RAPID EVIDENCE ASSESSMENT

IFAD
Investing in rural people

THE ROLE OF SMALLHOLDER PRODUCERS AND SMALL AND MEDIUM-SIZED ENTERPRISES ACROSS THE FOOD SYSTEMS SUMMIT ACTION TRACKS: A RAPID EVIDENCE ASSESSMENT

THE ROLE OF SMALLHOLDER PRODUCERS AND SMALL AND MEDIUM-SIZED ENTRERPRISES ACROSS THE FOOD SYSTEMS SUMMIT ACTION TRACKS: A RAPID EVIDENCE ASSESSMENT

Jack Daly, Sarah Zoubek, Florence Benn, Jyotsna Puri

IFAD

Suggested citation

Daly, J. et al., 2023. “The role of smallholder producers and small and medium-sized entrerprises across the food systems summit action tracks: A rapid evidence assessment”, International Fund for Agricultural Development (IFAD)

Disclaimer

This paper is a product of the International Fund of Agricultural Development. It is part of a larger effort to provide open access to its research and work and to make a contribution to climate change discussions around the world.

The opinions expressed in this publication are those of the authors and do not necessarily represent those of the International Fund for Agricultural Development (IFAD). The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of IFAD concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The designations “developed” and “developing” countries are intended for statistical convenience and do not necessarily express a judgement about the stage reached in the development process by a particular country or area.

Contents

Executive Summary

This paper is a Rapid Evidence Assessment that summarizes the role of smallholder producers and Small and Medium-sized Agrifood Enterprises (SMAE) across the five Action Tracks associated with the Food Systems Summit 2022 (FSS). The literature suggests smallholder producers and SMAEs will play a crucial role in global food systems in supporting progress towards Sustainable Development Goals (SDGs).

Action Track 1: Access to Safe and Nutritious Foods

Smallholder producers is the umbrella term used in this paper to aggregate related terms such as "small-scale producers" or "smallholders" or "small farms." The Key Terms and Methodology sections provide further detail. We operationalized the definition of Action Track (AT) 1 (safe and nutritious foods) to include four elements: 1) food production; 2) crop diversity; 3) nutrition; and 4) SMAE participation in mid-stream segments of agricultural value chains. We found the relationship between these variables and our target population (smallholder producers and SMAEs) is well detailed in recent publications.

There have been multiple recent studies that have employed different methodologies to arrive at similar conclusions: smallholder producers generate between 20-40% of the world's food, despite only operating on 12% of all agricultural land.[1] Farmers working 2 hectares (ha) or less are an especially critical component of production in Sub-Saharan Africa (SSA) and Asia, where they generate roughly 30% of most food commodities.

The total number of crop species decreases as farm size increases. Smallholder producers also tend to focus on different crops than larger farms, with larger shares of production in fruits, vegetables, and roots and tubers (and less in livestock). Medium-sized farms generate more nuts and have high shares of vegetable production. Larger farms are weighted towards cereal production or oil crops.

Mixed production systems of the kinds operated by smallholder producers generate more diversity of key nutrients. Bolstered by their large footprint in fruit, vegetables, root and tuber production, smallholder producers' share of nutrient production is highest for vitamin A, vitamin B12, and zinc. Smallholders generate low amounts of folate and iron.

In SSA/Asia, SMAEs in midstream segments (processors, traders, logistical actors) handle or move as much as 65% of the food consumed in those regions and capture similar shares of the value of final products as farmers.

[1] Citations for individual studies can be found in the body of the paper and are not included here for brevity.

Action Tracks 2 and 3: Environmental Sustainability

We condensed Action Track 2 (sustainable consumption) and Action Track 3 (nature-positive production) into one category to streamline the analysis. Based on our searches, we broke the analysis into six sections: 1) GHGs emissions; 2) food waste generation; 3) non-food use of crop production; 4) water usage; 5) agricultural biodiversity; and 6) sustainability certificates. While there is ample academic evidence overall, many studies do not disaggregate by farm size, resulting in literature gaps.

Food systems play a prominent role in climate change, accounting for an estimated 21-37% of greenhouse gas emissions. While there has been less research attention on emission footprints by farm size, recent evidence has suggested smallholder producers in developing countries produce at least 5% of total global greenhouse gas emissions. The real figure is likely higher—that estimate does not include supply chain activities as well as some emissions associated with land use changes.

Smallholder producers may have at least two factors working in their favor if emissions are considered on a per hectare basis (as opposed to per product): 1) outputs (smallholder producers generate relatively high shares of the world's fruits, vegetables, and roots and tubers, and lower shares of livestock, which has an especially high emissions profile); and 2) production systems (smallholder producers tend to be capital-poor and depend on low-efficiency agricultural practices, which reduces their input usage; high input usage, in turn, tends to push emissions higher).

Small farms account for 26-30% of total food waste (on-farm and post-harvest loss). The relatively high share is partially the result of smallholder producers' large contribution to total crop production—only 2.3–6.1% of smallholder production is wasted. By comparison, farms larger than 1,000 ha waste 0-18.5% of their outputs.

The other components associated with environmental sustainability included in the paper were the following:

- **Non-food use of crop production:** Smallholder producers allocate the largest percentage of their crop production (55–59%) to food compared to other size categories of farms.
- **Water usage:** While irrigated agriculture accounts for 70% total freshwater withdrawals globally, less than 37% of smallholder producers in low and middle-income countries have irrigation. With smallholder producers instead relying on rainwater, climate change and rising global temperatures could elevate risks associated with water scarcity.
- **Agricultural biodiversity:** Reviews of academic literature have found that 77% of studies report that small farms have greater agricultural biodiversity than larger farms.

- **Sustainable certifications:** Estimates suggest that less than 2% of smallholder producers in low-income countries have earned formal certificates for sustainable production.

Action Track 4: Equitable Livelihoods

The labour component of smallholder production and SMAE employment in food systems is significant. Up to 3.4 billion people live and work on small-scale farms and up to 75% of the world's poorest households live in rural areas that depend on agriculture for their livelihoods. Globally, agricultural production accounts for 26% of total employment. It is also important to note that food systems as a whole—not just farming—are major sources of employment. According to livelihood surveys from countries in Africa, Asia and Latin America, food systems account for 59% of rural employment.

Action Track 5: Resilient Supply Chains

Evidence about the resilience of complete supply chains is limited—existing studies generally focus on narrow segments and do not make comparisons between different typologies or types of shocks. There are studies related to specific shocks. With respect to the COVID-19 pandemic, modern, export-oriented agricultural supply chains with large, vertically-oriented agribusiness companies were often more resilient than traditional chains with smallholder producers and SMAEs, although this does not suggest these chains lack the ability to innovate. Instead, resilience capabilities in agricultural supply chains are often tied to various factors that can be challenging for smaller actors: 1) social innovations; 2) business strategy innovations; 3) technological innovations; and 4) financial resilience innovations.

Table 1: Summary of Evidence about Role of Smallholder Producers and SMAEs across Action Tracks

Action Track 1: Access to Safe and Nutritious Food			
Variable	**Notable Result**	**Strength of Findings**	**Further Reference**
Food Production	Smallholder producers generate between 20-40% of the world's food and may have higher yields than larger farms	Strong	— Ricciardi et al., 2018 — Herrero et al., 2017 — Lowder et al., 2021 — Samberg et al., 2016
Crop Diversity	The number of crop species decreases as farm size increases, although there are caveats	Strong	— Ricciardi et al., 2021 — Ricciardi et al., 2018 — Herrero et al., 2017
Nutrition	Smallholder producers' share of nutrient production is highest compared with	Strong	— Herrero et al., 2017 — Ricciardi et al., 2018

	larger farms for vitamin A, vitamin B12, and zinc		
SMAEs in Midstream Segments	In Sub-Saharan Africa and South Asia, SMAEs handle or distribute 65% of the food consumed in those regions	Medium	— Reardon et al., 2019, 2021
Action Tracks 2 and 3: Environmental Sustainability			
GHG Emissions	Within production, smallholder farming has been estimated to generate 32% of ag emissions	Light	— Herrero et al., 2013 — Vermeulen & Wollenberg, 2017 — Ricciardi et al., 2021
Food Waste	Small farms account for 26-30% of total food waste	Light	— Ricciardi et al., 2018
Non-Food Use of Crops	Smallholder producers allocate the largest percentage of their crop production to food	Light	— Ricciardi et al., 2018
Water	Less than 37% of smaller farms have irrigation in medium and low-income countries	Medium	— Ricciardi et al., 2020 — Mekonnen & Hoekstra, 2012
Agricultural Biodiversity	77% of studies report that small farms have greater non-crop biodiversity than larger farms	Medium	— Ricciardi et al., 2021 — Fanzo, 2019
Sustainability Certificates	Estimates suggest less than 2% of smallholder producers in low-income countries are certified	Medium	— Meemken et al., 2021
Action Track 4: Equitable Livelihoods			
Rural Poverty	Food systems account for 59% of rural employment in SSA, Latin America, and Asian countries	Medium	— Dolislager et al., 2021 — Reardon et al., 2021
Gender	In SSA, 66% of employed women work in food systems (60% of men); in southern Asia, 71% of employed women (47% men)	Medium	— FAO, 2023b
Action Track 5: Resilient Supply Chains			
Shocks	Evidence about resilience of supply chains for different commodities/shocks is limited	Light	— FAO, 2023a

Source: Authors. Note**:** Strength of Findings characterizes the depth of evidence available, not necessarily the quality of the individual articles. “Strong” indicates there were multiple articles that addressed smallholder production specifically or in extensive depth. “Medium” indicates there was at least one article that addressed smallholder producers. “Light” indicates an area where researchers have identified a gap.

1. Introduction

In 2021, the UN Secretary-General convened the Food Systems Summit (FSS) to raise awareness on the importance of the transformation of global food systems to help achieve the Sustainable Development Goals. In the aftermath of the FSS, the International Fund for Agriculture Development (IFAD) and the World Bank were given mandates to co-lead the financing agenda in support of the UN's Food Systems Coordination Hub.

As part of that effort, IFAD examined the role that smallholder producers and SMAEs play across the Action Tracks (ATs) associated with the FSS. This paper summarizes evidence related to the role (magnitude and qualitative) of smallholder producers and SMAEs across the five action tracks of the FSS. Key Terms are outlined in Section 2 before the Methodology (Section 3) associated with the Rapid Evidence Assessment (REA). Section 4 is the critical section of the report, providing a summary of the available evidence. Section 5 concludes with summary observations and highlighting some of the limitations of the study.

2. Key Terms

Family farms: Family farming is a mode of agricultural, forestry, fisheries, livestock and aquaculture production which is managed and operated by a family and predominantly reliant on family labour, including both women and men (FAO, 2018).

Food security: A situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. Based on this definition, four food security dimensions can be identified: food availability, economic and physical access to food, food utilization, and stability over time (FAO, 2022).

Food security dimensions: Food security dimensions refer to the four traditional dimensions of food security:

1. Availability: This dimension addresses whether or not food is actually or potentially physically present, including aspects of production, food reserves, markets and transportation, and wild foods.
2. Access: If food is actually or potentially physically present, the next question is whether or not households and individuals have sufficient physical and economic access to that food.
3. Utilization: If food is available and households have adequate access to it, the next question is whether or not households are maximizing the consumption of adequate nutrition and energy. Sufficient energy and nutrient intake by individuals is the result of good care and feeding practices, food preparation,

dietary diversity and intra-household distribution of food, and access to clean water, sanitation and healthcare. Combined with good biological utilization of food consumed, this determines the nutritional status of individuals.

4. Stability: If the dimensions of availability, access and utilization are sufficiently met, stability is the condition in which the whole system is stable, thus ensuring that households are food secure at all times. Stability issues can refer to short-term instability (which can lead to acute food insecurity) or medium to long-term instability (which can lead to chronic food insecurity). Climatic, economic, social and political factors can all be a source of instability (FAO, 2022).

Food systems: Gathers all the elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food, and the outputs of these activities, including socio-economic and environmental outcomes. This report pays specific attention to nutrition and health outcomes of food systems. It identifies three constituent elements of food systems, as entry and exit points for nutrition: food supply chains; food environments; and consumer behaviour (HLPE, 2017).

Small-scale (agricultural) producers: They comprise households running small-scale agricultural businesses of crops, livestock, fisheries, aquaculture, pastoralism or forestry, operating under greater constraints due to limited access to markets and resources such as land and water, information, technology, capital, assets, and institutions (FAO, 2021).

Small and medium-sized agrifood enterprises (SMAEs): These are independent post-harvest agrifood businesses (e.g. food processing, storage, transport or distribution) whose revenues, assets and number of employees are below a certain threshold. They are seen as more vulnerable and require special attention from both policy and research perspectives (FAO, 2021).

Smallholders: Smallholders, including those that are family farmers – women and men – include those that are small-scale producers and processors, pastoralists, artisans, fishers, communities closely dependent on forests, indigenous peoples, and agricultural workers (CFS, 2016). In this report, we have not defined a land holding size for smallholders or small-scale producers, to allow for multiple definitions to be considered in this rapid evidence assessment. Smallholders are those which manage areas varying from less than one hectare to 10 hectares, and definitions range within that.

Supply chain resilience: The ability of the supply chain to continue to fulfil its functions efficiently when exposed to disturbances and shocks based on its capacities to anticipate and absorb those that cannot otherwise be prevented, and to recover from them by adapting the nature of their behaviour and practices or transforming them so as to build back better (FAO, 2023a).

3. Methodology

Key Takeaways

- Smallholder producers and SMAEs are the key population for this paper.
- The term "smallholder producers" is intended as a catch-all for "smallholders," "small-scale agricultural producers," "small-scale farms".

An REA is a "rapid review that is a form of knowledge synthesis that accelerates the process of conducting a traditional systematic review through streamlining or omitting a variety of methods to produce evidence for stakeholders in a resource-efficient manner" (Hamel et al., 2021). Any type of systematic review will "aim to locate as many relevant studies as possible, select them for inclusion in a transparent way, assess their reliability and have quality assurance mechanisms built into the review process" (Thomas et al., 2013). Trade-offs always exist between systematic, comprehensive searches and those conducted quickly; our review should not be considered exhaustive and we discuss limitations of our review in the conclusion section.

We conducted a REA to answer the question: what is the role (magnitude and characteristics) of smallholder producers and SMAEs (producers, processors) in food systems across the five Action Tracks outlined by the FSS? There is not a common definition for smallholder producers and the many related terms ("smallholders," "small-scale agricultural producers," "small farms," etc.). While the definition advanced by the Committee on World Food Security does not include a size distinction (see Section 2), the FAO definition includes land areas of 1-10 ha (FAO, 2013). Other researchers use different thresholds, and there are still other ways to conceptualize the category (production techniques, technology usage, pool of labor, etc.). Since this is a summary of available evidence, we included as many sources as possible, noting distinctions on methodologies and operational definitions of land sizes where appropriate.

We used the five Action Tracks associated with the FSS to contextualize the contribution of smallholders and SMAEs to food systems. We use the definitions laid out at FSS but for ease collapse two of them to present and discuss evidence.[2]

Our search strategy included a list of terms and documents suggested by key stakeholders. The search strategy was delineated in advance to ensure it was transparent, verifiable, and reproducible. Searches were conducted in June-August 2023. Due to the extremely rapid nature of the analysis, we did not evaluate the methodologies of all the studies cited.

[2] The ATs have continued to evolve after the FSS in September 2021 but we use the 2021 definitions.

3.1. Inclusion Criteria

- **Date:** Articles published between 2014 and 2023. In selected cases, older articles were included when more contemporary were not available or the older articles helped provide comprehensive understanding.
- **Types of studies:** Quantitative and qualitative studies. Articles published in academic journals subject to peer review were targeted for inclusion, although non-peer reviewed materials and reports published by international organizations with agricultural expertise (FAO, IFAD, the World Bank) were included when relevant. The researchers attempted to identify systematic literature reviews across variables; these reviews were included when located.
- **Geography:** Global. In our repository, we identify papers that offer a regional or developing country context.
- **Outcome:** Articulates the role of smallholder producers/SMAEs in food systems.

3.2. Action Tracks

The FSS' five Action Tracks provided the foundation for discussion of the role of smallholder producers and SMAEs in food systems. These are presented below in individual sub-sections. There is an overlap between Action Track 2 (sustainable consumption patterns) and Action Track 3 (nature-positive production). We present the evidence on these Action Tracks in one aggregate section focused on ‘’environmental sustainability of smallholder producers and SMAEs.” This allows for streamlined discussion about the role of smallholder producers and SMAEs across four key pillars: 1) food security and nutrition; 2) environmental sustainability; 3) livelihoods; and 4) supply chain resilience.

3.2.1. Action Track 1: Food Security and Nutrition

Action Track 1 aims to end hunger and all forms of malnutrition and reduce incidence of non-communicable disease, enabling all people to be nourished and healthy. This goal requires that all people at all times have access to sufficient quantities of affordable and safe food products. Achieving the goal means increasing availability of nutritious food, making food more affordable and reducing inequities in access.

3.2.2. Action Tracks 2 and 3: Sustainable Consumption and Nature-Positive Production as Environmental Sustainability

Action Track 2 will work to build consumer demand for sustainably produced food, strengthen local value chains, improve nutrition, and promote the reuse and recycling of food resources, especially among the most vulnerable. This Action Track recognizes that we need to eliminate wasteful patterns of food consumption.

Action Track 3 will work to optimize environmental resource use in food production, processing, and distribution, thereby reducing biodiversity loss, pollution, water use, soil degradation and greenhouse gas emissions. Action Track 3 will also strive to support food system governance that realigns incentives to reduce food losses and other negative environmental impacts.

The discussion on Action Tracks 2 and 3 is aggregated in this paper to streamline the analysis and avoid extended discussions of the distinctions between "sustainable consumption" and "nature-positive production." Both categories share an emphasis on environmental sustainability. This section focuses its attention on the environmental footprint of smallholder producers and SMAEs.

3.2.3. Action Track 4: Livelihoods

Action Track 4 will work to contribute to the elimination of poverty by promoting full and productive employment and decent work for all actors along the food value chain, reducing risks for the world's poorest, enabling entrepreneurship, and addressing the inequitable access to resources and distribution of value.

3.2.4. Action Track 5: Resilient Supply Chains

Action Track 5 will work to ensure the continued functionality of sustainable food systems in areas that are prone to conflict or natural disasters. It will also promote global action to protect food supplies from the impacts of pandemics. The ambition behind Action Track 5 is to ensure that all people within a food system are empowered to prepare for, withstand, and recover from instability.

The FAO's definition of supply chain resilience was used as a baseline for this report: "the ability of the supply chain to continue to fulfil its functions efficiently when exposed to disturbances and shocks based on its capacities to anticipate and absorb those that cannot otherwise be prevented, and to recover from them by adapting the nature of their behaviour and practices or transforming them so as to build back better" (FAO, 2023a).

4. Evidence Review

4.1. Action Track 1: Access to Safe and Nutritious Foods

Action Track 1 focuses on availability and access considerations for safe and nutritious foods. Smallholder producers and SMAEs have prominent roles in ensuring food moves through various stages of the value chain and nourishes global populations. Our search yielded evidence that can be divided into four sections: 1) production; 2) crop diversity; 3) nutrition; and 4) SMAE participation in agricultural value chains. Each is discussed below.

If one aggregates the evidence, key themes emerge. Recent studies have used different methodologies and definitions of smallholder producers to arrive at disparate data points, but there is general agreement that they generate 20-40% of the world's food. The regional variance is significant—in developing regions in Sub-Saharan Africa (SSA) and South and Southeast Asia, they are responsible for prominent shares of production (30% of most food commodities), crop diversity, nutrition, and activity in the midstream segments of agricultural value chains.

4.1.1. Production

Key Takeaways

- Smallholder producers make up the majority of farms globally, despite operating on only 12% of all agricultural land.
- Smallholders are an especially critical component of food systems in SSA and Asia, generating roughly 30% of most food commodities.
- Important to differentiate between smallholder produces and family-owned farms. Family farms constitute 90% of the world's farms, account for 70-80% of farmland, and 80% of global food production in value terms.

The number of farms worldwide has been revised upwards in recent years.[3] The most recent studies suggest there are more than 608 million farms globally (Lowder et al., 2021). The same research reported smallholder producers (two ha or less) account for 84% of all farms worldwide but operate on only 12% of all agricultural land (Lowder et al., 2021). Others have found that smallholder producers account for 24% of gross agricultural area (Ricciardi et al., 2018).[4]

[3] Estimates published in 2005 suggested there were 525 million farms worldwide of all sizes, of which smallholders operating plots of two ha or less constituted 85% (Nagayets, 2005). In 2010, studies suggested there were 500 million small farms of less than two ha in the developing world (Hazell et al., 2010). In 2014, the FAO estimated 570 million farms (FAO, 2014).
[4] For the basis of comparison, the largest 1% of farms worldwide as measured by size (more than 50 ha) operate on more than 70% of the world's farmland (Lowder et al., 2021).

The crop and calorie content of production on smallholder plots is higher than their land area suggests, which researchers have noted to argue that smaller farms have great crop intensity and yields (Ricciardi et al., 2018).[5] Here, it should be noted that different studies have produced different estimates of food production, which can be partially attributed to contrasting definitions and methodologies.[6] Notable recent examples included the following conclusions:

- Farms two ha or smaller generate 28-31% of global crop production and 30-34% of the world's food (Ricciardi et al., 2018).
- Farms two ha or smaller produce roughly 35% of the world's food (Lowder et al., 2021).
- Farms with a "mean agricultural area" of five ha or less produce 55% of global food calories (Samberg et al., 2016).
- Smallholder producers (two ha or less) account for 18% of global food production (Herrero et al., 2017).

Table 2: Comparison between Estimates for Global Food Production by Smallholder Producers

Study	< 2 Ha	< 5 Ha	< 50 Ha	Methodological Notes
Herrero (2017)	30-34%	44-48%	62-66%	Direct measurement of 154 crops in 55 countries
Ricciardi (2018)	18%	—	56%	Modeled estimates of 41 crops, 7 livestock, 14 aquatic species with near global coverage
Samberg (2016)	37%	55%	—	Modeled estimates of 41 crops

Source: Ricciardi et al. (2018).

There is a large variance between different geographic regions regarding the proportion of total farmland worked by smallholder producers. Smallholders are an especially critical component of food systems in SSA and Asia, where 80% of farmland is managed by farmers working on land of 10 or fewer ha (Fanzo, 2018). In those regions, smallholders on two or fewer ha generate roughly 30% of most food commodities (Herrero et al., 2017). In China, the same-sized farms produce more than 50% of agricultural products except for fibre crops. And if one expands the definition of smallholder farms to five ha or less and includes Latin America with SSA and Asia,

[5] This despite the fact smallholder producers often work more marginal lands that larger farms (Harvey et al., 2018; Rapsomanikis, 2015).
[6] Some of the studies use direct measurements of production based on farm size using open-access datasets rather than modeling. Another difference is the range of crop species. For a detailed description of the methodological variance, see Ricciardi et al. (2018).

smallholder producers account for 52.5% of calories in those regions (Samberg et al., 2016).

Box 1: Contribution of Family Farms to Global Food Security

It is important to emphasize that family farms and smallholder producers are not the same thing and that the terms should not be used interchangeably. While the FAO and CFS definitions of smallholders includes family farms (CFS, 2016; FAO, 2014), not all family farms are smallholder producers. Instead, there is tremendous diversity within the "family farm" category, and the size and technical capacity within the category can vary significantly (Graeub et al., 2016; Lowder et al., 2021).

Although the focus of this paper is summarizing the evidence associated with smallholder production, there is research associated with family farms that accentuate some of the differences. Family farms constitute 90% of the world's farms, account for 70-80% of farmland, and 80% of global food production in value terms, higher in all cases than smallholders (Lowder et al., 2021). Other studies estimated that approximately 98% of all farms globally are family farms and collectively manage 53% of all cropland, meeting an estimated 36–114% of calorie requirements for various countries (Graeub et al., 2016).

Other regions are dominated by larger farms. In North America, South America, Australia and New Zealand, larger farms (50 ha or bigger) generate between 75% and 100% of all cereal, livestock, and fruit products, a pattern that is repeated across other commodity groups (Herrero et al., 2017).

4.1.2. Crop Diversity

Key Takeaways

- The number of crop species decreases as farm size increases.
- Smallholder producers have higher shares of production of fruits, vegetables, and roots and tubers compared to larger farms and less livestock.
- Larger farms are often weighted towards cereal production or oil crops, while medium-sized units produce more vegetables and nuts.

Food output and overall calories are only two of the ways smallholder producers support Action Track 1. Another consideration is what farms actually produce. Smallholder producers are often credited as being "custodians" for underutilized species and crop diversity (Hunter et al., 2019). What does the evidence say?

On a global scale, the number of crop species has been shown to decrease as farm size increases (Herrero et al., 2017; Ricciardi et al., 2018). However, there are some caveats. Areas with higher agricultural diversity produce more nutrients, regardless of farm size (Herrero et al., 2017). And systematic reviews of studies that examined the relationship between farm size and crop diversity in specific locations reported mixed findings and small sample sizes (Ricciardi et al., 2021).

Analysis of worldwide crop production disaggregated by farm size demonstrates different patterns among the various categories. Summarizing the findings, smallholder producers (two ha or less) have their highest shares in fruits, vegetables, roots and tubers, and cereals, while total production for larger farms is weighted towards oil and sugar crops (Herrero et al., 2017; Ricciardi et al., 2018).[7] Table 3a presents a summary of these trends and further detail on farm size distribution is provided in Table 3b.

Table 3a: Global Food Production by Weight and Farm Size

Size (ha)	Roots/ Tubers	Vegetables	Fruit	Cereals	Pulses	Livestock	Sugar Crops	Oil Crops
2 ha or less	30%	28%	21%	21%	19%	18%	13%	11%
All other sizes	70%	72%	79%	79%	81%	82%	87%	89%

Source: Adapted from IFAD (2021). Based on Herrero et al. (2017).

Table 3b. Indicative characteristics of farm numbers, area farmed and food production related to farm size

Scale	Farm size distribution					Gloal food production type by weight (%)								
	Farm size (Ha)	% Farms	No. farms (millions)	% Farmland	% Global production (kcal)	Cereals	Vegetables	Fruit	Sugar crops	Roots/ tubers	Oil crops	Pulses	Livestock	Average
Large	>200	0.2	1	57	18	18	11	18	35	9	39	18	18	21
	50-200	0.4	2	12.8	19	22	19	17	14	15	25	18	23	19
Medium	20-50	0.7	4	4.6	4	8	9	10	9	8	6	8	10	9
	5-20	4.3	23	8.8	14	31	30	34	30	38	19	37	31	32
	2-5	10.4	55	6.1	14									
Small	1-2	13.8	73	4	16	21	13	21	13	30	11	19	18	20
	<1	70.4	374	6.7	15									

Source: Adapted from IFAD (2021). Based on Herrero et al. (2017).

[7] Medium-sized farms produce more vegetables and nuts, and larger farms produce more oil crops (Ricciardi et al., 2018). Farms with 2 ha or less produce less livestock than other farm-size categories (Herrero et al., 2017).

4.1.3. Nutrition

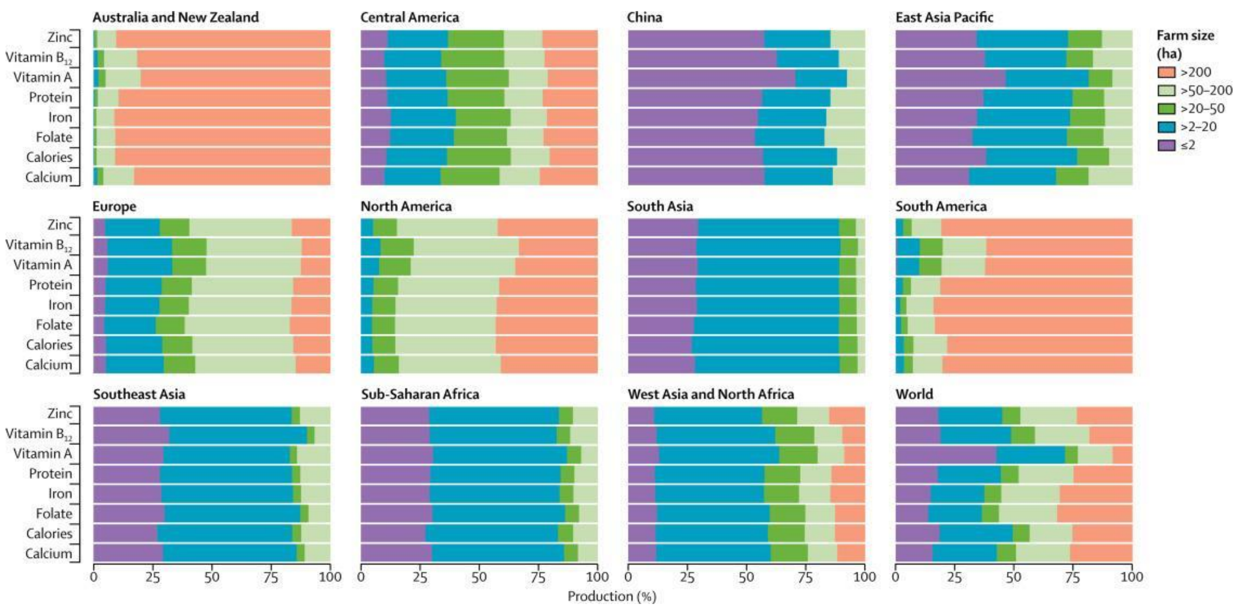
Key Takeaways

- Mixed production systems provide nutritional benefits, and smallholder producers account for high shares of global vitamin A, vitamin B12, and zinc production.
- Farms smaller than 2 ha provide 50% of all nutrients in China, and at least 25% of key nutrients in SSA, South and Southeast Asia, and East Asia/Pacific.

Global nutrient distribution by farm size mirrors the production and crop diversity patterns described in the preceding sections. Bolstered by their large footprint in fruit, vegetables, and root and tuber production, smallholder producers' nutrient share is highest for vitamin A, vitamin B12 and zinc and smallest in folate and iron (Herrero et al., 2017).[8] The disparities are less pronounced in other categories; smaller farms produce slightly higher percentages of carbohydrates, while larger farms have the advantage in proteins, but differences are generally small (Ricciardi et al., 2018).

Regional analysis suggests smallholders play an essential role in delivering nutrition in certain regions. Farms smaller than two ha provide 50% of all nutrients in China (Herrero et al., 2017). In SSA, South and Southeast Asia, and East Asia/Pacific, they account for at least 25% of key nutrient provision (Herrero et al., 2017). The profile is drastically different in other parts of the world, where farms larger than 200 ha produce most of the nutrients, especially in South America, Australia and New Zealand. Figure 1 below provides a summary.

Figure 1: Distribution of Nutrient Production by Farm Size



Source: Herrero et al., 2017.

[8] Vitamin A is supplied primarily from fruits, vegetables, and orange-fleshed roots and tubers.

Researchers have considered other ways that smallholder producers contribute to nutrition. There is an especially wide body of literature about the dietary diversity of smallholder households. The rationale for these studies often follows similar lines: as many as 3.4 billion people live and work on farms that qualify as small-scale (according to the FAO definition); smallholder producers often consume a significant amount of their output themselves, yet still count as food insecure or malnourished (Fanzo, 2018; HLPE, 2019). With up to 75% of the world's poorest households living in rural areas that depend on agriculture for their livelihoods, it would be noteworthy if smallholder production was correlated with positive nutrition outcomes.

Studies paint a nuanced picture. Systematic reviews of evidence provide support for the hypothesis that household agricultural production has positive linkages with the nutrition of household members, especially in SSA and South Asia. But the magnitude varies depending on local circumstance (Carletto et al., 2015). Reviews of 46 studies from 26 developing countries found that only 20% reported positive and significant associations between household production and nutrition; the remainder either were context-specific (60%) or reported no association (the remaining 20%) (Sibhatu & Qaim, 2018).

4.1.4. SMAEs in Midstream Segments of Agricultural Value Chains

Key Takeaway

- In Africa and South Asia, SMAEs in midstream segments of value chain handle or distribute 65% of the food consumed in those regions.

The evidence presented above mostly explored smallholders' role in production and upstream segments of agricultural value chains. However, food security is predicated on multiple dimensions, one of which is food availability. Food availability not only requires production but the presence of capable businesses in the midstream segment of value chains—processors, traders, transportation, and other logistical actors — to ensure that sufficient quantities of food moves from production sites to consumers.

While there is not readily available data on the global landscape, many of the key actors in these midstream segments in SSA and South Asia are SMAEs. They handle or move as much as 65% of the food consumed in those regions and capture similar shares of the value of final products as producers (Reardon et al., 2019, 2021).[9] In addition to helping backstop food availability, SMAEs in midstream segments can help smallholder farmers improve their economic fortunes by communicating market requirements to farmers (Minten et al., 2014; Reardon et al., 2021).

[9] Food retailers earn the remaining 20% (Reardon et al., 2019).

4.2. Action Tracks 2 and 3: Environmental Sustainability

Reducing the stress that food systems put on the environment is a central component of Action Tracks 2 and 3. This section aggregates sustainable consumption of Action Track 2 and nature-positive production of Action Track 3 to streamline the discussion. There are at least six areas where researchers have explored smallholder producers' roles with issues that relate either to Action Tracks 2 or 3. These are outlined below.

At a global level, there is not necessarily a straightforward narrative with respect to farm size and emissions. There are studies that suggest smallholder producers waste less of their production, devote less crop production to non-food use, and promote greater agricultural biodiversity.[10] However, the overall takeaway in many of these areas is that there is a need for additional research.

4.2.1. Emissions

Key Takeaways

- Climate change and food systems have a bi-directional relationship—food systems contribute to climate change; climate change's effects are felt within food systems.
- Estimates suggest smallholder producers generate at least 5% of global greenhouse gas emissions, although the real number is likely higher.
- Although evidence can vary depending on the unit of analysis (emissions per kg of protein vs. emissions per hectare), smallholder producers' per capita emissions footprint is helped by crop diversity and lower input usage.
- The majority of emissions from smallholder producers (71%) come from three countries: China, India, and Indonesia.

Climate change and food systems have a bi-directional relationship that has been the subject of regular academic interest. Researchers have often framed their analysis by separating the carbon footprints associated with food systems into three large buckets: 1) food production, including crop and livestock activities and the farm gate; 2) land use and land-use changes, including deforestation and peat degradation; and 3) post-production or supply chain activities, including processing, transportation and distribution, and food waste (Duku et al., 2022).

In total, between 21–37% of total greenhouse gas (GHG) emissions are attributable to the food system (IPCC, 2022). If one disaggregates according to the categories listed above, the breakdown is as follows:

[10] Please see the corresponding sections below for individual references.

- Production activities: 9-14%.
- Land use and land-use changes: 5–14%.
- Supply chain activities: 5–10%.

Still other studies have evaluated emissions associated with different agricultural products or production systems (Clark & Tilman, 2017; Clune et al., 2017). The overall trendline is toward increasing emissions; by 2050, they are expected to be 30-40% higher than levels when the IPCC study was published (2022).

There has been less research attention on emission footprints by farm size, although the literature has expanded in recent years. According to one rough estimate, smallholder producers in developing countries produce 5% of total global greenhouse gas emissions (Vermeulen & Wollenberg, 2017). In reality, the figure is likely higher—the estimate only includes emissions from production and land use changes but not supply chain activities.[11] Within production, smallholder farming was estimated to generate 32% of total agricultural emissions and 42% of the agricultural emissions from developing countries (Vermeulen & Wollenberg, 2017).

The evidence about whether smallholder producers generate more or less emissions per capita compared with larger farms has been described as inconclusive (Ricciardi et al., 2021). The existing findings are often predicated on the unit of analysis. There are at least two factors that suggest lower emission footprints for smallholder producers overall when compared with larger farms:

- **Outputs:** Older studies have noted that SSA is a global “hotspot” for emissions associated with livestock (Herrero et al., 2013). While such studies have analyzed emissions per kilogram of edible protein, the per hectare analysis is different based on the lower number of animals associated with smallholder production. As described in the section on crop diversity (Section 4.1.2.), smallholder producers generate comparatively high shares of the world’s fruits, vegetables, and roots and tubers, and have lower relative shares of livestock. While large-scale animal production may have a lower emission profile per kg, it has a higher emission footprint per hectare for multiple reasons, including animal feed, other inputs, land use, waste, and other factors. Meat, aquaculture, eggs, and dairy use roughly 83% of the world’s farmland and contribute 56-58% of food

[11] Additionally, the authors stressed the following: “these numbers … do not reflect carbon sequestration due to the planting of trees, pasture or organic matter input to the soil. The estimates are very rough due to poor availability of data on smallholder numbers and practices” (Vermeulen & Wollenberg, 2017).

systems' emissions, despite providing only 37% of our protein and 18% of our calories (Poore & Nemecek, 2018).[12]

- **Production Systems:** Again, the evidence depends on the unit of analysis. Smallholder producers tend to be capital-poor and depend on low-efficiency agricultural practices, which reduces overall food output and push emissions per calorie higher (Cohn et al., 2017). Yet lower input usage per hectare tends to lower emissions.[13]

Within land use and land use changes, commercial agricultural and smallholder farmers play significant roles in deforestation, although it should be noted that overall emissions from deforestation decreased from 2005-16 (Duku et al., 2022; UNEP & FAO, 2020). Net emissions from deforestation in Africa account for 38% of the global deforestation total, with deforestation in Africa largely driven by smallholders (UNEP & FAO, 2020).

The majority of global emissions from smallholder producers (71%) come from three countries: China, India, and Indonesia (Vermeulen & Wollenberg, 2017). Further analysis paints a complicated picture. Absolute emissions from smallholder producers are highest in Asia, but not necessarily emissions per smallholder farm (Vermeulen & Wollenberg, 2017). Areas dominated by smaller farms in SSA, Southeast Asia, and the Caribbean also generate significantly higher GHG emissions per calorie than areas dominated by larger farms, but not overall emissions (Cohn et al., 2017).

4.2.2. Food Waste

Key Takeaways

- Smallholder producers (two ha or less) account for 26-30% of total food waste.
- Small farms waste less food than farmers larger than 1,000 ha.

Sustainable consumption is a pillar of Action Track 2. While there are different ways to frame the issue, reducing food waste has significant environmental and food security components.

Food loss and waste contributed an estimated 8-10% to global emissions from 2010-16 (IPCC, 2022). If food loss and waste were cut by half, there would be a 6-16% decline in baseline projections for global emissions by 2050; if food loss and waste were cut by 75%, it would lead to 9-24% reductions (Springmann et al., 2018).

[12] Replacing animal-based foods with plant-based ones in some high income countries could reduce greenhouse gas emissions by 84% (Springmann et al., 2018).
[13] Although not in all cases—notable exceptions have been reported in China and Kenya (Vermeulen & Wollenberg, 2017).

The implications of food waste for overall food supply are also significant. An overview of recent studies on global food loss and waste magnitudes shows a range from 27%-32% of all food produced in the world (Schuster & Torero, 2016).[14]

What is the role of smallholder producers in the food waste landscape? Small farms (two ha or less) account for 26-30% of total food waste (on-farm and post-harvest loss) (Ricciardi et al., 2018). Although this is higher than many other size categories,[15] part of the explanation is the large number of smallholder farms worldwide. Only 2.3–6.1% of smallholder production is wasted; by comparison, farms larger than 1,000 ha waste 0-18.5% of their outputs (Ricciardi et al., 2018).

4.2.3. Non-Food Use of Crop Production

Key Takeaway

- Smallholder producers allocate the largest percentage of their crop production (55–59%) to food (vs animal feed or fuel) compared to larger categories.

The use of human-edible crops for animal feed and other products has both environmental and food security costs.[16] Recent estimates suggest globally that 33% of crops that are edible after harvest are fed to animals (Berners-Lee et al., 2018). Older estimates suggest 62% of global crop production is allocated to human food vs. 35% for animal feed and 3% for industrial products (Foley et al., 2011).

Smallholder producers (farms two ha or less) allocate the largest percentage of their crop production (55–59%) to food compared to other categories (Ricciardi et al., 2018). Farms with 200-500 ha have the largest allocation of their production to feed (16–29%); by comparison, farms that are two ha or less allocate 12–16% to feed (Ricciardi et al., 2018).

---

[14] There are significant differences across studies when one drills down to the commodity level. According to the FAO, cereal losses are estimated at 19–32%, root and tuber losses at 33–60%, and fruit and vegetable losses at 37–55% (Schuster & Torero, 2016). Although fruit and vegetables have a high rate of wastage, the resulting GHG emissions are relatively small, accounting for roughly 17% of total emissions from food loss (Duku et al., 2022).

[15] The Ricciardi et al. (2018) articles uses World Census of Agriculture farm size categories: 0-1 ha; 1-2 ha; 2-5 ha; 5-10 ha; 10-20 ha; 20-50 ha; 50-100 ha; 100-200 ha; 200-500 ha; 500-1000 ha; above 1000 ha. While the authors classify smallholder producers as less than 2 ha, it is less clear the groupings when it makes comparisons across categories. For example, the article states that farms less than 2 ha contribute the most to total food waste but do not indicate whether the comparison is with the seven other size categories or if there is additional aggregation.

[16] The water footprint of livestock feed is also significant, equating to 41% of total agricultural water use (Heinke et al., 2020).

4.2.4. Water

Key Takeaway

- Water scarcity is a prominent challenge for smallholder producers.

There are different ways to consider how smallholder producers' usage of water relates to environmental sustainability. One is freshwater withdrawals. Irrigated agriculture accounts for 70% of total freshwater withdrawals globally (FAO, 2017).

While there are not a multitude of studies that map water footprints based on farm size, there is reason to suspect smallholder producers put less pressure on water resources than larger sites. Irrigation is regularly unaffordable for smallholders, who instead often rely on rain water (Ubisi et al., 2017). Crop diversity is another component. Similar to emissions, animal products (beef and pork especially) have large water footprints relative to crops (Mekonnen & Hoekstra, 2012). Section 4.1.2. discussed how smallholder producers tend to have more diversified crop portfolios and not concentrate on livestock production.

Water scarcity is a prominent risk to global food production. Even before climate change, many locations faced challenges. In Saudi Arabia, water withdrawals for agriculture exceed total renewable water resources by a factor of eight; in Libya, by five; in Yemen, by 1.5 times; in Egypt, it is closer to parity (Scheierling & Treguer, 2016).

The implications for smallholder producers are stark (Giordano et al., 2019). Water scarcity is a global issue that disproportionately affects smallholder producers in low- and middle-income countries (Aguilar et al., 2022; Ricciardi et al., 2020). Less than 37% of smaller farms have irrigation in such regions, compared with 42% of larger farms.[17] As climate change elevates temperatures and extends droughts, smallholder producers may be the most at risk.

4.2.5. Agricultural Biodiversity

Key Takeaway

- Reviews of academic literature have found that 77% of studies report that small farms have greater agricultural biodiversity than large farms at the farm or landscape levels. This can be tied to three factors: 1) ecological management practices; 2) increased field edges, and 3) landscape composition.

[17] The size of small-scale farms was not quantified in this study.

Action Track 1 included discussion on smallholder producers' contribution to crop diversity. Agricultural biodiversity expands the concept and includes all components of biological diversity relevant to food and agriculture, including species, genetic, and ecosystem diversity (Fanzo, 2019). Practically, this captures not only the biological variety exhibited in crops and livestock directly relevant to agriculture, but also soil fauna, weeds, pollinators, pests, and predators (Hunter & Fanzo, 2013).

Although knowledge gaps persist in the relationship between agricultural biodiversity and smallholder producers (Fanzo, 2019), systematic reviews of the academic literature have indicated that 77% of studies reported that farms two ha or less support greater non-crop biodiversity than larger farms at the farm or landscape levels (Ricciardi et al., 2021). Broadly, there are three factors that help explain these findings:

- **Ecological management practices:** Smallholder producers distinguish themselves with limited insecticide use and use of organic management practices.
- **Increased field edges:** Increased field edges lead to larger available breeding habitats for arthropods (insects with an exoskeleton), provide living habitat for arthropods and smaller species to colonize, support pollinators and increase the numbers of beneficial predators within fields, and act as conservation corridors.[18]
- **Landscape composition**: Landscapes dominated by smaller farms boast diverse land cover types (such as forests and wetlands), fields of different crops, or fields in different stages of their lifecycle (flowering, fruiting, seeding, hibernation, etc.).[19]

If smallholder producers have been shown to provide certain benefits related to agricultural biodiversity, it should be noted they face pressures that can complicate the equation. As global food supply has homogenized (Khoury et al., 2014), smallholders have often responded by intensifying production and reducing crop diversity. In some cases, this has not only damaged biodiversity but led to economic difficulties and deteriorating nutritional outcomes for smallholders (Rasmussen et al., 2018).[20]

4.2.6. Sustainability Certificates

Key Takeaways

- The benefits of land sustainability certificates are mixed and context-specific.

[18] The studies focused on strawberry crops (Ahrenfeldt et al., 2015), plant diversity in Mediterranean croplands (Concepción et al., 2012), and coffee production in Colombia (Bravo-Monroy et al., 2015).
[19] Land use among smallholder producers in Turkey were among studies included (Pekin, 2016).
[20] There are many studies about the challenges smallholders face with respect to agricultural biodiversity. A representative example is soil quality: smallholder producers regularly encounter poorer soil quality on their land than large farms (Franke et al., 2019; Giller et al., 2011).

- Although there is some evidence of environmental and income benefits, estimates suggest less than 2% of smallholder producers in low-income countries cultivate certified land.

Third-party certification standards are intended to communicate adherence to many of the sustainability goals captured by Action Tracks 2 and 3 and covered in this section.[21] Whether there are data that support the link between the two is not conclusive—there is evidence that third-party certificates have helped improve sustainability production processes in certain situations and industries (coffee and cocoa especially), but questions remain about whether they are sufficient to enhance the sustainability of broader food systems (Meemken et al., 2021).

Estimates suggest that nearly 10 million farmers worldwide have earned sustainable certificates and that less than 2% of smallholder producers in low-income countries cultivate certified land (Meemken et al., 2021). The barriers against more widespread adoption are numerous. Some are financial, including the costs of equipment and the certification process. Others are market driven. Domestic markets in SSA or South or Southeast Asia may not prioritize products with sustainability certification, and SMAEs often have difficulty accessing export markets that are the purview of larger firms.

The implication of sustainability standards on smallholder producer incomes appears to be context specific. Studies looking at examples in Africa concluded that standards have helped raise incomes; however, in Latin America, the results are sometimes less positive (Meemken, 2017).

Some of the differences can partly be explained by regional differences. For example, smallholder production in Africa is sometimes characterized by poor access to agricultural inputs and extension services. In such situations, sustainability standards can have positive yield and income effects. In Latin America, increased access to agricultural technology and services may mean the benefit of sustainability certifications is less pronounced for smallholders (Meemken, 2017).

4.3. Action Track 4: Equitable Livelihoods

Action Track 4 centers on food systems' roles in poverty reduction and generating equitable livelihoods for diverse categories of actors. The labour components of smallholder production and SMAE employment in food systems have been touched on in earlier sections of this report—Section 4.1.3 highlighted how 3.4 billion people live and work on farms that qualify as small-scale according to the FAO definition, and up to

[21] Examples of certifications include the Marine Stewardship Council (MSC), Aquaculture Stewardship Council (ASC), Rainforest Alliance Certification (coffee, tea, fruit and vegetables), among many others.

75% of the world's poorest households live in rural areas that depend on agriculture for their livelihoods (Fanzo, 2018; HLPE, 2019).

It is important to note that food systems as a whole—not just farming—are major sources of employment in both rural and urban settings. Estimates published by the ILO and World Bank indicate that agricultural production accounts for 26% of global employment and 52% in SSA. According to livelihood surveys from countries in Africa, Asia and Latin America, food systems account for 59% of rural employment, with farming generating the largest share (Dolislager et al., 2021). The numbers are even higher in SSA—food systems generate 66% of rural employment.

Table 4: Rural Employment in Food Systems

Region	Own Farming	Farm Wage Employment	Midstream SMAE Employment in Agrifood VCs	Food System Total	Non-Food System Employment
SSA	39%	3%	24%	66%	34%
Asia	27%	13%	18%	57%	43%
Latin America and the Caribbean	16%	12%	21%	50%	50%
TOTAL	**29%**	**9%**	**21%**	**59%**	**41%**

Source: IFAD (2021). Based on Reardon et al., (2021) and Dolislager et al., (2021). Based on household surveys in 13 countries: Ethiopia, Malawi, Niger, Nigeria, Tanzania, Uganda (SSA); Bangladesh, Cambodia, Indonesia, Nepal (Asia), and Mexico, Nicaragua, Peru (Latin America).

4.3.1. Rural Poverty

Key Takeaways

- Poverty is primarily rural, and a key driver of global inequality is low levels of economic return for agricultural production and processing activities in rural and traditional systems.
- Estimates for a bulging youth population in SSA argue for a particular focus on this region.

Poverty is still primarily rural, with two-thirds of extreme poverty concentrated in rural areas. These areas are more at risk from under-malnutrition and (particularly women) have reduced access to health, education, assets, and information (Guarin et al., n.d.; United Nations, 2020).

A key driver of global inequality is low levels of economic returns for agricultural production and processing activities in rural and traditional systems, with smallholder producers being one of the most impoverished groups of people globally (Barrett et al., 2022; Gomez Y Paloma et al., 2020). About a third of the global population could be classified as living in “rural and traditional food systems” (Marshall et al., 2021).

Food systems are “powerful avenues to address equity and inclusion objectives” as they provide food and jobs (Barrett et al., 2022). Several researchers urge the global community to expand attention beyond smallholder producers and poor consumers to other agricultural workers and SMAEs (Barrett et al., 2022; Dolislager et al., 2021). Especially as, outside of Africa, employment is tied primarily to SMAEs or farm wage labor than their own farms, and even in urban areas of LMICs 26% work in post-harvest agricultural value chains (Dolislager et al., 2021).

Evidence around population trends suggests targeting SSA as critical for improvements in equitable livelihoods where smallholder poverty is most acute (Barrett et al., 2022; Gomez Y Paloma et al., 2020). The global population is expected to peak in about 2064 at about 9.7 billion people (Vollset et al., 2020), and there will be a shift from Europe and East Asia to SSA, where the population will grow dramatically into the next century, leading to expansions in food demand (Barrett et al., 2022; UNDESA, 2019).

4.3.2. Gender

Key Takeaways

- In some regions, agrifood systems are a more critical livelihood source for women than men.
- Inequities persist regarding female workers access to land, inputs, services, financing, and digital technology.

Globally, food systems account for 36% of total employment for women. This is drop of almost 10 percentage points since 2005 as there has been a decline in employment in primary agricultural production (FAO, 2023b).

The FAO recently launched a report on the status of women in agrifood systems, which included a look at smallholder producers. It concluded that inequities exist for female workers in agrifood systems regarding access to land, inputs, services, financing, and digital technology. Shocks and crises are more detrimental to women’s agrifood livelihoods than men’s—job losses, food insecurity rates, and drawdowns of savings for women during the pandemic were higher (22% of women lost their jobs in off-farm agrifood segments in the first year of the COVID-19 pandemic compared to only 2% of men) (FAO, 2023b). These persisting inequities impact productivity and allow wage gaps between male and female workers to continue.

Women represent a greater share of agricultural employment in lower-income economic development areas. In SSA, 66% of employed women work in food systems, compared with 60% of men; in southern Asia, 71% of the female labor force works in food systems versus 47% of men (FAO, 2023b). Female workers in these areas are limited in their ability to access off-farm work due to lack of rural employment opportunities, lack of sufficient education, and decreased access to infrastructure and markets. Women often are engaged in growing less lucrative crops, control less-profitable livestock breeds, are unpaid family workers, are less likely to participate as entrepreneurs, have more difficultly accessing capital and credit, and lag behind men in utilizing mechanization.

4.4. Action Track 5: Resilient Supply Chains

Key Takeaways

- Evidence about the resilience of complete supply chains is limited—existing studies generally focus on narrow segments and do not make comparisons between different typologies or types of shocks.
- Resilience capabilities in agricultural supply chains are often tied to factors where smallholder producers might need external support.

Concern about the state of global food systems led policymakers to convene the FSS in September 2021 to spur action toward targets associated with the Sustainable Development Goals (SDGs). With food insecurity metrics already on the rise, a variety of recent shocks—the COVID-19 pandemic, the effects associated with climate change, Russia's invasion of Ukraine, and other conflicts—there has been widespread attention about what makes food systems and supply chains resilient (Ali et al., 2018; Béné, 2020; Tendall et al., 2015; Zurek et al., 2022).

At a fundamental level, "supply chain resilience" attempts to capture the idea that supply chain actors can recover from disruptions by unexpected shocks and stresses (FAO, 2021, 2023a). The unit of analysis can alter interpretations of resilience and there can be tradeoffs with potential responses. The composition and orientation of the supply chain plays a critical role in determining its resilience as does the type of shock.

Supply chains can be divided into different ideal types: "modern" ones that span international borders; "traditional" ones with shorter distances between production and consumption; and "transitional" supply chains that are hybrids (FAO, 2021). While there are nuances across commodity groups and regions, traditional supply chains often dominate in developing countries, especially in SSA and South and Southeast Asia (Reardon & Swinnen, 2020). These chains are heavily tilted towards smallholder producers and SMAEs.

Evidence about the resilience of complete supply chains for different commodities and/or types of chains is extremely limited (FAO, 2023a). Existing studies generally focus on narrow segments and do not make comparisons between different typologies or types of shocks.[22]

The literature on food systems and specific shocks provides some evidence on how smallholder producers and SMAEs might contribute to supply chain resilience. Conflict tends to have far-reaching, negative implications on food systems, although context can be critical—intercommunal conflicts, for instance, often target agricultural production areas, which can endanger the livelihoods of smallholders (Adelaja & George, 2019; Ang & Gupta, 2018; Olaniyan & Okeke-Uzodike, 2021). Yet efforts that target smallholder producers for resilience strategies may lead to collective action and conflict prevention (Hellin et al., 2018).

Although there has been widespread academic interest in COVID-19's effect on food supply chains, many focus mostly on producers and consumers and tend not to consider all actors in the chain (Abu Hatab et al., 2021). From the global perspective, there is indication that agribusiness value chains were more resilient during the pandemic than other export-oriented industries—worldwide, the value of agricultural exports grew by 0.9% in 2020 against the previous year, compared to a 5.2% decline in manufactured goods (FAO, 2023a).

Yet there is still the question of resilient for whom? Although there is evidence of the durability of smallholder producers (Dixon et al., 2021; Hirvonen et al., 2021; Lopez-Ridaura et al., 2021), there has also been indication that modern, export-oriented agricultural supply chains with large, vertically-oriented agribusiness companies were more resilient to the pandemic than traditional chains with smallholder producers and SMAEs, whom may prove vulnerable to the cumulative effects of multiple shocks (Tripathi et al., 2021; Van Hoyweghen et al., 2021). The disparity in outcomes has been attributed to different levels of coordination with other supply chain actors, labour and capital-intensity, and economies of scale and scope (Ali et al., 2018; Hobbs, 2021; Reardon & Swinnen, 2020).

This is not to suggest that traditional supply chains with smallholder producers and SMAEs operating on a more local scale lack the ability to innovate. However, resilience capabilities in agricultural supply chains are often tied to various factors: 1) social innovations; 2) business strategy innovations; 3) technological innovations; and 4) financial resilience innovations (Reardon & Swinnen, 2020). Given the financial constraints faced by smallholder producers and SMAEs, policy support from governments and other stakeholders may be needed to help smaller actors (FAO, 2021).

[22] Shocks associated with agricultural value chains can be divided into the following buckets: 1) natural, which can then be broken in sub-categories: a) biological; b) geophysical; and c) climatological, hydrological, meteorological; 2) human-induced; and 3) underlying stressors.

5. Conclusion

This paper attempts to summarize the role that smallholder producers and SMAEs play in global food systems along the Action Tracks articulated by the FSS. It should be noted that the paper was a REA, which has inherent limitations based on the expedited timeframe. Because of the rapid nature of the project, a systematic literature review was not conducted, and it is possible that certain articles were overlooked.

Nonetheless, the review found that the available evidence is particularly robust for Action Track 1. While studies use different methodologies, there is consensus that smallholder producers play a critical role in production, crop diversity, nutrition, and participation in midstream segments of the agricultural value chain, especially in SSA and Asia.

Action Tracks 2 and 3 have areas where the available academic evidence is not as robust, with greenhouse gas emissions being among the most prominent. There are, however, at least two reasons to suspect that smaller farms emit less total greenhouse gas than larger ones: while smallholder producers often generate more emissions per calorie, their crop diversity and production systems also reduce their footprints on a per hectare basis. There are also indications that smallholder producers promote more agricultural biodiversity than larger farms.

Smallholder producers and SMAEs are substantial sources of employment, especially in SSA and Asia, and provide significant opportunities for women. While there are not necessarily comparative studies of supply chain resilience across commodity types or shocks, there are steps that policymakers and other stakeholders can take to improve prospects for smallholders or SMAEs.

6. References

Abu Hatab, A., Krautscheid, L., & Boqvist, S. (2021). COVID-19, livestock systems and food security in developing countries: A systematic review of an emerging literature. *Pathogens*, *10*(5), 586.

Adelaja, A., & George, J. (2019). Effects of conflict on agriculture: Evidence from the Boko Haram insurgency. *World Development*, *117*, 184–195. https://doi.org/10.1016/j.worlddev.2019.01.010

Aguilar, F. X., Hendrawan, D., Cai, Z., Roshetko, J. M., & Stallmann, J. (2022). Smallholder farmer resilience to water scarcity. *Environment, Development and Sustainability*, *24*(2), 2543–2576. https://doi.org/10.1007/s10668-021-01545-3

Ahrenfeldt, E. J., Klatt, B. K., Arildsen, J., Trandem, N., Andersson, G. K., Tscharntke, T., Smith, H. G., & Sigsgaard, L. (2015). Pollinator communities in strawberry crops–variation at multiple spatial scales. *Bulletin of Entomological Research*, *105*(4), 497–506.

Ali, I., Nagalingam, S., & Gurd, B. (2018). A resilience model for cold chain logistics of perishable products. *The International Journal of Logistics Management*, *29*(3), 922–941. https://doi.org/10.1108/IJLM-06-2017-0147

Ang, J. B., & Gupta, S. K. (2018). Agricultural yield and conflict. *Journal of Environmental Economics and Management*, *92*, 397–417. https://doi.org/10.1016/j.jeem.2018.10.007

Barrett, C. B., Benton, T., Fanzo, J., Herrero, M., Nelson, R. J., Bageant, E., Buckler, E., Cooper, K., Culotta, I., Fan, S., Gandhi, R., James, S., Kahn, M., Lawson-Lartego, L., Liu, J., Marshall, Q., Mason-D'Croz, D., Mathys, A., Mathys, C., … Wood, S. (2022). *Socio-Technical Innovation Bundles for Agri-Food Systems Transformation*. Springer International Publishing. https://doi.org/10.1007/978-3-030-88802-2

Béné, C. (2020). Resilience of local food systems and links to food security – A review of some important concepts in the context of COVID-19 and other shocks. *Food Security*, *12*(4), 805–822. https://doi.org/10.1007/s12571-020-01076-1

Berners-Lee, M., Kennelly, C., Watson, R., & Hewitt, C. N. (2018). Current global food production is sufficient to meet human nutritional needs in 2050 provided there is radical societal adaptation. *Elem Sci Anth*, *6*, 52.

Bravo-Monroy, L., Tzanopoulos, J., & Potts, S. G. (2015). Ecological and social drivers of coffee pollination in Santander, Colombia. *Agriculture, Ecosystems & Environment*, *211*, 145–154.

CFS. (2016). *Connecting Smallholders to Markets*. Committee on World Food Security. https://www.fao.org/3/bq853e/bq853e.pdf

Clark, M., & Tilman, D. (2017). Comparative analysis of environmental impacts of agricultural production systems, agricultural input efficiency, and food choice. *Environmental Research Letters*, *12*(6), 064016.

Clune, S., Crossin, E., & Verghese, K. (2017). Systematic review of greenhouse gas emissions for different fresh food categories. *Towards Eco-Efficient Agriculture and Food Systems: Selected Papers Addressing the Global Challenges for Food Systems, Including Those Presented at the Conference "LCA for Feeding the Planet and Energy for Life" (6-8 October 2015, Stresa & Milan Expo, Italy)*, *140*, 766–783. https://doi.org/10.1016/j.jclepro.2016.04.082

Cohn, A. S., Newton, P., Gil, J. D. B., Kuhl, L., Samberg, L., Ricciardi, V., Manly, J. R., & Northrop, S. (2017). Smallholder Agriculture and Climate Change. *Annual Review of Environment and Resources*, *42*(1), 347–375. https://doi.org/10.1146/annurev-environ-102016-060946

Concepción, E. D., Fernández-González, F., & Díaz, M. (2012). Plant diversity partitioning in Mediterranean croplands: Effects of farming intensity, field edge, and landscape context. *Ecological Applications*, *22*(3), 972–981.

Dixon, J. M., Weerahewa, J., Hellin, J., Rola-Rubzen, M. F., Huang, J., Kumar, S., Das, A., Qureshi, M. E., Krupnik, T. J., Shideed, K., Jat, M. L., Prasad, P. V. V., Yadav, S., Irshad, A., Asanaliev, A., Abugalieva, A., Karimov, A., Bhattarai, B., Balgos, C. Q., … Timsina, J. (2021). Response and resilience of Asian agrifood systems to COVID-19: An assessment across twenty-five countries and four regional farming and food systems. *Agricultural Systems*, *193*, 103168. https://doi.org/10.1016/j.agsy.2021.103168

Dolislager, M., Reardon, T., Arslan, A., Fox, L., Liverpool-Tasie, S., Sauer, C., & Tschirley, D. L. (2021). Youth and Adult Agrifood System Employment in Developing Regions: Rural (Peri-urban to Hinterland) vs. Urban. *The Journal of Development Studies*, *57*(4), 571–593. https://doi.org/10.1080/00220388.2020.1808198

Duku, C., Alho, C., Leemans, R., & Groot, A. (2022). *IFAD Research Series 72: Climate Change and Food System Activities—A Review of Emission Trends, Climate impacts and the effects of Dietary Change* (IFAD Research Series 320722). International Fund for Agricultural Development. https://ideas.repec.org/p/ags/unadrs/320722.html

Fanzo, J. (2018). The role of farming and rural development as central to our diets. *The Pace of Life and Feeding: Health Implications*, *193*, 291–297. https://doi.org/10.1016/j.physbeh.2018.05.014

Fanzo, J. (2019). Biodiversity: An essential natural resource for improving diets and nutrition. In *Agriculture for improved nutrition: Seizing the momentum*. IFPRI. http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/133090

FAO. (2013). *Smallholders and Family Farmers*. https://www.fao.org/fileadmin/templates/nr/sustainability_pathways/docs/Factsheet_SMALLHOLDERS.pdf

FAO. (2014). *The State of Food and Agriculture: Innovation in Family Farming*. Food and Agricultural Organization. https://www.fao.org/3/i4040e/i4040e.pdf

FAO. (2018). *FAO'S Work on Family Farming*. Food and Agricultural Organization. https://www.fao.org/3/ca1465en/CA1465EN.pdf

FAO. (2021). *The State of Food and Agriculture: Making Agrifood Systems More Resilient to Shocks and Stresses*. Food and Agricultural Organization. https://www.fao.org/3/cb4476en/cb4476en.pdf

FAO. (2022). *State of Food Security and Nurition in the World*. Food and Agricultural Organization. https://www.fao.org/3/cc0639en/cc0639en.pdf

FAO. (2023a). *Guidelines to Increase the Resilience of Agricultural Supply Chains*. Food and Agricultural Organization. https://www.fao.org/3/cc5481en/cc5481en.pdf

FAO. (2023b). *The status of women in agrifood systems*. FAO. https://doi.org/10.4060/cc5343en

Foley, J. A., Ramankutty, N., Brauman, K. A., Cassidy, E. S., Gerber, J. S., Johnston, M., Mueller, N. D., O'Connell, C., Ray, D. K., West, P. C., Balzer, C., Bennett, E. M., Carpenter, S. R., Hill, J., Monfreda, C., Polasky, S., Rockström, J., Sheehan, J., Siebert, S., … Zaks, D. P. M. (2011). Solutions for a cultivated planet. *Nature*, *478*(7369), 337–342. https://doi.org/10.1038/nature10452

Franke, A. C., Baijukya, F., Kantengwa, S., Reckling, M., Vanlauwe, B., & Giller, K. E. (2019). Poor farmers – poor yields: socio-economic, soil fertility and crop management indicators affecting climbing bean productivity in northern Rwanda. *Experimental Agriculture*, *55*(S1), 14–34. Cambridge Core. https://doi.org/10.1017/S0014479716000028

Giller, K. E., Tittonell, P., Rufino, M. C., Wijk, M. T. van, Zingore, S., Mapfumo, P., Adjei-Nsiah, S., Herrero, M., Chikowo, R., Corbeels, M., Rowe, E. C., Baijukya, F., Mwijage, A., Smith, J., Yeboah, E., Burg, W. J. van der, Sanogo, O. M., Misiko, M., Ridder, N. de, …

Vanlauwe, B. (2011). Communicating complexity: Integrated assessment of trade-offs concerning soil fertility management within African farming systems to support innovation and development. *Agricultural Systems*, *104*(2), 191–203. https://doi.org/10.1016/j.agsy.2010.07.002

Giordano, M., Barron, J., & Ünver, O. (2019). Chapter 5—Water Scarcity and Challenges for Smallholder Agriculture. In C. Campanhola & S. Pandey (Eds.), *Sustainable Food and Agriculture* (pp. 75–94). Academic Press. https://doi.org/10.1016/B978-0-12-812134-4.00005-4

Gomez Y Paloma, S., Riesgo, L., & Louhichi, K. (Eds.). (2020). *The Role of Smallholder Farms in Food and Nutrition Security*. Springer International Publishing. https://doi.org/10.1007/978-3-030-42148-9

Graeub, B. E., Chappell, M. J., Wittman, H., Ledermann, S., Kerr, R. B., & Gemmill-Herren, B. (2016). The State of Family Farms in the World. *World Development*, *87*, 1–15. https://doi.org/10.1016/j.worlddev.2015.05.012

Guarin, A., Nicolini, G., Vorley, B., Blackmore, E., & Kelly, L. (n.d.). *Taking stock of smallholder inclusion in modern value chains*.

Hamel, C., Michaud, A., Thuku, M., Skidmore, B., Stevens, A., Nussbaumer-Streit, B., & Garritty, C. (2021). Defining Rapid Reviews: A systematic scoping review and thematic analysis of definitions and defining characteristics of rapid reviews. *Journal of Clinical Epidemiology*, *129*, 74–85. https://doi.org/10.1016/j.jclinepi.2020.09.041

Harvey, C. A., Saborio-Rodríguez, M., Martinez-Rodríguez, M. R., Viguera, B., Chain-Guadarrama, A., Vignola, R., & Alpizar, F. (2018). Climate change impacts and adaptation among smallholder farmers in Central America. *Agriculture & Food Security*, *7*(1), 1–20.

Hazell, P., Poulton, C., Wiggins, S., & Dorward, A. (2010). The Future of Small Farms: Trajectories and Policy Priorities. *The Future of Small Farms*, *38*(10), 1349–1361. https://doi.org/10.1016/j.worlddev.2009.06.012

Heinke, J., Lannerstad, M., Gerten, D., Havlík, P., Herrero, M., Notenbaert, A. M. O., Hoff, H., & Müller, C. (2020). Water Use in Global Livestock Production—Opportunities and Constraints for Increasing Water Productivity. *Water Resources Research*, *56*(12), e2019WR026995. https://doi.org/10.1029/2019WR026995

Hellin, J., Ratner, B. D., Meinzen-Dick, R., & Lopez-Ridaura, S. (2018). Increasing social-ecological resilience within small-scale agriculture in conflict-affected Guatemala. *Ecology and Society*, *23*(3).

Herrero, M., Havlík, P., Valin, H., Notenbaert, A., Rufino, M. C., Thornton, P. K., Blümmel, M., Weiss, F., Grace, D., & Obersteiner, M. (2013). Biomass use, production, feed efficiencies, and greenhouse gas emissions from global livestock systems. *Proceedings of the National Academy of Sciences*, *110*(52), 20888–20893.

Herrero, M., Thornton, P. K., Power, B., Bogard, J. R., Remans, R., Fritz, S., Gerber, J. S., Nelson, G., See, L., Waha, K., Watson, R. A., West, P. C., Samberg, L. H., van de Steeg, J., Stephenson, E., van Wijk, M., & Havlík, P. (2017). Farming and the geography of nutrient production for human use: A transdisciplinary analysis. *The Lancet Planetary Health*, *1*(1), e33–e42. https://doi.org/10.1016/S2542-5196(17)30007-4

Hirvonen, K., Minten, B., Mohammed, B., & Tamru, S. (2021). Food prices and marketing margins during the COVID-19 pandemic: Evidence from vegetable value chains in Ethiopia. *Agricultural Economics*, *52*(3), 407–421. https://doi.org/10.1111/agec.12626

HLPE. (2017). *Nutrition and food systems*. FAO. http://www.fao.org/3/a-i7846e.pdf

HLPE. (2019). *Agroecological and other innovative approaches for sustainable agriculture and food systems That enhance food security and nutrition*. Committee on World Food Security. https://www.fao.org/3/ca5602en/ca5602en.pdf

Hobbs, J. E. (2021). Food supply chain resilience and the COVID-19 pandemic: What have we learned? *Canadian Journal of Agricultural Economics/Revue Canadienne d'agroeconomie*, *69*(2), 189–196. https://doi.org/10.1111/cjag.12279
Hunter, D., Borelli, T., Beltrame, D. M. O., Oliveira, C. N. S., Coradin, L., Wasike, V. W., Wasilwa, L., Mwai, J., Manjella, A., Samarasinghe, G. W. L., Madhujith, T., Nadeeshani, H. V. H., Tan, A., Ay, S. T., Güzelsoy, N., Lauridsen, N., Gee, E., & Tartanac, F. (2019). The potential of neglected and underutilized species for improving diets and nutrition. *Planta*, *250*(3), 709–729. https://doi.org/10.1007/s00425-019-03169-4
Hunter, D., & Fanzo, J. (2013). Introduction: Agricultural biodiversity, diverse diets and improving nutrition. In *Diversifying food and diets* (pp. 1–13). Routledge.
IPCC (Ed.). (2022). Technical Summary. In *Climate Change and Land: IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems* (pp. 37–74). Cambridge University Press; Cambridge Core. https://doi.org/10.1017/9781009157988.002
Lopez-Ridaura, S., Sanders, A., Barba-Escoto, L., Wiegel, J., Mayorga-Cortes, M., Gonzalez-Esquivel, C., Lopez-Ramirez, M. A., Escoto-Masis, R. M., Morales-Galindo, E., & García-Barcena, T. S. (2021). Immediate impact of COVID-19 pandemic on farming systems in Central America and Mexico. *Agricultural Systems*, *192*, 103178. https://doi.org/10.1016/j.agsy.2021.103178
Lowder, S. K., Sánchez, M. V., & Bertini, R. (2021). Which farms feed the world and has farmland become more concentrated? *World Development*, *142*, 105455. https://doi.org/10.1016/j.worlddev.2021.105455
Marshall, Q., Fanzo, J., Barrett, C. B., Jones, A. D., Herforth, A., & McLaren, R. (2021). Building a Global Food Systems Typology: A New Tool for Reducing Complexity in Food Systems Analysis. *Frontiers in Sustainable Food Systems*, *5*. https://www.frontiersin.org/articles/10.3389/fsufs.2021.746512
Meemken, E.-M. (2017). Do smallholder farmers benefit from sustainability standards? *Rural 21*. https://www.rural21.com/fileadmin/downloads/2017/en-01/rural2017_01-S27-29.pdf
Meemken, E.-M., Barrett, C. B., Michelson, H. C., Qaim, M., Reardon, T., & Sellare, J. (2021). Sustainability standards in global agrifood supply chains. *Nature Food*, *2*(10), 758–765. https://doi.org/10.1038/s43016-021-00360-3
Mekonnen, M. M., & Hoekstra, A. Y. (2012). A Global Assessment of the Water Footprint of Farm Animal Products. *Ecosystems*, *15*(3), 401–415. https://doi.org/10.1007/s10021-011-9517-8
Minten, B., Stifel, D., & Tamru, S. (2014). Structural Transformation of Cereal Markets in Ethiopia. *The Journal of Development Studies*, *50*(5), 611–629. https://doi.org/10.1080/00220388.2014.887686
Nagayets, O. (2005). Small farms: Current status and key trends. *The Future of Small Farms*, *355*, 26–29.
Olaniyan, A. O., & Okeke-Uzodike, U. (2021). When two elephants fight: Insurgency, counter-insurgency and environmental sufferings in northeastern Nigeria. *Journal of Contemporary African Studies*, *39*(3), 437–453. https://doi.org/10.1080/02589001.2020.1825649
Pekin, B. K. (2016). Anthropogenic and topographic correlates of natural vegetation cover within agricultural landscape mosaics in Turkey. *Land Use Policy*, *54*, 313–320.
Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. *Science*, *360*(6392), 987–992. https://doi.org/10.1126/science.aaq0216
Rapsomanikis, G. (2015). Small farms big picture: Smallholder agriculture and structural transformation. *Development*, *58*, 242–255.

Reardon, T., Awosuke, T., Haggblade, S., Mirten, B., & Vos, R. (2019). The quiet revolution in agri-food distribution (wholesale, logistics, retail) in Sub-Saharan Africa. In *Africa Agriculture Status Report 2019*. IFPRI. https://agra.org/wp-content/uploads/2019/09/AASR2019-The-Hidden-Middleweb.pdf

Reardon, T., Liverpool-Tasie, L. S. O., & Minten, B. (2021). Quiet Revolution by SMEs in the midstream of value chains in developing regions: Wholesale markets, wholesalers, logistics, and processing. *Food Security*, *13*(6), 1577–1594. https://doi.org/10.1007/s12571-021-01224-1

Reardon, T., & Swinnen, J. (2020, July 6). COVID-19 and resilience innovations in food supply chains. *IPFRI Blog Post: Issue Post*. https://www.ifpri.org/blog/covid-19-and-resilience-innovations-food-supply-chains

Ricciardi, V., Mehrabi, Z., Wittman, H., James, D., & Ramankutty, N. (2021). Higher yields and more biodiversity on smaller farms. *Nature Sustainability*, *4*(7), 651–657. https://doi.org/10.1038/s41893-021-00699-2

Ricciardi, V., Ramankutty, N., Mehrabi, Z., Jarvis, L., & Chookolingo, B. (2018). How much of the world's food do smallholders produce? *Global Food Security*, *17*, 64–72. https://doi.org/10.1016/j.gfs.2018.05.002

Ricciardi, V., Wane, A., Sidhu, B. S., Godde, C., Solomon, D., McCullough, E., Diekmann, F., Porciello, J., Jain, M., Randall, N., & Mehrabi, Z. (2020). A scoping review of research funding for small-scale farmers in water scarce regions. *Nature Sustainability*, *3*(10), 836–844. https://doi.org/10.1038/s41893-020-00623-0

Samberg, L. H., Gerber, J. S., Ramankutty, N., Herrero, M., & West, P. C. (2016). Subnational distribution of average farm size and smallholder contributions to global food production. *Environmental Research Letters*, *11*(12), 124010. https://doi.org/10.1088/1748-9326/11/12/124010

Scheierling, S. M., & Treguer, D. O. (2016). Enhancing water productivity in irrigated agriculture in the face of water scarcity. *Choices*, *31*(3), 1–10.

Schuster, M., & Torero, M. (2016). Toward a Sustainable Food System: Reducing Food Loss and Waste. In *Global Food Policy Report*. International Food Policy Research Institute. http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/130211

Springmann, M., Wiebe, K., Mason-D'Croz, D., Sulser, T. B., Rayner, M., & Scarborough, P. (2018). Health and nutritional aspects of sustainable diet strategies and their association with environmental impacts: A global modelling analysis with country-level detail. *The Lancet Planetary Health*, *2*(10), e451–e461.

Tendall, D. M., Joerin, J., Kopainsky, B., Edwards, P., Shreck, A., Le, Q. B., Kruetli, P., Grant, M., & Six, J. (2015). Food system resilience: Defining the concept. *Global Food Security*, *6*, 17–23. https://doi.org/10.1016/j.gfs.2015.08.001

Thomas, J., Newman, M., & Oliver, S. (2013). Rapid evidence assessments of research to inform social policy: Taking stock and moving forward. *Evidence & Policy*, *9*(1), 5–27. https://doi.org/10.1332/174426413X662572

Tripathi, H. G., Smith, H. E., Sait, S. M., Sallu, S. M., Whitfield, S., Jankielsohn, A., Kunin, W. E., Mazibuko, N., & Nyhodo, B. (2021). Impacts of COVID-19 on diverse farm systems in Tanzania and South Africa. *Sustainability*, *13*(17), 9863.

Ubisi, N. R., Mafongoya, P. L., Kolanisi, U., & Jiri, O. (2017). Smallholder farmer's perceived effects of climate change on crop production and household livelihoods in rural Limpopo province, South Africa. *Change and Adaptation in Socio-Ecological Systems*, *3*(1), 27–38.

UNDESA, U. N. D. of E. and S. (2019). World Urbanization Prospects The 2018 Revision. *United Nations, New York, NY*, *ST/ESA/SER.A/420*. https://population.un.org/wup/publications/Files/WUP2018-Report.pdf

UNEP, & FAO. (2020). *The State of the World's Forests: Forests, Biodiversity and People*. UN Environmental Programme & Food and Agricultural Organization. https://www.unep.org/resources/state-worlds-forests-forests-biodiversity-and-people

United Nations. (2020). *World Social Report 2020: Inequality in a Rapidly Changing World*. UN. https://doi.org/10.18356/7f5d0efc-en

Van Hoyweghen, K., Fabry, A., Feyaerts, H., Wade, I., & Maertens, M. (2021). Resilience of global and local value chains to the Covid-19 pandemic: Survey evidence from vegetable value chains in Senegal. *Agricultural Economics*, *52*(3), 423–440.

Vermeulen, S., & Wollenberg, E. (2017). *Info Note: A rough estimate of the proportion of global emissions from agriculture due to smallholders*. https://cgspace.cgiar.org/bitstream/handle/10568/80745/CCAFS_INsmallholder_emissions.pdf?sequence=1&isAllowed=y

Vollset, S. E., Goren, E., Yuan, C.-W., Cao, J., Smith, A. E., Hsiao, T., Bisignano, C., Azhar, G. S., Castro, E., Chalek, J., Dolgert, A. J., Frank, T., Fukutaki, K., Hay, S. I., Lozano, R., Mokdad, A. H., Nandakumar, V., Pierce, M., Pletcher, M., … Murray, C. J. L. (2020). Fertility, mortality, migration, and population scenarios for 195 countries and territories from 2017 to 2100: A forecasting analysis for the Global Burden of Disease Study. *The Lancet*, *396*(10258), 1285–1306. https://doi.org/10.1016/S0140-6736(20)30677-2

Zurek, M., Ingram, J., Sanderson Bellamy, A., Goold, C., Lyon, C., Alexander, P., Barnes, A., Bebber, D. P., Breeze, T. D., Bruce, A., Collins, L. M., Davies, J., Doherty, B., Ensor, J., Franco, S. C., Gatto, A., Hess, T., Lamprinopoulou, C., Liu, L., … Withers, P. J. A. (2022). Food System Resilience: Concepts, Issues, and Challenges. *Annual Review of Environment and Resources*, *47*(1), 511–534. https://doi.org/10.1146/annurev-environ-112320-050744

7. Annex.

7.1. Search terms

Internet searches were conducted from June-August 2023. At the outset, IFAD provided the researchers with a list of articles to consider for inclusion. Additional sources were discovered based on the following search strategies.

The following search terms that were used across all Action Tracks:

- "Smallholders"
- "Smallholder producers"
- "Small-scale farmers"
- "Farm size"
- "Agricultural producers"
- "Small and medium-sized enterprises (SMEs)" or "small and medium-sized agrifood enterprises (SMAEs)"

For Action Track 1 (access to safe and nutritious foods), the following search terms were used:

- "Food security"
- "Nutrition"
- "Food access"
- "Food availability"
- "Food, agricultural and/or agribusiness value chains"

For Action Tracks 2 and 3 (environmental sustainability), the following search terms were used:

- "Food waste"
- "Biodiversity" and "agricultural biodiversity"
- "Sustainable diets"
- "Sustainability"
- "Environmental footprint"
- "Climate change," "climate mitigation," "adaptation"
- "Emissions"
- "Pollution"
- "Biofuels," "animal feed," "non-food use of agricultural products"
- "Water usage," "water scarcity," "water stress," "water footprint"
- "Sustainability certifications"

For Action Track 4 (equitable livelihoods), the following search terms were used:

- "Employment"
- "Jobs"
- "Poverty"
- "Livelihoods"
- "Women"
- "Youth"

- “Entrepreneurs”

For Action Track 5 (resilient supply chains), the following search terms were used:

- “Supply chain resilience”
- “Shocks”
- “COVID-19 pandemic”
- “Conflict”

Investing in rural people

International Fund for
Agricultural Development
Via Paolo di Dono, 44
00142 Rome, Italy
Tel: +39 06 54591
Fax: +39 06 5043463
Email: ifad@ifad.org
www.ifad.org

instagram.com/ifadnews
linkedin.com/company/ifad
twitter.com/ifad
youtube.com/user/ifadTV

September 2023

Authors
Jack Daly, Sarah Zoubek, Florence Benn (IFAD), Jyotsna Puri (IFAD)