product differentiation (and quality efforts) by farmers. But the data for the two countries shows that this has changed, and most is bought graded.

In Kenya, most farmers had their tomatoes graded per the farmer survey. The grading was mainly done by workers (the graders noted in the cluster message 4 chapter) hired 90% of the time by the buyer, who was usually a wholesaler, and 10% of the time hired by the farmer. Triangulating this information was the grading information from the trader survey, which showed that 75% of the traders pay a third party (the graders) to do the grading, or, in 26% of the cases, the traders directly grade the crop.

However, in Kenya, there is a mixed story on how much value-addition service traders provide directly (or by outsourcing such as to graders) to farmers (apart from grading discussed above). That is, in shares of traders doing those services, the study found that 11% did loading (at the farm), 17% did packing, 27% supplied crates to the farmer, and 53% provided no non-transport or non-grading service.

In Kenya, all the contact of the trader with the farmer was done in person (8%) or by a phone call (92%). There was no use of digital/social apps or digital marketing apps.

In Odisha, farmers themselves graded their vegetables before selling to traders or retailers, and undertake much more product upgrading and value addition activities than wholesalers or retailers. Many farmers grade, wash, and remove damaged produce prior to sale, enhancing value capture and simultaneously reducing transaction costs for buyers.

By contrast, traders provided little value-added services to farmers: 79% did nothing; 2% held the product in storage. 16% removed damaged vegetables; no wholesaler graded the produce; and only 1% repacked, and 4% washed the produce.

Policy Recommendations derived from INCATA

General

1. **Recognize the huge potential in horticulture value chains for the inclusive transformation** of food systems in developing regions. Horticulture's value chain feeds and employs many (input supply, production, and distribution), but faces growing pains. These include inefficient water use in production, insufficient infrastructure to cope with rapid growth, and limited participation by certain groups (e.g., gender and minority castes) across various segments of the value chain. The horticulture sector needs more attention, as it has traditionally received less than staples and is now receiving less than Aquaculture.

2. **A systems view is necessary to address food security, economic growth, and poverty reduction.** It is not enough to focus solely on farmer productivity and/or consumer behavior; the entire value chain must be considered. Though often complicated and informal, the mutually beneficial interaction between small-scale producers and MSMEs in the hidden middle has been key to the observed transformation and growth in the horticulture value chain. These complex interactions are also important for addressing the growing pains and adjustments that come with rapid growth. For example, farmers displaced at the production node (or traders) can be absorbed into other nodes as entrepreneurs or hired workers, as observed in the Kenyan tomato value chain.[6]

3. **Enabling conditions remain key facilitators of the initial and maintained rapid growth of horticulture value chains**. These include roads (both highways and feeder roads critical to link farms to markets), electricity and communication technology, affordable and efficient irrigation systems, storage and WASH facilities in markets, and land markets. They also include policies, regulations, and programs that support horticulture MSMEs (farm and off-farm) by reducing transaction costs associated with entry, enterprise formation, and business operations, and by aligning MSME incentives with national and/or regional food security objectives.

4. **Do not reinvent the wheel**. Horticulture value chains are facing growing pains but are not stagnant. Thus, avoid interventions based on assumptions that everything is broken and nothing is happening. Recognize that a lot is already happening but can still be improved, particularly given the identified growing pains. MSMEs along the value chain are an important resource for

[6] As has been documented by Espinoza, A. et al., (2025a) policy interventions (and the impact evaluations of these interventions) tend to overlook interventions targeting MSMEs and the non-farm actors of the agrifood value chains.

designing interventions to support their activities, and this resource should be tapped into rather than ignored. Their participation is key to the success and sustainability of any intervention.

5. **Donor advocacy** is needed (in addition to direct interventions) to enable policymakers, the private sector (companies and investors), and local authorities to coordinate and support value chain growth and development for a more inclusive transformation. Attention needs to be paid to governance at multiple levels (national, regional, local), across sectors (e.g., agriculture, trade, health, etc.), and actors (civil society, market leadership committees, farmer and trader associations, etc.) to ensure the needs and preferences of all actors (particularly minority groups) are informing decisions. Public-Private Partnerships (PPPs) should be considered an important potential mechanism for financing and coordinating value chain interventions.

Specific recommendations (Table 13).

Table 13. Specific policy recommendations based on responses by value chain actors in the INCATA micro survey in Kenya and Odisha

	Evidence	
Farmers and input suppliers	**Kenya**	**Odisha**
Recommendation		
• Invest in developing new and better seeds and other vegetable production inputs. • Improved regulation and certification for inputs, particularly pesticides with detrimental effects on food safety and human health • Support for niche crops that can support the sustainability of spontaneous clusters that are producing these niche crops that are not commonly supported or sold, and which have positive environmental benefits, such as low input use	• A high incidence of pests and diseases in the last production season was noted by 63% of tomato farmers interviewed • Kenyan farmers note the tension between cheaper and effective but unregulated pesticides smuggled from Tanzania	• 85% of farmers had faced a weather shock in the last decade • 100% have faced either weather or pests in the last decade • Rise of spontaneous clusters whose sustainability/survival is a concern, but which specialize in niche crops
• Provide/Support the financing (instruments and funds) and	• Only 3% of tomato producers used	

development of technologies (including digital technologies) to improve water use and chemical application in production (e.g., solar, drip, drones, and the Internet of Things (IoT)). • Improve and maintain government irrigation infrastructure.	solar for water pumps, and almost none (0.1%) use drip irrigation.	• The most noted constraint to entering (50%) and continuing (65%) vegetable production was water availability. • Community surveys consistently revealed the significant disrepair of public irrigation infrastructure (largely lift irrigation) in Odisha
• Improved training and regulation of input suppliers	• Input suppliers are the main source of information for tomato producers on input use (87% of farmers who received training got it from an input supplier)	• About 25% of vegetable farmers noted that input dealers were the most valuable source of information for vegetable farming and over 52% of input dealers noted that they had offered advice to farmers when they made their most recent sale.
Wholesale markets		
• Improve water availability and management • Improve the number of toilets and sewage management • Decongest loading/Unloading areas, and provide parking spaces for transporters and customers . • Improved roads (number and quality of principal and secondary) to reduce transaction costs and time to get to the markets • Addressing the tension between low participation fees for market actors (key for	• 30% of WMs have no water • The average trader toilet ratio is 143	• 18% of WMs have no water • The average trader toilet ratio is 102 • Only 38% of WMs have access to electricity • 0.4% of wholesalers are female • 0.08% and 1.2% of wholesalers were Scheduled Tribes (ST)

<table>
<tr><td>inclusion) and low provision of key services and infrastructure
● Improve access to electricity
● Support more inclusive participation in trading and market governance
● Where possible, leverage market governance as a mechanism to improve market infrastructure and service provisions</td><td></td><td>and Scheduled Castes (SC), respectively
● 23% of retailers in WMs are female
● 6% and 10% of retailers in WMs are ST and SC
● 15% of WMs have parking spaces
● 12% of WMs have surfaced roads within the markets</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Inclusion and social protection</td><td></td><td></td></tr>
<tr><td colspan="3">Implement programs to support specific groups (women, youth, and minority castes) to participate in the horticulture value chain, such as:
● Free pass for public transportation for women (implemented in Odisha in India, during COVID, and remains a practice in other states, such as Tamil Nadu).
● Lower entry barriers (financial and non-financial) for women in the marketplace.</td></tr>
<tr><td colspan="3">Increasing the capacity for the marginalized to participate, such as
● Leverage on self-help groups/women’s groups/ other local networks that can be used as a mechanism to implement targeted interventions more effectively
● Consider market space as a potential platform for targeted interventions for marginalized groups
● Support effective state-driven coordination with civil society and the private sector (such as the Agricultural Production Clusters APC program in India) who are not traditional targets/recipients of social protection programs. Respondents in India noted that the APC program was an important avenue for learning new techniques, expanding their area under vegetables, increasing their productivity, accessing inputs, and securing better prices and social connections.
● Targeted social transfers within the horticulture value chain to marginalized groups (e.g., minority castes and/or urban low-income traders).</td></tr>
</table>

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Extended data

The following repository contains Annex 1 (methodological notes) and Annex 2 (tables A1-A6):

Fuica Barrios, Andres Antonio, 2026, "Annex for Symbiosis between commercial small-scale producers and micro, small and medium enterprises in the "Hidden Middle": evidence from the Horticulture Value Chains in Africa and Asia", https://doi.org/10.7910/DVN/SHAPPG, Harvard Dataverse, V1

Regarding tables and figures replication, data supporting the findings of this study are currently being cleaned and anonymized. They will be deposited in RIMISP's Harvard Dataverse repository as soon as they are ready for public release. Until deposition is complete, the datasets are not yet available. The authors will update the preprint with the persistent repository link and citation upon release.

Competing interests

No competing interests were reported.

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