
DLL
Knowledge Review

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The impact of production diversification on livelihood outcomes among smallholder farmers

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Abstract

This review provides exploratory scientific evidence on the linkages between on-farm production diversity and livelihood outcomes of rural smallholders in the Global South. It focuses on dietary diversity, nutrition, food security, and shock resilience, as well as other livelihood outcomes that may be affected by promoting on-farm production diversity.

Findings show that the links between production diversity and dietary or nutritional outcomes are generally positive but small, and heavily context dependent. Diversified cropping systems offer clearer benefits for resilience and food security, particularly by buffering against climatic shocks and increased climatic variability, while stabilizing yields and enhancing ecosystem services. There is also some evidence that diversification improves food security in smallholders in rural settings, where self-sufficiency from own production is prevalent. There is also emerging evidence that more diversified agricultural production can benefit women's empowerment and reduce smallholders' reliance on external inputs. However, diversification may involve trade-offs with specialization and income generation, especially on small plots.

More generally, production diversification alone might be insufficient to improve livelihoods in a meaningful way. Interventions are most effective when combined with complementary measures such as nutrition education, market access, and gender-sensitive programming. Policy strategies should therefore move beyond farm-level diversification to also consider community- and regional-level diversity, while embedding diversification within broader efforts to strengthen food systems and rural development.

Main points

- Links between agricultural production diversity and livelihood outcomes like dietary diversity, women's empowerment or food security are generally positive but often small.
- Diversified agricultural systems are more resilient to climatic shocks and provide important ecosystem benefits.
- Diversification interventions are likely most effective when addressing a specific nutritional gap, resilience need or market opportunity and combined with relevant interventions around market access, nutritional education or extension services.
- Approaches focusing on homesteads offer promising alternatives regarding livelihood outcomes but need to be understood as distinctly different to interventions targeting main agricultural activities.

1 Introduction

Smallholders in the Global South play an important role in local and global food supply. Yet they are among the poorest populations worldwide and are often most likely to suffer from food insecurity, malnutrition, and hunger. At the same time, ecosystems worldwide are suffering from the expansion of monoculture cropping systems and climate change, further undermining smallholders' livelihoods and exacerbating their vulnerability to poverty and food insecurity.

Diversifying agricultural production has long been seen as a possible means to serve both smallholders and the environment. The core argument is that consuming diverse foods improves dietary quality and nutrition. Hence, to address food insecurity and malnutrition, diversified agricultural production could provide a larger variety of foods for smallholder households to consume and market while being both more tolerant of shocks and beneficial for the environment. As such, diversification has become a prominent theme for development interventions in agricultural development interventions.

Diversification can take many forms, ranging from the provision of seeds or livestock through implementing practices like intercropping or crop rotation to below-ground diversification of soils using minimum tillage or by the addition of organic inputs. This review focuses primarily on the possible effects of on-farm crop diversification, given its centrality to smallholder livelihoods. The rationale for this focus is that crop production is the main source of income, employment and food for most rural households in the Global South. Many development projects also target homestead production of vegetables, fruits or livestock under the umbrella of diversification. These interventions will not be discussed in detail in this review. The rationale for this being that homestead interventions have a different set of assumptions in terms of adoption, risk and pathways to livelihood outcomes, compared to crop production as the main income-generating activity of most households. The review will still highlight overlaps and possible benefits of homestead interventions and note complementarities between the two.

Accordingly, this review should be understood as a targeted analysis of evidence linking on-farm crop diversification to livelihood outcomes for smallholder farmers, rather than a comprehensive assessment of all forms of agricultural diversification and its potential links to livelihood outcomes of smallholder farmers in the Global South. Throughout the document, the terms *on-farm production diversity*, *on-farm crop production diversity*, *production diversity*, and *crop diversity* are used interchangeably.

2 Methodology

This review is based on a targeted assessment of existing scientific literature examining the links between on-farm production diversity and livelihood outcomes in the Global South. The primary sources of evidence were identified through searches in Web of Science, Google Scholar, and the 3ie Evidence Portal, supplemented by cross-references from relevant publications. Priority was given to systematic reviews, meta-analyses, and rigorous evaluations such as randomized controlled trials (RCTs) and longitudinal studies, while also drawing on other peer-reviewed articles that provide contextual insights.

It is important to note that this review does not represent a full systematic review. Instead, it reflects a narrative synthesis of available evidence, guided by the author's judgment and knowledge of the field. As such, while it integrates findings from a broad range of studies, it may not capture all relevant publications.

The review primarily focuses on on-farm crop diversification interventions, given their central role in smallholder livelihoods. Where appropriate, overlaps with homestead-based interventions (e.g., small-scale vegetable gardens, poultry, or livestock) are highlighted, though these are not the central focus. The analysis emphasizes both the direct effects of production diversity on livelihood outcomes (e.g., diets, food security, resilience) and the indirect pathways mediated by factors such as market access, income, and gender dynamics.

3 Dietary diversity and nutrition

When describing the possible links between production diversity and livelihood outcomes (e.g., dietary diversity or nutrition), it is important to note that these indicators often follow different metrics. Production diversity is mostly assessed as the number of different crops or crop varieties produced by a household. Nutritional diversity is measured by the number food groups consumed over a given recall period (mostly 7-day or 24 hours recall period). The important differentiation here is that multiple crops or crop varieties fall into the same food group – for example, maize, wheat and barley are all classified as cereals and even if a household produced and consumed all three, it would translate into just one food group on the nutritional diversity scale.

The association between production diversity and nutritional diversity has been studied extensively over the past two decades or more. Studies from countries across the Global South have mostly found small positive or no association between agricultural production diversity and dietary diversity or nutrition¹⁻⁸. Given this vast amount of research, multiple reviews summarizing and interpreting individual studies exist as well⁹⁻¹². The studies included in these reviews are largely based on observational data, meaning that they are often not using experimental designs (like RCTs) but either before-after comparisons of interventions/programs or using observational data from household datasets. As such, they do not allow to deduct causal inferences but should be understood as evidence of associations.

The key takeaways of the reviews selected here are as follows:

1. **Associations between production diversity and dietary diversity or nutritional diversity are often positive but almost always small in their effect size.** This means that to increase dietary diversity by one food group, production diversity would often have to include 10 additional crops or more in small household farms (average farm size in sub-Saharan Africa is about 1.5 ha), likely not making it an effective pathway on average.
2. **Associations are very context-specific and differ by country and within countries.** Production diversity can improve dietary diversity, for example, in subsistence farming systems where households rely heavily on their own production for food.
3. **Many studies show that other household characteristics are more important drivers of dietary diversity and nutrition,** among them market access and income. Focusing solely on diversifying agricultural production without taking these factors into account would likely not improve nutritional outcomes by much.
4. **Production diversification may reduce farm specialization and thus productivity and household income.** When very poor households produce many different crops or even food groups on small plots, this is likely a coping strategy and not necessarily a promising development trajectory.

Generally, the authors of all reviews highlight the need for studies using longitudinal data or, better yet, randomized controlled trials to better understand the complex links between production diversity and nutritional outcomes⁹⁻¹².

One newer study indeed uses longitudinal data from six African countries, largely confirming earlier findings⁸. In addition to also showing small associations between production diversity and dietary diversity generally, the authors also assess the importance of market linkages and local or regional production diversity. Their analysis shows that associations of production and dietary diversity are larger for households further away from markets, which is attributed to the higher prevalence of subsistence farming in more remote areas. Furthermore, they show that local production diversity (i.e. the number of crops or food groups produced at the village, district or regional level) is also associated with higher levels of household dietary diversity. Given that increasing the number of crops or food groups produced at a local or regional level is much more feasible, this underscores the importance of food production diversity at larger geographic scales than the household.

Evidence from randomized controlled trials (RCTs) remains scarce in this area of research. The author identified two potentially relevant randomized interventions for this review^{13,14}.

The first study assesses a cluster-randomized intervention in Bangladesh, designed to understand how training on agricultural practices, nutrition and gender sensitization could benefit household livelihoods individually or jointly¹⁴. The trainings consisted of 17 (agriculture), 19 (nutrition) and 8 (gender) sessions respectively over the course of 17 months. Agricultural and nutritional trainings were administered by agricultural extension agents whereas the gender training was administered by women from the communities, which were hired and trained for this purpose. None of the treatments increased production

diversity on fields cultivated by the households but all increased the production of fruit and vegetables, eggs, dairy and fish at the homestead, although these changes were small in absolute terms. Most of these improvements took place where some production already existed and were therefore mostly an increase in production volumes, rather than a significant increase in diversity. Nevertheless, all treatments individually improved dietary diversity albeit only by 0.2 to 0.4 food groups on average¹⁴. The authors conclude that the program enabled participants to increase their existing production but probably did not lead to significant changes in the composition of their land use. It is noteworthy that this intervention was only carried out in areas with good market connectivity and may therefore have excluded very remote areas. Finally, the gender sensitization treatment did not have any additional effect on the outcome indicators observed.

The second study conducted a cluster-randomized controlled trial in Tanzania and found that providing households with legume seeds as well as a mentoring program on agroecology and nutrition did improve children's dietary diversity scores by 0.57 food groups, on average. This is out of 7 total food groups and from a baseline of 1.8 food groups consumed in the growing season and 2.2 food groups consumed in the harvesting season. While the authors do not provide a dedicated pathway analysis, households also cultivated 1.05 species more due to the intervention – driven by uptake of legumes following the seed dispersal¹³. However, the study also found that this did not translate into improvements in child anthropometric measurements like weight-for-age or weight-for-height z scores, stunting rates or wasting rates in any of the years between the beginning of the interventions in 2016 and the end in 2019.

Summarizing, the randomized trials largely underscore the findings reported in the review articles mentioned before. While tailored production diversity interventions can likely benefit dietary diversity scores of households or individuals, it is questionable if this is the most effective pathway to improve diets. Given the low effect sizes of almost all studies reviewed, other interventions aimed at dietary diversity improvements could probably yield larger benefits. However, in subsistence settings, tailored interventions can indeed improve diets, if they fill a dietary gap in the population. Otherwise, market access is crucial to enabling households to sell new produce and buy more diverse foods.

4 Resilience and food security

Diversifying food production on agricultural lands may provide a hedge against many types of shocks arising from fluctuations in prices for inputs or marketed goods, temperatures or precipitation and disturbances such as violent conflicts, labor shortages or pest outbreaks. In hedging against shocks, this would theoretically make households more food secure as well, as they are less likely to suffer a catastrophic collapse of their food production which they may either consume themselves or market to purchase food for the household.

Macro-level studies assessing and comparing national food production trends have recently found that a diversification of crops can stabilize national calorie production & yields¹⁵. It is still a point of discussion whether this effect is mainly driven by the fact that different crops have different growing and harvesting

times, or a general aspect of diversification¹⁶. Newer research has also shown that diversification can help to reduce premiums in crop insurances and thus the cost of becoming more resilient to shocks¹⁷. While this is based on European agricultural data for now, the concept may also be transferable to areas of the Global South.

Studies using household or farm-level data have also found that diversified cropping systems are associated with lower levels of pest outbreaks, which is becoming increasingly important as pest outbreaks are fueled by an increase in climate variability¹⁸. Furthermore, a more diversified production has been associated with higher production stability¹⁹.

These associations are also supported by the results of a large review, providing a systematic review of 98 existing review articles as well as a meta-analysis of 69 existing meta-analyses from across the Globe on the effects of agricultural diversification on ecosystem services²⁰. The evidence gathered in this review clearly shows that diversification practices largely improve multiple ecosystem services without compromising yields. Among the ecosystem services benefiting from diversification are soil fertility, nutrient cycling, carbon sequestration, water regulation, pest control, biodiversity and pollination services. This is also true explicitly for crop diversification practices like intercropping or crop rotation, except for biodiversity and pollination services²⁰.

On the link of production diversity and food security, one study conducted in Malawi found that households that had received agroecological training as well as seeds for indigenous grain crops and edible legumes were associated with improvements in household food security²¹. Using a mixed methods approach, the authors attribute this improvement to multiple channels being utilized by farmers. Higher levels of productivity were used to market crops and purchase more foods while consumption of own production could also be increased²¹. As this study does not provide insights into the randomization of their treatments, these findings also must be understood as associations, not causal relationships.

Randomized controlled trials are also rare in this area of research but the study from Tanzania, assessing household diets (see previous section) also considered household food security as an outcome indicator¹³. Here, the intervention of providing households with a mentoring program and legume seeds reduced the share of households experiencing moderate or severe food insecurity (measured using the HFIS score) by 12.5% in the postharvest season (from 71.4% of households at the baseline) and by 9% in the growing season (from 86.8%). The study does not provide evidence on the pathway which may have led toward this increase and the authors highlight that they did not collect information on income or yield from legumes which would have allowed a detailed pathway analysis. They also point out that the findings of this study are specific to one rural area of Tanzania where poverty rates are high and food insecurity prevalent¹³.

Summarizing, it appears very likely that a diversified portfolio of crops is more resilient to shocks generally and that this resilience will often translate into higher levels of food security. While randomized interventions on this link are still rare, the evidence from multiple meta-analyses suggesting that diversifying agricultural production improves ecosystem services appears very robust and it is very likely that these services provide a hedge against climatic shocks or increased weather variability.

5 Other livelihood outcomes

5.1 Income/household expenditures

Income serves an important purpose as an intermediary toward other livelihood outcomes discussed in this review. Even in subsistence settings, many smallholder farmers purchase large shares of their consumed foods on markets – especially in the case of nutritious foods compared to staples. Increases in income therefore often translate into increases in dietary diversity, reductions in food insecurity and higher levels of resilience.

To increase income through diversification of agricultural production, markets where produced goods can be sold must be available and functioning. Under these conditions, production diversity may indeed be associated with higher levels of income, which has been shown in multiple studies²²⁻²⁴. However, increasing the productivity of existing crops rather than diversifying into new crops has also been shown to increase income for smallholders²⁵. As resources are limited, intensification and diversification might be mutually exclusive choices for smallholders. Recent research from Italian farmers shows that specialization increases income levels while diversification reduces income risk²⁶.

5.2 Women's empowerment

Cash crop production is often a male-dominated sphere in rural societies and within rural households^{27,28}. By diversifying crop production into areas less dominated by men, women may benefit through improved access to financial resources, bargaining power within the household and decision power over household expenditures and assets.

Indeed, the randomized intervention conducted in Tanzania found that mentoring and legume seed provision did improve a number of indicators connected to women's empowerment such as decision-making on income allocation, adequate social support and reductions in women reporting probable depression¹³. This is in line with findings from other similar interventions who also found positive effects on women's empowerment^{29,30}. These interventions often encompass components specifically targeted at women's empowerment such as gender sensitization trainings or female-led extension work – the positive effects can therefore not be linked to diversification alone.

6 Agroecological and nutrition-sensitive agricultural projects

Several studies have been conducted in the past years under the framework of agroecology and/or nutrition-sensitive agricultural interventions. The literature on nutrition-sensitive agricultural interventions originates in nutrition studies. Here, outcome variables of interest are most often child or women's anthropometric measures, feeding and care practices, access to health services, occurrence of diseases among children and mother's or other related outcomes. In this area, multiple reviews of existing

experimental studies have been conducted, and they find positive effects on multiple livelihood outcomes³¹.

The main difference of these studies to others is that their agricultural interventions mostly focus on the homestead, meaning production of vegetables, fruits, milk or eggs mainly for the households' direct consumption. As such, the effects are not directly comparable to diversification interventions aimed at crop production. Crop production is usually the main income source for smallholders and thus the opportunity cost of diversifying production on a limited amount of land in a specific growing season is much greater than cultivating vegetables in a home garden. As such, homestead interventions should be regarded as fundamentally different from those targeting the main crop production of smallholders. This is not to say that home garden interventions should not be implemented but to underline that they must be regarded as their own set of possible interventions to improve smallholder livelihoods – not as a subset of agricultural interventions that take place on the main plots of smallholders.

Agroecology aims to implement agricultural practices that improve agricultural production through natural processes. The idea is that this can create biological interactions and synergies which reduce the reliance on synthetic inputs and improve ecosystem services as well as smallholder autonomy³². A review harmonizing data from 24 individual studies in 11 countries across the Americas, Africa and Asia on interventions such as crop and non-crop diversification, soil conservation or water retention shows that following multiple strategies of agroecological diversification is associated with both human and natural benefits across multiple landscape compositions³³. And another review synthesizing evidence from 56 studies on agroecology and their effect on food security and nutritional outcomes found that most studies showed a positive effect – even among those with only one component³⁴. In this review, effect sizes were not considered and as such they do not disagree with findings of earlier reviews – especially those looking into crop diversification specifically.

7 Conclusion and policy recommendations

The evidence reviewed demonstrates that production diversification alone is not a guaranteed pathway to improved smallholder livelihoods. While crop diversification can enhance resilience, stabilize yields, and deliver important ecosystem services, its effects on dietary diversity, nutrition, and income are generally small and highly context dependent. The results of many studies conducted in this area of research largely agree that production diversification alone may not improve livelihoods *per se*.

What emerges clearly is that diversification strategies are most effective when combined with complementary interventions. Programs that integrate agricultural diversification with nutrition training, improved market access, or gender-sensitive approaches show stronger and more consistent impacts on household food security, diets, and empowerment. Conversely, diversification without these enabling conditions is unlikely to yield substantial livelihood gains.

The findings also highlight an important debate over smallholder development trajectories in the Global South. Proponents of agroecological approaches emphasize the human and environmental benefits of

diversified landscapes, while others argue that specialization, market integration, and commercialization remain the primary engines of rural transformation. Emerging research suggests a middle ground: diversification at higher scales—village, district, or regional—may provide resilience and dietary benefits without constraining farm-level specialization.

Policy implications are threefold:

1. Diversification interventions should address specific nutritional gaps, resilience needs, or market opportunities rather than promoting diversity as a goal by itself.
2. Linking farmers to markets, extension, and nutrition education is essential to translate production diversity into improved diets and incomes.
3. Greater benefits may be realized by promoting crop and food diversity at community or regional levels beyond the household, supported by policies on value chains, trade, and agroecological practices.

In a nutshell, crop diversification is best understood not as a standalone solution, but as part of a broader livelihood and food system strategy that integrates economic, nutritional, and environmental objectives.

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