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EVIDENCE REVIEW: INVESTMENTS AND POLICIES IN AGRIFOOD CHAIN LINKAGES

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ABSTRACT:

Agrifood systems are increasingly shaped by activities beyond the farm gate, yet the midstream and downstream segments—known as the hidden middle—remain severely under-researched. This paper presents a review of 276 impact evaluations and systematic reviews to assess what is currently known about effective policies and programs targeting the hidden middle in low- and middle-income countries. While 52% of the studies focus on smallholder-oriented interventions and 21% on public goods, only 27% address the hidden middle, and nearly half of these concern contract farming—a mechanism designed to bypass intermediaries rather than strengthen them. Most intervention categories in the midstream and downstream are supported by fewer than four rigorous studies. Moreover, services like storage, training, and market information are evaluated almost exclusively in the context of producers, ignoring the micro, small, and medium enterprises (MSMEs) that dominate the hidden middle. The paper concludes that addressing this evidence gap is essential to designing inclusive, resilient agrifood systems and calls for a shift in research and policy focus toward the actors and services that connect farms to markets and consumers.

RESUMEN EJECUTIVO:

Los sistemas agroalimentarios están cada vez más definidos por actividades que ocurren más allá del ámbito agrícola, pero los segmentos intermedios y posteriores —conocidos como el “eslabón oculto”— siguen siendo escasamente investigados. Este artículo presenta una revisión de 276 evaluaciones de impacto y revisiones sistemáticas para evaluar lo que actualmente se sabe sobre políticas y programas efectivos dirigidos al “eslabón oculto” en países de ingresos bajos y medianos. Mientras que el 52 % de los estudios se enfocan en intervenciones orientadas a pequeños productores y el 21 % en bienes públicos, solo el 27 % aborda el “eslabón oculto”, y casi la mitad de estos se centran en la agricultura por contrato, un mecanismo diseñado para eludir a los intermediarios más que para fortalecerlos. La mayoría de las categorías de intervención en los segmentos intermedios y posteriores cuentan con menos de cuatro estudios rigurosos. Además, servicios como almacenamiento, capacitación e información de mercados son evaluados casi exclusivamente en el contexto de los productores, ignorando a las micro, pequeñas y medianas empresas (MIPYMES) que predominan en el “eslabón oculto”. El artículo concluye que abordar esta brecha de evidencia es esencial para diseñar sistemas agroalimentarios inclusivos y resilientes, y hace un llamado a reorientar la investigación y las políticas hacia los actores y servicios que conectan las fincas con los mercados y los consumidores.

INTRODUCTION

The objective of this product is to identify investments and policies implemented to strengthen specific segments of agrifood value chains, focusing exclusively on those for which there is sufficient evidence to assess their relevance and effectiveness.

Given this objective, our focus is on locating and analyzing *impact evaluations* and *systematic reviews*. Impact evaluations rely on rigorous methods to quantify causal effects—such as randomized controlled trials (RCTs), difference-in-differences (DiD), instrumental variables (IV), and matching techniques, among others—while systematic reviews assess and synthesize high-quality studies, typically impact evaluations, to verify the consistency and reliability of reported outcomes across multiple contexts.

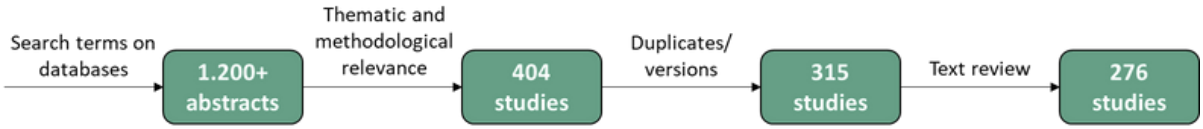
The main sources consulted to identify relevant studies included public databases from 3ie (particularly useful for its pre-identified repository of impact evaluations), IFPRI, CGIAR, OECD, and the World Bank, complemented by targeted searches on Google Scholar. Priority was given to studies published from 2010 onward, although a small number of highly cited studies from the previous five years were also included due to their continued relevance.

Search categories were derived from a set of highly cited academic papers focused on describing the hidden middle. For simplicity and analytical clarity, they were grouped into three broad domains:

I. **Public Goods**, referring primarily to enabling infrastructure (typically state-financed) that supports the entire agrifood system, from production to consumption.
II. **Producers**, encompassing interventions directly aimed at supporting smallholder activities.
III. and **Hidden Middle**, referring to services and institutional arrangements that facilitate the flow of agricultural products from farm to final consumers

The literature review began with a rapid search across the databases mentioned, using the subcategories detailed in Annex 1, which are themselves grouped into the three broad domains described earlier. This initial search yielded over 1,200 abstracts, which were progressively filtered based on thematic relevance and, critically, their methodological approach—specifically whether they were compatible with the criteria for impact evaluations or systematic reviews. This screening process produced a shortlist of 404 studies, which was further narrowed to 315 after removing duplicates, including different versions or titles of the same research. The full texts of these 315 studies were then reviewed—focusing in particular on their methodological design—to ensure that only genuine impact evaluations and systematic reviews were retained. The final result of this selection process is a sample of 276 documents: 47 systematic reviews and 229 impact evaluations.

Figure 5. Study Selection Process for the Evidence Review



Itis important to acknowledge several limitations of this review. First, we did not conduct an in- depth appraisal of the methodological quality of each included study; rather, we verified only whether each study employed a recognized impact evaluation or systematic review methodology. As a result, some studies with potential concerns about internal validity—particularly quasi- experimental designs with weak controls for selection bias—may have been included. In fact, 75% of the selected impact evaluations rely on quasi-experimental designs, 19% use experimental methods, and 6% employ mixed-methods approaches. Annex 2 provides a detailed breakdown of the methodological composition of the sample.

Second, there is a strong geographical bias in the evidence base: 62% of the final sample focuses on Sub-Saharan Africa—half of these studies concentrated in just four countries (Ethiopia, Tanzania, Kenya, and Uganda). South Asia (16%), Southeast Asia (9%), Latin America and the Caribbean (8%), and China (3%) are clearly underrepresented. As a result, most studies refer to low-income countries, where the hidden middle tends to be smaller, and thus opportunities to evaluate midstream and downstream interventions are more limited. This regional bias was also present—though somewhat less pronounced—in the systematic reviews included.

Third, the review may be affected by **publication bias** and **language bias.** Although the search strategy included major institutional databases and Google Scholar, it focused primarily on English-language sources and formally published studies. As a result, high-quality evaluations from government agencies, NGOs, or development partners—especially those found in the grey literature or published in other languages—may have been missed.

Finally, it must be acknowledged that many impact evaluations assess multi-component interventions, which makes it difficult to isolate the effects attributable to specific action areas, such as those defined in Annex 1. In such cases, classification was based on the dominant intervention components or the clearest pathway of impact reported by the authors—which could lead to incorrect attribution of observed outcomes to a single intervention type.

1. PUBLIC GOODS

1.1. Rural Electrification

Agrowing body of systematic evidence highlights the significant, though heterogeneous, socio-economic effects of rural electrification in low- and middle-income countries (LMICs). Across multiple thematic domains—including household welfare, productivity, education, health, and gender dynamics—electrification interventions demonstrate substantial potential to catalyze rural transformation, albeit with context-dependent outcomes.

All five systematic reviews reviewed here affirm the positive association between rural electrification and improvements in household income, employment, education, and productivity. For instance, Ayana and Degaga [194] conducted a meta-regression of over 70 studies and found statistically significant genuine effects of electrification on key welfare indicators, particularly education and employment, after controlling for publication bias. This finding is consistent with ESCAP [190], which documents electrification's capacity to enhance access to economic opportunities, public services, and gender equity.

Evidence on income gains is particularly robust. Three reviews [112, 184, 194] report measurable increases in household income following electrification, driven by both direct cost savings (e.g., from reduced kerosene use) and new income-generating activities enabled by electricity access. However, the magnitude and sustainability of these effects vary widely, depending on the design of interventions and the enabling context. For example, Bensch et al. [184] found that while market- based reforms contributed to improved electricity access, outcomes were mixed across different countries and reform packages, underlining the limited effectiveness of regulatory change in isolation.

The reviews also converge on electrification's positive effects on time use and female empowerment. Electrification was found to reduce the time burden of domestic chores [190, 194], potentially freeing up time for education or income-generating work, particularly for women. Nonetheless, the findings underscore that such benefits often accrue disproportionately to men or to wealthier households unless specific gender-sensitive components are included in program design [112, 190].

Education outcomes emerge as one of the most consistent benefits of rural electrification. Improved lighting and access to information technologies support higher school attendance and completion rates [112, 185, 190]. However, evidence on direct learning outcomes remains limited, and future studies are needed to explore the quality dimension of educational gains [185].

The reviews also examine environmental and technological factors. Berthelemy and Millien [185], using a meta-analysis of 421 decentralized electrification projects, emphasize the superior performance of hybrid mini-grid systems over small-scale Solar Home Systems (SHS), particularly in Latin America and parts of Asia. They argue that system size and technological configurations are critical for maximizing development outcomes. Similarly, the review by UN ESCAP [190] notes that the geographic context substantially shapes project viability and long-term impacts, with mountainous or sparsely populated areas showing lower cost-effectiveness for grid expansion.

From a policy perspective, several implications emerge. First, electrification alone is insufficient to trigger large-scale rural transformation. The effectiveness of rural electrification increases when bundled with complementary interventions such as credit access, training, and institutional reform [112, 194]. Second, targeting mechanisms are essential to avoid exacerbating inequality, as electrification benefits tend to concentrate in better-off households unless subsidies or pro-poor components are explicitly integrated [112, 190].

In terms of research gaps, all reviews call for better-quality impact evaluations, especially longitudinal studies that track longer-term effects on economic resilience, gender empowerment, and climate outcomes. Importantly, Ayana and Degaga [194] highlight the underrepresentation of studies in low-income African countries, suggesting a skew in the evidence base that needs to be addressed through targeted empirical research.

Electrification and the Hidden Middle

Several of the reviews also highlight the role of rural electrification in enabling the emergence and expansion of midstream and downstream economic activities. For example, the ESCAP review [190] identifies linkages between electrification and the creation of non-farm enterprises, including agro-processing and informal commerce. Similarly, Ayana and Degaga [194] emphasize that electricity access facilitates diversification into commercial activities beyond agriculture, particularly when combined with supportive infrastructure and market access. Berthelemy and Millien [185] further stress that the scalability of productive uses of electricity depends heavily on system size, with mini-grids offering more potential than small standalone systems. Nonetheless, these benefits are uneven and require deliberate design and coordination to overcome limitations in infrastructure and policy alignment. Absent such conditions, electrification risks reinforcing existing inequalities rather than enabling inclusive food system transformation.

In sum, rural electrification is a necessary, though not sufficient, condition for inclusive rural development. While its developmental returns can be significant, the heterogeneity in outcomes stresses the need for careful program design, integration with other development tools, and ongoing monitoring and evaluation to ensure equitable benefits across different population groups and regions.

1.2. Rural Roads

Agrowing body of evidence from systematic reviews and rigorous impact evaluations supports the role of rural roads and transport connectivity as critical enablers of rural development. One review synthesizes extensive global evidence and concludes that road investments generally produce significant welfare gains in rural areas, particularly through increased non-agricultural employment, reduced transport costs, improved access to services, and reduced poverty. However, these benefits are highly context-dependent and moderated by the initial level of remoteness, complementary infrastructure, and market conditions. Importantly, the review also identifies unintended negative consequences, such as increased transmission of diseases (e.g., HIV), and adverse effects on nearby communities excluded from investment [188]. Another review complements these findings by showing that road infrastructure, especially when bundled with irrigation and other services, contributes to multidimensional poverty reduction and improved agricultural outcomes [80].

Income, Poverty, and Employment Outcomes

The findings of 23 relevant impact evaluations provide rich, country-specific evidence that reinforces and expands upon these conclusions. Several studies document consistent income gains and poverty reduction following road construction or rehabilitation. In Nepal, one evaluation estimates a 28% increase in household income due to rural roads, with stronger gains for poorer households [36]. In Nigeria, reduced transport costs through road improvements led to higher agricultural and non-agricultural income and reduced multidimensional poverty [8]. In Bangladesh, major road infrastructure development contributed to a shift toward higher-return employment and cropping intensity [101].

Several studies highlight important labor market effects. In Vietnam, evaluations observe shifts from agricultural to non-farm or self-employment [102, 125]. Similarly, rural roads enabled migration to non-agricultural jobs without major improvements in local farm productivity [17]. A study in India's transport corridors reports a shift toward non-farm work, although these did not significantly affect poverty or wage employment, emphasizing the need for complementary policies [97].

Agricultural Productivity and Market Integration

Evidence on agricultural productivity is similarly robust. In Mozambique, road expansion significantly raised agricultural production, with the largest gains in previously disconnected regions [71]. In India, paved rural roads improved market integration, prices, and technology adoption [3]. Studies from China and Bangladesh also report increased specialization and productivity linked to transport infrastructure, although some effects are geographically heterogeneous [123, 26].

Limitations and Heterogeneous Effects

The evidence base also reveals important limitations. In Tanzania, road upgrades reduced rice prices and lowered life satisfaction due to competition-induced pressures [49]. In Vietnam, only male-headed households benefited from increased agricultural trade, due to gendered constraints in accessing capital and labor [93]. Some studies point to resilience and income gains in remote areas, yet effects on agriculture or health remain inconclusive in the short term [106, 144]. Furthermore, highway investments can have uneven distributional impacts, with U-shaped effects on income inequality [155].

The importance of local context is a recurring theme. Many evaluations emphasize that the impacts of road investments are stronger in poorer, isolated regions [71, 102], and vary by terrain and access to markets. Geographic targeting and bundling with extension, credit, or irrigation services appear essential to maximize returns [48, 127].

Hidden Middle Considerations

Despite the wealth of evidence on rural roads, explicit references to midstream value chain activities —such as storage, wholesale markets, processing, or aggregation—are largely absent in both SRs and IEs. One review notes the lack of rigorous studies examining the role of rural roads in supporting midstream logistics or small and medium enterprises [188]. Another highlights the potential synergies between infrastructure and agribusiness development but does not offer specific evidence on value chain transformations [80]. Among the IEs, some provide limited indications of improved local market development and price integration, but do not detail effects on wholesale or storage infrastructure [102, 3]. This notable gap underscores the need for future research explicitly focused on the hidden middle and its interaction with rural road investments.

Conclusion

Overall, the combined evidence underscores the developmental value of rural roads, particularly when deployed in lagging regions and accompanied by complementary policies. Road investments are shown to enhance income, agricultural productivity, market integration, and non-farm employment, though effects vary considerably by geography, household characteristics, and policy context. The persistent lack of analysis on midstream value chain outcomes suggests an important blind spot in the literature—one that future impact evaluations and systematic reviews should address to better understand how rural connectivity can unlock inclusive agrifood system development.

1.3. Large-scale Irrigation

This synthesis draws on two Systematic Reviews (IDs 187 and 189), with partial supporting evidence from a third (ID 193), to assess the impacts of large-scale irrigation schemes, typically defined as government- or donor-financed infrastructure projects serving areas greater than 100 hectares. The reviews focus on their effects on agricultural productivity, rural livelihoods, environmental outcomes, and institutional performance, based primarily on evidence from Sub-Saharan Africa and South Asia.

Economic Performance and Cost-effectiveness

Large-scale irrigation systems have generally underperformed in terms of economic returns when compared to small-scale alternatives. Evidence shows that internal rates of return (IRR) for large schemes are often low, especially in Sub-Saharan Africa, where average construction costs reached US$14,455 per hectare—more than twice the cost in other regions. These elevated costs were rarely matched by proportionate productivity gains, and many systems suffered from high operation and maintenance burdens, limited responsiveness to farmer needs, and poor institutional frameworks [193]. Historically, these systems played a critical role in the expansion of irrigated area during the Green Revolution, but many have since struggled to maintain performance due to underinvestment in upkeep and weak governance [187].

Agricultural Productivity and Input Synergies

The productivity impacts of large-scale irrigation were most evident in the early decades of the Green Revolution, where irrigation enabled broader adoption of high-yielding varieties and fertilizer packages. These systems facilitated higher cropping intensity and expansion into higher-value crops. However, their benefits were often conditional on access to complementary inputs and effective extension services. Where such conditions were not present, gains were uneven and often captured by wealthier farmers [187].

Poverty and Food Security

While large-scale irrigation contributed to poverty reduction through enhanced food production, job creation, and price stabilization, its pro-poor effectiveness has declined. Recent evidence points to diminishing marginal returns as land and water become scarcer and project costs increase. Moreover, large systems often failed to target the most vulnerable populations effectively. In contrast, smallholder-oriented systems have demonstrated greater precision in poverty targeting, often yielding stronger livelihood improvements for marginalized groups [187; 193].

Environmental Impacts and Externalities

Large irrigation schemes have been associated with a wide range of environmental issues. These include soil salinization, waterlogging, contamination from agrochemicals, and depletion of groundwater resources. In several documented cases, the construction of large dams and canal systems resulted in reduced downstream sediment flows, wetland degradation, and biodiversity loss. These negative externalities were particularly acute in systems lacking environmental planning or adequate drainage infrastructure [187].

Distributional and Equity Concerns

Access to irrigation water within large-scale systems tends to be highly unequal. Head-end farmers benefit from more reliable and better-quality water, while tail-end users frequently receive insufficient or degraded flows. Inequities are further reinforced by landholding structures, as larger or politically connected farmers are more likely to benefit from irrigation access and complementary services. This pattern has led to concerns about the regressive nature of benefits in many large public irrigation systems [189].

Institutional Weaknesses and Policy Implications

Institutional shortcomings have played a key role in limiting the success of large-scale irrigation. Common problems include poor cost recovery mechanisms, lack of farmer participation in decision-making, weak coordination across agencies, and underfunded maintenance regimes. Many systems were implemented with insufficient attention to long-term financial and environmental sustainability. The evidence suggests that future investments should be accompanied by stronger institutional frameworks, with integrated planning, accountability mechanisms, and clear strategies for ensuring inclusiveness and environmental resilience [187].

1.4. Regulations

Adiverse set of regulatory interventions—ranging from trade policy and legal reforms to market governance—has been evaluated in recent years, offering insights into how institutional frameworks shape the performance and inclusiveness of agrifood systems.

Trade-related regulations can have far-reaching effects on both production and consumption. In Brazil, trade liberalization reduced employment across genders, but disproportionately affected male workers in tradable sectors, thus contributing to a narrowing of gender gaps in labor force participation—though largely through negative outcomes for men rather than gains for women [55]. In contrast, guaranteed price policies, such as Mexico's recent program for smallholder maize farmers, had positive distributional effects: while overall cultivated area declined nationwide between 2018 and 2020, beneficiaries of the price support experienced a smaller reduction in production area and increased incomes—driven primarily by the price effect, not yield expansion [62].

More structural reforms, such as legal changes expanding women's economic rights, have also shown transformative impacts. In Ethiopia, reforming the Family Law to enhance women's autonomy over property and employment resulted in a significant rise in women's participation in full-time, paid, and off-farm occupations in regions where the reform was enacted. The magnitude of this change— 15–24% increases—points to the strong potential of institutional reforms to influence labor allocation and occupational choice [64].

Trade agreements and tariff policies affect not only producer incentives but also food environments. The phased implementation of NAFTA in Mexico was associated with long-term shifts in dietary patterns: animal-source food consumption increased after 1994 and 2008, while pulse consumption declined, suggesting that liberalization contributed to structural dietary transitions [134]. Similarly, in Indonesia, the use of dairy import tariffs was found to support domestic supply by increasing prices and production, while slightly dampening demand—highlighting the dual protective and distortive effects of such tools [122].

Other forms of market-oriented regulation aim to stabilize prices and improve risk management. In China, concerns had emerged that the introduction of futures markets in apples may have triggered excessive volatility in spot markets. However, time-series analysis showed that futures trading was not responsible for spot price spikes and may, in fact, reduce long-term volatility, offering evidence in favor of regulated price discovery instruments [154].

Finally, regulatory governance of agricultural markets themselves appears critical. A panel study from India found that stronger implementation of post-harvest marketing laws—specifically through the Agricultural Produce Market Committee (APMC) Act—was positively associated with agricultural growth and technology adoption across states. The findings caution against deregulation efforts that weaken market institutions, emphasizing instead the need for effective regulatory structures to crowd in investment and sustain rural development [369].

1.5 Public goods interventions: Summary

Number of studies found, by intervention category and type of impact*

Intervention	Impact assessment			Total
	Positive	Mixed/ Inconclusive	Null/ Negative	
Public goods				
Electrification	8 (7)		2	10
Irrigation	3 (1)	2 (2)		5
Roads	16 (1)	7 (1)	2	25
Storage	1			1

* Number of systematic reviews in parentheses.
Note: Each study could be included in more than one intervention category.
Own elaboration

2. PRODUCERS

2.1 Smallholder Irrigation

This synthesis is based on two Systematic Reviews [193, 410] and 16 complementary Impact Evaluations. It examines the effects of smallholder irrigation interventions on productivity, food security, and rural livelihoods in low- and middle-income countries. The evidence focuses on technologies and programs designed for small-scale farmers, including community-managed systems, low-cost irrigation kits, treadle pumps, and drip or sprinkler irrigation adapted to fragmented plots. While one of the reviews includes comparative analyses of small and large-scale irrigation systems, this synthesis exclusively considers findings related to smallholder-focused interventions. Results pertaining to large-scale, government-built irrigation schemes are addressed separately in the thematic synthesis on large-scale irrigation.

Access and Adoption of Irrigation Technologies

Systematic Reviews reveal that smallholder irrigation expansion occurs through both formal and informal channels. In South Asia, public and NGO-led efforts to promote tubewells, surface systems, and solar irrigation technologies have increased adoption, especially where land tenure and subsidies support farmer investment [193]. In Africa, farmer-led irrigation initiatives—such as treadle or motor pumps—predominate, yet access remains limited and uneven due to lack of financing and technical support [410].

Impact evaluations confirm this pattern. In Ethiopia, smallholder participation in targeted irrigation schemes led to increases in income, expenditure, and asset accumulation [406]. In Kenya, farmer-led irrigation adoption—especially during drought episodes—boosted crop income significantly [418]. Other studies document expanded use of irrigation through small reservoirs in Ghana [411], land husbandry and water harvesting systems in Rwanda [427], and informal irrigation in peri-urban vegetable markets [429].

Some interventions explicitly addressed gender or institutional gaps. In Uganda, the provision of solar hand pumps to women improved income, reduced domestic burdens, and contributed to shifts in household decision-making [433]. A study in Benin involving solar drip irrigation showed yield improvements and stronger food security [431].

Agricultural and Economic Impacts

A strong consensus emerges around the productivity benefits of irrigation. The African review [410] reports increased yields—particularly for rice and vegetables—as well as improved cropping intensity and profitability in systems using treadle or solar pumps. In South Asia, positive effects on income and poverty reduction are consistently linked to irrigation access when combined with extension, input availability, or electricity [193].

Among the 15 impact evaluations, 13 report positive effects on income, yields, or market participation. For example, Ghanaian farmers participating in IMT schemes increased rice yields by nearly 40% and saw net returns rise by 24.5% [419]. In Rwanda, LWH irrigation projects enhanced food security and economic resilience [427]. In Ethiopia, irrigation users showed greater food variety and crop diversity [425], and in Mali, SSI use improved household income and accumulation of productive assets [426]. Conversely, one study in Ghana found no income gains from multi-purpose reservoirs, pointing to infrastructure limitations and management failures [411].

Gender, Empowerment, and Social Outcomes

Gender-targeted irrigation interventions showed promising results. An RCT in Uganda [433] found that access to solar pumps increased women's productivity, income control, and time reallocation. In other cases, irrigation participation enhanced women's inclusion in cooperatives or decision-making spaces, although effects were not always formally measured [428, 432].

A few evaluations also highlighted broader social impacts. Rainwater harvesting ponds in Kenya were associated with resilience-building and asset gains [407], while some studies noted reductions in vulnerability to drought and increased food availability [423].

Barriers and Enabling Conditions

Both SRs underscore structural and institutional barriers. These include small landholdings, weak extension systems, inadequate infrastructure maintenance, and limited access to finance or inputs [193; 410]. Informal irrigation expansion in Africa often lacks coordination, leading to overuse of water sources and inequitable outcomes [410].

IEs confirm these concerns. For instance, in Ghana, weak institutional capacity contributed to poor performance of irrigation reservoirs [411]. In Ethiopia, limitations in input markets and extension constrained the full realization of irrigation benefits [430]. Successful cases, by contrast, often involved participatory governance (e.g., IMT schemes) [419] or bundled interventions that included irrigation, training, and land conservation [427].

Policy Implications

The evidence points to several policy priorities. First, irrigation investments must go beyond infrastructure and address the broader enabling environment, including access to inputs, technical support, and financing. Second, support for farmer-led irrigation—including solar and low-cost technologies—can be highly effective if paired with risk management tools and maintenance systems. Third, inclusive and participatory governance arrangements, such as IMT or water user associations, enhance sustainability and equity of outcomes.

Finally, gender-responsive design and targeted support for women—through ownership of pumps or access to training—can amplify the transformative effects of irrigation on rural livelihoods [433].

2.2 Inputs

This synthesis reviews the effects of interventions designed to improve smallholder access to agricultural inputs—mainly seeds, fertilizers, and related production technologies. It draws on four Systematic Reviews and 44 Impact Evaluations. Overall, input-related interventions tend to increase technology adoption and, in many cases, improve yields or household consumption. However, effects on income and long-term productivity are more mixed, and effectiveness depends critically on design, context, and the availability of complementary services such as credit, extension, or market access.

Fertilizer and Subsidy Programs

Subsidized access to seeds and fertilizers has been a cornerstone of agricultural policy in many countries. These programs can increase the use of improved inputs, enhance yields, and contribute to short-term food security. In Malawi, fertilizer subsidies under the national FISP program increased the adoption of improved maize varieties and contributed to food availability at household level. However, evidence of sustained productivity or nutritional gains remains limited, and many studies report weak or null effects on child health and dietary quality [152].

Several evaluations highlight positive results when subsidies are well targeted and embedded in broader packages. In Tanzania, a fertilizer subsidy program with training and soil testing increased maize productivity and farm profits among smallholders [408]. In Zambia, agro-input subsidies paired with a savings match program improved planning horizons and led to modest gains in investment and productivity [86]. However, other cases report little to no impact when subsidies are not accompanied by complementary interventions. In Kenya, fertilizer subsidies increased usage but had no measurable effect on yields or household income, due to poor targeting and inadequate extension [57].

Improved Seeds

A systematic review, focused on the impact of adopting CGIAR-supported improved seed varieties on smallholder welfare in low- and middle-income countries, offers robust evidence on the direct effects of improved varieties on poverty, income, and expenditure [57].

Across 27 experimental and quasi experimental studies examining the adoption of improved seeds for food crops such as maize, rice, wheat, legumes, and bananas, the meta-analysis reveals a 35% average increase in income and a 14% increase in household expenditure among adopting households. However, the reduction in poverty incidence—estimated at 4%—was not statistically significant. The evidence suggests that improved seeds can lead to higher agricultural productivity and income through mechanisms such as better yields, shorter maturation cycles, and improved tolerance to environmental stress. Yet, the extent of the impact varies substantially by context, crop type, and household characteristics. For example, studies in Ethiopia and Mexico found substantial poverty reductions from legume and maize adoption, while others, like those in Kenya, Zambia, and Bangladesh, found only modest or no significant effects.

Importantly, the review identifies a strong correlation between reported welfare gains and the methodological risk of bias, cautioning that many of the largest effects come from studies with weaker identification strategies. Furthermore, access to improved varieties is often limited to better- off farmers, raising concerns about equity and inclusion. The authors also stress the importance of complementary measures—such as credit access, extension services, and input subsidies—to facilitate broader adoption and ensure more inclusive benefits.

Input Provision in Value Chain Programs

Many input interventions are delivered as part of larger value chain support programs. These often include the distribution of improved seeds, fertilizers, tools, or irrigation technologies. When coupled with training or guaranteed markets, these interventions tend to improve adoption and, in some cases, commercialization. In Niger, seed distribution paired with training and climate adaptation improved yields, but did not affect child nutrition outcomes [131]. In Burkina Faso, farmers who received improved inputs through a value chain program adopted new technologies and expanded production, although income effects were small [407].

Programs that combined input provision with marketing support showed stronger results. In Nigeria, a warehouse receipt system linked to subsidized inputs improved maize storage and led to higher sales volumes and prices [432]. In the Copperbelt region of Zambia, an Oxfam program distributed seeds and tools alongside market access support, yet produced no significant impacts on women's empowerment or household nutrition [25].

Distribution Channels and Institutional Arrangements

Delivery mechanisms matter. Programs relying on community-based targeting or local cooperatives tend to reach more vulnerable farmers and achieve better adoption outcomes. In Ethiopia, the CRIAR program used input vouchers distributed through producer groups, increasing adoption of improved seeds and fertilizers and raising food consumption among beneficiaries [413].

However, poorly coordinated delivery channels often result in delays, leakage, or exclusion of smallholders. Several reviews report cases in which inputs arrived late in the season, reducing their effectiveness, or were captured by larger, politically connected farmers. These governance challenges partly explain the inconsistent results observed in national subsidy programs in West Africa and Southern Africa [66].

Complementarity with Other Services

The success of input interventions depends heavily on complementary services. Subsidies or distributions are most effective when paired with extension, credit, or infrastructure. In Ghana, input provision alone had no effect on yields or commercialization, but when combined with training, results improved significantly [414]. In Senegal, an input-focused value chain intervention produced limited results in the absence of market access and transport support [56].

These findings highlight the importance of integrated design. Training improves farmers' ability to use inputs effectively, while credit and markets ensure that adoption can be sustained. Programs that address only one constraint—such as seed availability—without supporting information or financial access tend to have muted or short-lived effects.

Cross-Cutting Patterns and Design Implications

The evidence across reviews and evaluations suggests that:

- Input interventions generally increase technology adoption, especially for improved seeds and fertilizers.
- Productivity and income effects are highly variable. They tend to be positive when programs are well-targeted, timely, and delivered alongside training or market support.
- Subsidies without complementary services often show no impact or short-lived gains. Misaligned timing and poor governance are major risks.
- Nutrition outcomes are rarely improved by input interventions alone. Programs need to explicitly link input use to dietary practices or food consumption pathways to produce broader effects.
- The sustainability of adoption depends on continued affordability, access to advice, and the ability to commercialize production gains.

Conclusion

Input-related interventions remain a key policy lever in agricultural development. They are particularly effective in increasing adoption and yields when delivered with complementary services and through responsive local institutions. However, impacts on income, resilience, or nutrition are far from guaranteed. Poor design, weak targeting, and lack of coordination frequently undermine results. The combined evidence points to a clear lesson: inputs are necessary, but not sufficient. Their effectiveness depends on how they are delivered, to whom, and in what combination.

2.3 Training

This synthesis explores the effects of training interventions across five key dimensions: agricultural production, post-harvest practices, nutrition, commercialization, and cross-cutting enablers. The analysis draws on seven Systematic Reviews and 44 Impact Evaluations. While the overall evidence base points to consistent gains in knowledge and adoption of improved practices, results on yields, income, and nutrition are more variable. Several studies document null or context-dependent effects, particularly when training is poorly delivered or implemented in isolation. Effectiveness is highest when training is well-targeted, participatory, and supported by complementary services.

Training in Agricultural Production and Technical Knowledge

Training interventions aimed at improving agricultural practices—delivered through extension services, NGOs, or value chain projects—consistently increase the adoption of modern inputs and techniques. Participants often adopt improved seeds, fertilizers, and water management practices, with positive effects on yields and household consumption. These outcomes are more pronounced when training is repeated, field-based, and paired with input access or extension support [120; 107].

In Ethiopia, integrated agricultural training delivered with productive asset transfers and coaching increased adoption of improved varieties and household food consumption [413]. In India, peer-led training proved more effective than private-agent-led approaches in promoting the use of biofertilizers and organic practices [425]. However, several evaluations show that knowledge gains do not always translate into measurable changes in output or income. In Niger, farmers who received training with modern inputs improved yields but showed no significant improvements in child nutrition [131]. In Uganda, training within self-help groups increased savings and agronomic awareness, but the effects on agricultural income were limited [418].

Farmer Field Schools

Participatory and experiential approaches like Farmer Field Schools have been associated with higher levels of knowledge retention, reduced pesticide use, and increased yields and profits. Impacts are amplified when training is delivered with support for market access or input provision [151]. In Mali and Tanzania, FFS contributed to improved land management and commercialization among smallholders, particularly where trainers were well-prepared and activities sustained over multiple seasons.

Yet evidence also shows that results can be highly uneven. Training quality varies widely, and poor facilitator preparation, inflexible curricula, or lack of post-training support often lead to weak outcomes. In several cases, impacts on income or productivity were statistically insignificant. A widely implemented advisory program in Uganda that relied heavily on training showed no measurable effect on household income, despite reaching thousands of participants [141]. Diffusion of knowledge to non-participants remains limited, especially where practices are complex or require inputs that are not readily available.

Post-Harvest and Food Safety Training

Training focused on post-harvest handling, drying, and aflatoxin prevention has shown strong effects on food quality and safety, particularly when combined with practical tools and risk communication. Programs that deliver demonstrations, improved bags, or moisture meters consistently report reductions in contamination and spoilage [150].

In Ghana, participatory stakeholder platforms were used to deliver post-harvest training and align practices across actors in the maize value chain, reducing losses by more than half [452]. A similar approach in Nigeria, which provided drying sheets and storage tools along with training, resulted in lower aflatoxin levels and better prices at market [434]. However, interventions that relied solely on theoretical training, without physical tools or follow-up, often failed to change behavior or reduce losses meaningfully.

Nutrition and Food Education

Agriculture–nutrition training programs—especially those targeting women—can improve dietary diversity, food consumption, and nutrition knowledge. These effects are stronger when training is combined with home gardening, livestock rearing, or behavioral messaging [95].

In Burkina Faso, a homestead food production program with nutrition training improved dietary intake and reduced stunting among children under five [407]. In Zambia, poultry training linked to infant feeding education increased household egg production and improved child dietary quality [438]. Yet, not all nutrition-sensitive training yields transformative outcomes. In a multi-country program covering West Africa and the Sahel, training on nutrition and climate-smart agriculture reached over 37,000 households, but measurable effects on nutritional outcomes were limited [56]. In Niger, despite high participation in training and messaging activities, no significant impacts were found on child growth indicators [131].

Business, Marketing, and Commercialization Training

Training in marketing, record-keeping, and negotiation skills has the potential to increase commercialization and income when linked to input supply, aggregation services, or buyer contracts. Business training is often delivered through value chain programs, digital platforms, or cooperatives. Impacts on commercialization are strongest where training is part of a broader support ecosystem [107].

In Vietnam, group-based training for pig producers led to higher average prices and profits, particularly for women who gained greater control over marketing decisions [135]. In Nigeria, maize farmers who received training on quality standards, price negotiation, and warehouse systems increased sales volumes and received better prices [432]. However, in contexts where training was delivered in isolation, without structural support or guaranteed markets, behavior change was rare and income effects negligible. Digital training programs in Ghana, while effective in improving knowledge, did not improve market outcomes unless combined with credit access or group organization [414; 436].

Cross-Cutting Lessons and Design Considerations

Across all domains, several conditions consistently shape the effectiveness of training:

- Training improves knowledge and adoption, but outcomes on income, productivity, and nutrition are more variable and depend heavily on follow-up support and the availability of complementary services.
- Training alone rarely leads to meaningful transformation. Access to inputs, markets, credit, and institutional support are often necessary to translate knowledge into action.
- Poor implementation quality—rushed curricula, untrained facilitators, or lack of contextualization—can lead to null or even negative results.
- Gender constraints often undermine effectiveness. Training programs that do not account for women's time use, literacy gaps, or mobility restrictions frequently reinforce exclusion rather than reduce it [141].
- Sustainability remains a challenge. High-cost, high-contact models like FFS are difficult to scale without dedicated institutional investment. Short-term workshops, while cheaper, often lack depth and durability.
- Behavior change takes time. Most training programs are evaluated in the short term, with limited follow-up to assess whether changes persist.

Conclusion

Training can strengthen agricultural systems by building farmer capacity, promoting adoption of improved practices, and enabling greater participation in markets. When well designed, adapted to context, and delivered alongside other support services, training contributes to improved resilience, productivity, and food security. However, many programs fall short of these goals. Results are often modest, and in some cases, nonexistent. Effective training requires more than information transfer—it must be part of an integrated system of support that addresses the structural constraints farmers face. The combined evidence shows that training works, but only when it is done well.

2.4 Storage

Most of the interventions related to storage identified in the existing literature are designed for and implemented at the level of producers. These typically focus on enabling smallholders to adopt improved on-farm storage technologies, practices, or infrastructure—such as hermetic bags, silos, or granaries—with the goal of reducing post-harvest losses, improving food security, or allowing farmers to delay sales for better prices. However, these are not third-party storage services or commercial storage enterprises that serve multiple actors along the value chain. Virtually none of the studies examine interventions targeting private storage providers, cooperatives acting as storage hubs, or SMEs offering storage as a service, highlighting a significant gap in the evidence base on midstream logistics.

Hermetic Storage Bags

A broad set of studies confirm that hermetic storage bags are a highly effective intervention to reduce post-harvest losses, maintain grain quality, and improve food security outcomes for smallholder farmers. Evidence from Tanzania, Uganda, Kenya, Senegal, and other countries shows consistent reductions in pest damage, weight loss, and pesticide use when hermetic bags are used [1], [108], [451]. These improvements are often accompanied by increases in grain quality, sales during the lean season, and even farmgate prices [39], [110].

The use of hermetic storage has been associated with significant improvements in food security during both regular lean seasons and periods of systemic shock such as the COVID-19 pandemic [29], [68]. The technology has also enabled longer storage durations and improved dietary resilience [378], [113].

Economically, the intervention is cost-effective, with studies from Kenya and India showing that hermetic bags can pay off within a single agricultural season if used correctly [108], [139]. Furthermore, the use of subsidies to promote early adoption appears to "crowd in" private demand, with farmers later buying additional bags at market prices [114]. However, a longer-term study in Uganda revealed that the initial gains from one-time subsidies may not persist due to supply-side constraints, limiting continued adoption [386].

Inventory Credit and Warehouse Receipts

Inventory credit and warehouse receipt systems aim to help farmers better manage the timing of sales and access credit. However, evidence of impact is mixed. In Sierra Leone, uptake of inventory credit was low, and the intervention primarily substituted pre-existing informal storage practices without significantly altering sales patterns [32].

Conversely, evidence from Malawi suggests that combining hermetic storage bags with collective village storage increases storage duration and volumes, and yields modest gains in prices and revenue (up to 12%) [110]. In a separate intervention in Malawi, warehouse receipt systems helped improve access to input credit and ISFM adoption, although impacts on income and yield remained limited [91].

Storage Subsidy or Public Investment

Public investment in storage infrastructure can yield substantial productivity gains. In India, a subsidy program for rural godown construction led to a 20% increase in rice yields and a 21% rise in fertilizer use, likely due to reduced storage costs enabling better input use [38]. This highlights the potential for well-targeted capital investment to deliver both post-harvest and upstream productivity benefits.

2.5 Processing

Impact evaluations suggest that processing-related interventions can improve food security, productivity, and incomes—particularly when technologies are appropriate, locally accessible, and accompanied by training.

In Malawi, the Farmers Income Diversification Program (FIDP) promoted agricultural productivity, diversification, value addition, and commercialization through a nationwide initiative. It led to significant gains in productivity (20–24%) and moderate improvements in income diversification, suggesting that broad-based support programs can strengthen upstream and midstream processing capacity, especially when integrated into market-oriented strategies [157].

In Mozambique, the use of passive solar dryers combined with training led to measurable improvements in household food availability, women's dietary diversity, and reduced food insecurity among rural households [371].

The CCDP project in Indonesia supported fish processing through community-led infrastructure development, including smokehouses, cold storage, and market facilities. It also promoted the formation of local processing groups—primarily involving women—which contributed to improved product quality, reduced post-harvest losses, and better access to profitable markets [373].

Complementary evidence from descriptive studies points to broader structural challenges. In Ethiopia, Integrated Agro-Industrial Parks (IAIPs) have improved infrastructure and value chain integration but face serious implementation difficulties that threaten their long-term effectiveness [161]. In Myanmar, the food processing sector remains underdeveloped and shock-prone, limiting its contribution to employment and broader agri-food system transformation [167]. While these studies are not based on impact evaluation, they offer useful context on enabling conditions and systemic barriers.

Overall, the evidence suggests that processing interventions targeted to small-scale actors can deliver substantial benefits when adapted to local conditions and supported institutionally. Yet broader transformation requires stable systems, cross-cutting coordination, and sustained investment.

2.6 Agricultural Finance

This synthesis summarizes the main findings on agricultural finance interventions from six systematic reviews [24, 107, 145, 354, 357, 358], complemented with eleven high-quality impact evaluations [19, 32, 35, 47, 58, 118, 156, 186, 309, 316, 334] listed in the `Finance.xlsx` database. The SRs provide structured evidence on financial inclusion instruments, rural finance policies, contract farming, and insurance programs. This narrative is organized by four key subthemes: credit, insurance, savings, and price risk management. Throughout, we emphasize convergence in evidence, highlight trade-offs, and assess complementarities between interventions.

Credit

Systematic evidence points to modest but positive impacts of rural credit programs, particularly when bundled with complementary interventions [24, 145, 358]. Credit increases productive investments and, in some contexts, leads to income gains or consumption smoothing, though effects vary by design and target group.

Bundled interventions—such as those combining credit with training—show stronger and more consistent effects. For example, combining loans with technical assistance or farmer field schools increased adoption of improved practices and input use [145, 358]. One SR finds that loans offered through community-based groups like Village Savings and Loan Associations (VSLAs) improved access, especially for women and vulnerable populations [107].

In terms of agricultural output, credit shows moderate effects, especially when tailored to the production cycle. Seasonal or harvest-timed loans can support storage and off-season sales, reducing distress sales and improving prices received [354, 358].

Complementing these findings, several impact evaluations offer detailed insights:

- A seasonal credit intervention in Kenya significantly improved farmers' ability to exploit price differentials, boosting revenues by 29% [186].
- A harvest loan in Tanzania increased storage and lean-season sales by 50% [35].
- A community-based microfinance model combined with training raised incomes and adoption of CSA practices [118].
- An agricultural loan and training package improved food security and reduced depression, even though it did not affect HIV clinical outcomes [316].

Nonetheless, challenges remain: high interest rates, trust issues, or poor adaptation to local contexts limit take-up or impact [32, 334]. Some IE studies report low participation rates, even when credit products are well-designed, especially when farmers perceive risks as too high or benefits too uncertain [32].

Insurance

Insurance is the most rigorously studied financial intervention in agriculture, especially index-based crop insurance. Systematic reviews agree on a limited but positive effect on risk management and agricultural investment [107, 354, 357].

Increased investment in higher-risk, higher-return crops is one of the clearest effects of access to insurance, especially when paired with training or technology [357]. A review of digital and weather-based insurance schemes shows that trust, understanding, and experience are critical for sustained uptake [357]. However, insurance alone rarely boosts productivity or income unless accompanied by other inputs or learning mechanisms [354].

Impact evaluations confirm these patterns. A multi-year RCT shows that bundling drought-tolerant seeds with index insurance helped households recover after shocks and increase future investments [309]. Another RCT in Ghana demonstrated that insurance increased demand for supplemental irrigation, revealing potential policy synergies [437]. One evaluation in India offered digital insurance products to landless farmers, using georeferenced plots to overcome land-title constraints [334].

Overall, insurance can mitigate risk and protect livelihoods, but its success depends on integration with other services, clear payout mechanisms, and farmers' past experiences with risk and shocks [309, 357].

Savings

Savings are less frequently the primary focus of SRs, but emerge as a critical complementary mechanism in bundled interventions. In particular, Village Savings and Loan Associations (VSLAs) are effective platforms to promote financial literacy, risk mitigation, and access to funds [107, 358].

One SR shows that participation in VSLAs improves household resilience, gender empowerment, and income diversification [358]. Evidence suggests that savings groups not only improve financial access but also function as risk-pooling mechanisms during crises [107].

Impact evaluations add depth: in Tanzania, participation in savings groups increased the adoption of CSA practices, food security, and nutrition [118]. These effects were stronger when paired with training and women's empowerment.

Nonetheless, the standalone effects of savings programs remain underexplored. Most studies analyze savings as part of broader microfinance or community-based interventions. Further research is needed to understand the independent contribution of savings to rural financial resilience.

Price Risk Management

Price risk management strategies—such as inventory credit (warrantage), storage finance, and market timing tools—are well-covered in both SRs and IEs. Systematic reviews suggest that inventory credit helps farmers delay sales, invest more in production, and smooth consumption [354, 358]. However, the effects on food security and income are often short-term or context- dependent.

One SR highlights that storage-backed credit enables better market timing, particularly for perishable or price-volatile commodities [354]. However, uptake may be low when trust in lenders is weak or price forecasts are uncertain [358].

Impact evaluations reinforce these conclusions:

- A warrantage program in Burkina Faso increased input investments and education spending, though food security effects were short-lived [47].
- A storage and credit program in Indonesia reduced seasonal consumption gaps [19].
- An inventory credit scheme in Sierra Leone failed to improve storage behavior due to trust and institutional barriers [32].

Together, this evidence suggests that inventory credit and price risk management work best when tied to market transparency, reliable storage infrastructure, and trust in institutions. Alone, these tools may not suffice to stabilize incomes or food security, but they are essential components of broader financial inclusion strategies.

Conclusion

Across all subthemes, the strongest impacts come from integrated financial packages—those that combine credit, insurance, savings, training, or technological support. Gender-sensitive and community-based models (e.g., VSLAs, FFBS) also demonstrate superior outcomes, particularly when targeting vulnerable groups [107, 145, 358].

Despite scattered limitations in uptake and sustainability, the body of evidence supports a multidimensional approach to agricultural finance, tailored to farmers' risk profiles, cash cycles, and market access. The integration of digital technologies and alternative collateral systems appears promising but remains under-researched.

This synthesis offers a robust platform to inform policies aimed at strengthening agricultural finance systems, with attention to bundling instruments, reducing transaction costs, and promoting farmer trust and understanding.

2.7 Innovation

This synthesis explores the role of innovation-oriented interventions in improving smallholder outcomes. Based on four Systematic Reviews and 13 Impact Evaluations, it examines the effectiveness of efforts to generate, diffuse, and support the adoption of agricultural innovations.

The reviews provide consistent evidence that adaptive, participatory, and decentralized innovation models increase the likelihood of adoption. However, impacts on productivity, income, and nutrition vary widely, and depend critically on institutional arrangements, delivery quality, and local relevance.

Drivers of Adoption: Fit, Framing, and Access

A large body of evidence highlights that the likelihood of adoption hinges on how well the proposed technology fits farmers' constraints and capabilities. Reviews consistently find that uptake is higher when innovations are developed or selected with farmer participation, when they respond to perceived risks, and when they are aligned with local agronomic and socio-economic conditions \ [111; 141; 448].

Adoption is also shaped by how innovations are framed and delivered. Programs that combine technology with capacity building, input access, and post-adoption support are more effective than those based on simple dissemination. The success of innovation initiatives is linked not only to technical superiority but also to the credibility of providers, timeliness of delivery, and availability of complementary services \[111; 145].

In Benin, the introduction of improved maize technologies accompanied by field demonstrations and input subsidies led to yield gains of over 20% \[301]. In Ethiopia and Tanzania, on the other hand, the diffusion of improved seed and agronomic packages achieved limited reach and weak results due to fragmented supply chains and poor alignment with local needs \[448].

Institutional Innovation and Knowledge Systems

Innovative institutional arrangements play a critical role in enabling the uptake and scaling of new technologies. Evidence shows that decentralized, multi-actor systems—such as farmer-led research, plant clinics, or local innovation platforms—tend to outperform top-down models in responsiveness and effectiveness \[111; 448].

Reviews point to the value of iterative, inclusive, and learning-oriented innovation systems. These not only facilitate adoption but also improve farmer agency and adaptation. Programs that integrate feedback mechanisms, allow for local customization, and involve multiple stakeholders (farmers, researchers, NGOs, private sector) show more sustainable results \[111].

In India, intensive support through farm science centers contributed to significant improvements in agricultural income and household consumption \[84]. In Bangladesh, plant clinic programs helped farmers manage pest outbreaks more effectively, increasing yields and profitability among vegetable producers \[59].

However, adoption tends to be segmented. Innovations often benefit better-connected or better-resourced farmers, while those in remote areas or with limited capital remain excluded. In Peru, a reform that introduced pluralistic extension markets improved access for commercial producers, but informal providers dominated among poorer or isolated farmers, generating uneven outcomes \ [173].

Digital and Technological Innovation

Technological and digital innovation has expanded rapidly in recent years. Reviews show that digital platforms can lower information barriers, enhance decision-making, and reduce the cost of reaching dispersed populations. However, the effectiveness of these tools depends on connectivity, content relevance, and farmers' ability to act on information \[145].

Simple digital advisories rarely shift behavior unless supported by complementary incentives, trusted intermediaries, or follow-up services. Programs that combine digital tools with group-based training or embedded input delivery achieve better results \[145]. Furthermore, digital exclusion— especially for women or older farmers—remains a major concern.

In Ghana, a bundled intervention that offered digital agronomic advice alongside savings and input support increased adoption and input use among rice producers \[414]. In Nigeria, mobile-based weather and planting information improved yields only when accompanied by follow-up extension visits \[436].

Innovation with Nutrition Goals

The evidence on innovations explicitly designed to improve nutrition is mixed. While biofortified crops, solar drying, and nutrition-sensitive agriculture show promise, reviews highlight that adoption alone is rarely sufficient to achieve dietary change \[448]. Impacts on child nutrition and food diversity are most likely when innovations are embedded in broader behavior change efforts.

In India, solar-powered drying technologies introduced to women's self-help groups increased seasonal dietary diversity, especially for children and women \[105]. In other contexts, weak adoption and the absence of food environment changes limited the nutritional impact of otherwise promising innovations.

Barriers, Trade-Offs, and Structural Constraints

Across contexts, reviews document persistent structural barriers to innovation. These include insecure land tenure, limited liquidity, weak market access, and gender-based constraints \[141; 448]. Women in particular often face greater obstacles to accessing, testing, and benefiting from innovation, especially when interventions fail to account for time burdens or decision-making dynamics within households.

Adoption trade-offs are also relevant: labor-saving technologies may displace income-generating activities, and some innovations may introduce new risks or increase dependency on external inputs. Moreover, many interventions still prioritize technical delivery over farmer agency, overlooking the social, institutional, and market dimensions that shape innovation trajectories \[111].

Conclusion

Innovation-oriented interventions can be powerful drivers of agricultural transformation when they are inclusive, adaptive, and well-supported. The strongest results are seen where innovations are co-developed or selected with farmer input, delivered through credible and responsive institutions, and accompanied by services that enable uptake. Yet, innovation is not a stand-alone solution. Its success depends on context-sensitive design, institutional innovation, and attention to power, equity, and learning. When done well, innovation can enhance productivity, resilience, and food security—but when done poorly, it risks reinforcing existing inequalities or producing little change.

2.8 Information/ICT

This synthesis reviews twelve impact evaluations of agricultural interventions centered on information and communication technologies (ICT). It focuses on programs where the core mechanism is the delivery of information—such as agronomic advice, market prices, or risk alerts— via digital tools like mobile phones, SMS, or apps.

Training

Several studies evaluated the use of ICT tools to strengthen or complement agricultural training and extension services. In Mali, mobile voice reminders sent after in-person training significantly improved the timing of cereal harvests, encouraged the use of improved storage methods, and reduced on-farm losses, although they had no detectable effects on yields or revenues [344]. A similar intervention targeting harvest aggregation led to higher adoption of post-harvest practices and reduced hunger incidence, but did not affect post-harvest losses or income from food crops [116].

In Cambodia, a randomized trial assessed whether SMS-based messages could promote the adoption of integrated pest management (IPM). While messages alone had no effect, combining them with in-person training increased IPM adoption by 20%. However, this was accompanied by a rise in pesticide use, suggesting that information may have been misinterpreted or applied inconsistently [311]. In Ethiopia, demonstration trials and improved facilitation by extension agents increased the adoption of improved wheat varieties and chemical inputs, although only some effects—such as pesticide and herbicide use—were statistically significant [328].

Other interventions focused on digitally enabled, personalized, or performance-based training systems. In Nigeria, an app offering tailored fertilizer advice led to a 7% increase in rice yields and a 10% increase in profits, without raising overall fertilizer use, suggesting gains in input efficiency [15]. In Uganda, linking extension agents' compensation to activity-based digital monitoring systems improved performance, particularly among younger agents, and illustrates the potential of ICT to enhance accountability and service delivery [9]. A farmer-to-farmer extension model in Tanzania, supported by training cascades and social network dynamics, showed strong diffusion of practices over time. Farmers connected to trained peers experienced notable gains in rice yields, even in the absence of direct training [430].

Commercialization

Two studies examined ICT interventions designed to strengthen smallholders' integration into commercial markets. In Ghana, providing yam farmers with price information via SMS led to a 9% increase in prices received by treated farmers, with indirect spillover benefits accruing to those linked through marketing networks. The intervention was effective in part because yam markets rely heavily on negotiation, illustrating how ICT impact depends on crop-specific market structures [201].

In eastern India, a randomized evaluation of KhetScore—a digital credit scoring tool using satellite imagery—demonstrated significant positive effects on access to credit and crop insurance for landless and smallholder farmers. The bundled service led to increased uptake and renewal of insurance policies, higher borrowing from formal sources, improved monsoon-season revenues, and lower input costs in the dry season. Despite increased borrowing, repayment difficulties declined, indicating that the intervention helped mitigate risk. Women in the treatment group also reported greater participation in household decisions and lower stress levels, underscoring the broader welfare potential of digitally enabled financial tools [334].

Information

A third group of studies focused on ICTs as stand-alone tools to improve decision-making or reduce transaction risks. In East Africa, a quasi-experimental evaluation of mobile platforms delivering agronomic and market information found no statistically significant welfare effects for farmers or traders. The study underscores the difficulty of translating access to information into behavioral or economic change without complementary support [202].

In Uganda, an input authentication system using e-verification labels (E-tag) increased the use of high-quality hybrid maize seed and herbicides, especially in areas exposed to promotional messages and vouchers. However, actual authentication rates were low, and many farmers remained skeptical about input quality, highlighting persistent trust and behavioral barriers [365].

Finally, a multi-year study in India evaluated a portfolio of climate-smart agronomic practices, which included digital advisory components. The intervention improved yields, profitability, and resource-use efficiency, while reducing greenhouse gas emissions. Although not a purely ICT intervention, the digital tools played a key role in delivering context-specific recommendations and monitoring results at scale [432].

Mobile apps uptake

Despite the growing enthusiasm around developing mobile apps and digital platforms to support smallholder farmers with personalized agricultural advice, a number of structural and behavioral barriers have limited their effectiveness and uptake. Evidence from multiple impact evaluations shows that while information and communication technologies (ICTs) can increase awareness or knowledge, they rarely lead to consistent behavior change or measurable improvements in productivity or income. For example, a study in East Africa found that although ICT platforms allowed farmers to access market and weather information, the welfare effects were statistically insignificant [202]. Similarly, in Cambodia, SMS-based pest management messages had limited effect unless combined with in-person training, and even then, they led to unintended increases in pesticide use [311]. The heterogeneity in results underscores the importance of context and delivery mechanisms: voice reminders in Mali, when reinforcing existing training, improved the timing of harvest and storage practices, but had no impact on revenues [344].

Moreover, a recent meta-analysis of site-specific nutrient management (SSNM) using digital tools revealed significant co-benefits in terms of yield and profitability, but also highlighted the difficulty of scaling such tools across diverse smallholder settings. While apps like Rice Crop Manager and Nutrient Expert have reached hundreds of thousands of users in Asia, uptake remains low in Africa due to constraints such as low literacy, poor smartphone access, and limited integration with financial or input markets. Many digital platforms are overly complex or fail to incorporate the nuanced agronomic, economic, and social realities of smallholders. Even well- designed tools require strong institutional support and complementary services to be effective at scale. As emphasized in the systematic review, achieving widespread adoption of digital advisory systems will require significant public and private investment, adaptive co-design with users, and improved linkage with input, credit, and output markets [463].

2.9 Producer Organizations

This section is based on one Systematic Review [462] and five Impact Evaluations. The analysis focuses exclusively on organizations formed by producers—such as cooperatives, farmer associations, self-help groups, and other grassroots structures—used to strengthen market access, service delivery, and collective action. It excludes multi-stakeholder or governance-oriented organizations. The topic of producer organizations is cross-cutting, intersecting with interventions in commercialization, training, input access, and institutional linkages.

Market Access and Commercialization

Evidence shows that well-functioning producer organizations can significantly improve access to output markets by enabling collective sales, price negotiation, and coordination with buyers. According to the Systematic Review [462], organizations help smallholders overcome transaction costs and information asymmetries, especially when linked to formal markets or supported by NGOs and government programs. However, it also emphasizes that these benefits are often unevenly distributed: wealthier farmers tend to dominate organizational leadership, while poorer farmers, women, and youth are underrepresented.

Impact evaluations confirm these patterns. In Tanzania, participation in farmer organizations led to improved incomes and better market integration, especially through collective marketing schemes [5]. In Ethiopia, dairy cooperatives increased both milk productivity and commercialization, with significant welfare effects [6]. In Ecuador, participation in producer-led coordination platforms in the potato sector enhanced market access, service uptake, and household income [33].

Training, Capacity Building, and Technology Adoption

Producer organizations are often used as platforms for agricultural extension, training, and knowledge dissemination. The Systematic Review [462] highlights that such organizations can foster adoption of improved practices, especially when supported by external actors that provide structured training in agronomy, post-harvest management, and financial literacy. It also notes that leadership development and participatory governance within organizations can improve psychological well-being and trust among members.

Impact evaluations provide further insights. In Rwanda, land consolidation policies that leveraged community-based producer organizations contributed to specialization and higher productivity, though results were mixed across regions [46]. In Ethiopia's apiculture sector, honey cooperatives supported training and coordination, leading to better quality standards and access to export markets [7].

Access to Inputs and Support Services

Producer organizations can facilitate access to inputs, financial services, and information, acting as intermediaries between smallholders and service providers. According to the Systematic Review [462], collective purchasing and input distribution through cooperatives can lower transaction costs and improve bargaining power, though the effectiveness varies by organizational capacity.

One evaluation [46] showed that organizations involved in land and input coordination led to improved production efficiency and food consumption. However, the review also warns that without strong internal governance, such organizations may struggle to maintain service delivery and financial sustainability.

Conclusions and Policy Implications

There is broad agreement that producer organizations are effective vehicles to deliver services and improve market access for smallholders. However, success is conditional on governance quality, inclusion mechanisms, and external support. The Systematic Review [462] stresses the importance of tailoring interventions to local contexts and avoiding one-size-fits-all models. Moreover, organizations should be integrated into wider value chain strategies without losing their grassroots orientation.

Key policy recommendations include: (1) investing in long-term organizational capacity building, (2) promoting inclusive governance and gender equity within organizations, and (3) supporting linkages between producer organizations and formal institutions. Future research should focus on comparative evaluations of organizational models, long-term sustainability, and the role of OPs in climate resilience.

2.10 Certifications/Standards

This synthesis draws upon four Systematic Reviews [117, 442, 446, 447] that evaluate the effects of agricultural certifications and sustainability standards on smallholder farmers and their environments. Together, these reviews provide a broad evidence base, integrating quantitative meta-analyses and qualitative syntheses across multiple countries and commodities. The evidence covers economic, social, and environmental dimensions, with a primary focus on voluntary certification schemes such as Fairtrade, Rainforest Alliance, and Organic. To complement these reviews, the synthesis also incorporates findings from ten recent impact evaluations, which offer additional detail on specific country cases and help assess variation in certification outcomes across different implementation contexts. The thematic discussion is structured around four key areas: income effects, price transmission and premium capture, social and environmental outcomes, and heterogeneous effects.

Income and Profitability

Across the four reviews, there is broad agreement that certification can generate positive, though often modest, effects on smallholder income. Fairtrade and organic certifications are associated with statistically significant income increases in most cases, although the magnitude varies substantially by context [117]. Certification appears especially beneficial when linked to stable market access and cooperative participation [447].

A systematic review highlights the importance of complementary services—such as training, inputs, and long-term buyer relationships—which amplify the income benefits of certification. In the absence of such support, income effects tend to be marginal or even negative [442]. Another review notes that producers involved in certified schemes often report modest improvements in profitability, although these may not persist in the absence of continued support or favorable market conditions [446].

Findings from impact evaluations confirm and contextualize these insights. In Uganda, triple- certified producers experienced improvements in both income and productivity, while those under double certification benefited from price increases but faced productivity declines [4]. Additional evidence from Uganda shows that certification contributed to greater household wealth, particularly through increased joint asset ownership and improved access to agricultural extension services [96]. Similar patterns emerged in Vietnam, where certified producers reported higher sales prices and incomes, alongside a rise in hired labor costs—pointing to more commercially intensive operations [147]. In Ethiopia, certification schemes that combined Fairtrade, Organic, and Rainforest Alliance standards led to higher incomes and reduced poverty, whereas organic-only certification delivered less consistent income benefits [179].

Price Premiums and Commercialization

There is consistent evidence that certified producers generally receive higher prices than non- certified counterparts, although actual premium capture depends on the structure of the value chain [117], [447]. Premium distribution is found to be highly uneven: cooperatives with strong governance tend to pass more of the benefit to members, while individual or poorly organized producers often see limited gains [117]. The presence of asymmetric power relations can further restrict producers' ability to capture premiums [447].

One review emphasizes the role of intermediaries and exporters in shaping how premiums are negotiated and distributed. In several cases, middlemen or buyer cooperatives captured a significant share of the price benefits, reducing the incentive for farmers [442]. Another review finds that even when premiums are present, they may be offset by higher production and compliance costs unless coupled with yield increases or improved efficiency [446].

Impact evaluations echo these concerns. In Indonesia, certification improved coffee prices and raised per capita income, although it had no discernible effect on daily household expenditures [65]. A case from Ethiopia illustrates the limits of premium capture: while a quality-based bonus was part of the scheme, only about 30% of the premium actually reached producers, translating into a modest income gain of roughly $22 per year [99].

Production and Sustainability Outcomes

Evidence indicates that certifications generally lead to improved natural resource management practices, including reduced pesticide use, enhanced soil conservation, and increased biodiversity [446]. These effects tend to be stronger when standards are rigorously enforced and when monitoring mechanisms are in place [442], [447]. However, the environmental impacts may be minimal in contexts where enforcement is weak or ecological practices are poorly understood [442].

A systematic review identifies a potential trade-off: some certifications reduce environmental harm but may limit yields, especially during early adoption stages [117]. Aligning environmental benefits with income incentives, such as ecosystem service payments or eco-premiums, is considered essential to sustaining adoption [117].

Evidence from impact evaluations reinforces these findings. In Colombia, certified producers reported better environmental practices such as improved fertilizer management and waste disposal, although these improvements did not result in measurable economic gains [70]. In Kenya, differences across certification schemes were notable: Fairtrade supported greater specialization and improved post-harvest processing, while UTZ certification contributed to higher yields and overall returns [128].

Heterogeneous and Long-term Effects

The reviews consistently warn that certification benefits are not evenly distributed. Barriers for resource-poor farmers are common, and some certification programs may inadvertently exclude less advantaged producers [447], [442].

Impact evaluations similarly reveal uneven results. In Ethiopia, one program showed limited overall impact on livelihoods, with low price premiums, persistent productivity constraints, and weak cooperative services undermining potential benefits [75]. In Madagascar, although certification led to higher sales and prices, the effects were not uniform across participants, highlighting the importance of contextual and structural factors [142].

Conclusions

Certifications can generate positive outcomes across economic, social, and environmental domains, but their success depends heavily on institutional support, value chain structure, and farmer capabilities. While income and price effects are the most consistently reported benefits, their magnitude and distribution vary widely. Social impacts are promising but uneven, and environmental gains require robust monitoring and farmer training. Across all reviews, there is a call for better integration between certification schemes and broader rural development efforts, including investment in extension, governance, and market transparency. The impact evaluations reinforce these insights, providing specific examples of both achievements and limitations across diverse implementation contexts.

2.11 Producer-oriented interventions: Summary

Number of studies found, by intervention category and type of impact*

Intervention	Impact assessment			Total
	Positive	Mixed/ Inconclusive	Null/ Negative	
Producers				
Smallholder iIrrigation	15	2 (2)	1	18
Smallholder irrigation + [Inputs, Subsidies, Training, Credit, Insurance, Innovation, Organization, Information]	7	3	1	11
Inputs	3 (1)	1 (1)		4
Inputs + [Irrigation, Subsidies, Training, Credit, Storage, Commercialization, Information, ICT, Organization, Innovation]	17 (1)	6	1	24
Training	5 (1)	5 (3)		10
Training + [Irrigation, Inputs, Subsidies, Infromation, ICT, Innovation, Credit, Organization, Commercialization, Retail]	30	5 (1)	4	39
Storage	13			13
Storage + [Inputs, Commercialization, Organization, Credit]	1	3	1	5
Processing	3	1		4
Credit	3	1 (1)		4
Credit + [Irrigation, Inputs, Subsidies, Training, Storage, Insurance, Information, ICT]	6	5	1	12
Insurance		2 (1)		2
Insurance + [Irrigation, Inputs, Credit, Innovation, ICT]	3	4 (2)		7
Innovation	4 (2)	1 (1)		5
Innovation + [Irrigation, Inputs, Training, Credit, Insurance, Commercialization, Information, ICT]	11 (1)	2	1	14
Information	1			1
Information + [Inputs, Training, ICT, Organization, Credit, Commercialization]	9	2	1	12
ICT + [Training, Information]	4		2	6
ICT + [Irrigation, Inputs; Credit, Insurance, Innovation]	5	1		6
Organization	5	2 (1)		7
Organization + [Irrigation, Inputs, Subsidies, Training, Information, Processing, Contract farming, Commercialization]	5	2		7
Certification	8 (1)	5 (2)	1 (1)	14

* Number of systematic reviews in parentheses.
Note: Each study could be included in more than one intervention category.
Own elaboration

3. HIDDEN MIDDLE

Despite growing recognition of the strategic role of the midstream segment in food systems— including activities such as storage, processing, transport, intermediation, and SME support— rigorous evidence on interventions targeting this level remains limited, fragmented, and poorly systematized. Although many studies acknowledge its importance for rural transformation and for connecting smallholders to markets, few directly address this segment or provide disaggregated evaluations that identify its specific impacts [27; 94].

One of the main challenges is the sheer scarcity of studies explicitly focused on midstream functions. Across several reviews, interventions related to value chains, commercialization, or post-harvest services often appear as secondary components within broader projects, making it difficult to isolate their effects or understand how they operate. In some cases, improvements in processing, storage, or market coordination are reported, but these are embedded within general strategies and lack robust evidence on their standalone contribution [27; 94; 85].

Another key issue lies in the design of many programs, which tend to focus either on producers or on the efficient delivery of aid, overlooking midstream actors. Even when traders, transporters, or small retailers are involved, they are often left out of monitoring systems, and few programs assess how strengthening these actors contributes to food security or rural incomes. Moreover, programs frequently favor large, established firms, thereby excluding those who form the core of the "hidden middle" [77; 160].

Where evaluated, outcomes are mixed. Some interventions that combine producer organization, financial services, and improvements in storage or commercialization have reported positive effects on income, market access, or economic empowerment. However, other initiatives have shown null or even negative effects when governance is weak, access is unequal, or local capacity is not adequately supported [85; 92; 94]. Experiences with certification, cooperative processing, and contract farming, for example, illustrate how benefits can concentrate among better- connected producers or exclude women and vulnerable groups when inclusion is not intentionally designed [92; 94].

More recent reviews focused on Latin America have started to document midstream-oriented interventions targeting agro-processing SMEs, technology adoption, export consortia, or productive clusters. These programs have in some cases improved productivity and market access, particularly for medium-sized firms. However, effects on employment, inclusion of smaller enterprises, and long-term sustainability vary widely, depending on program design, institutional support, and implementation capacity [121; 160].

Overall, the available evidence confirms that while the midstream is a crucial node in food systems, it remains underserved. Despite broad recognition of its enabling role in agricultural development, the lack of rigorous evaluations, the peripheral nature of many interventions, and the limited focus on midstream actors have constrained its effective integration into development policy. The reviews consistently call for more targeted and disaggregated research on midstream interventions, with attention to distributional effects, sustainability, and scalability [27; 77; 85; 92; 94; 121; 160].

3.1 Storage

Three impact evaluations provide solid evidence on the effects of storage interventions aimed at increasing incomes, reducing post-harvest losses, and strengthening food security in rural contexts across Africa and China.

In Uganda, the Purchase for Progress (P4P) initiative by the World Food Programme (WFP) established satellite collection points (SCPs) with storage capacities ranging from 100 to 300 metric tons for small-scale maize producers. An econometric analysis revealed that use of these facilities was associated with higher volumes of sales, better selling prices, and increased crop income. These effects are explained by the ability to store maize under suitable conditions while waiting for better prices, as well as by access to more organized markets through collective management of storage and sales. Participation in savings and credit groups and lower price uncertainty in SCP catchment areas also encouraged the use of these services [79].

A pilot of the same P4P program in Tanzania combined institutional procurement from farmer organizations with the rehabilitation of community warehouses, provision of tarpaulins and equipment, and training in post-harvest handling and management. While there was a modest increase in the commercial activity of participating smallholders, no significant impacts were found on farm income, food security, or crop value sold. The evaluation suggests that the limited regularity and intensity of purchases, along with logistical and payment challenges on WFP's side, constrained the intervention's potential. Additionally, targeting was conducted at the level of farmer organizations rather than directly at households, which diluted the effect of storage services on individual farmers [88].

In China, the "Scientific Grain Storage Project" promoted the adoption of modern storage infrastructure, such as metal silos, with up to 60% of costs subsidized by the government. Using a quasi-experimental design, the study found that these facilities reduced maize storage losses by 60% (from 2.85% to 0.87%), allowed farmers to store grain for a longer period (+0.2 quarters), reduced pesticide use, and strengthened food security by lowering reliance on market purchases. The average estimated benefit from using metal silos was a savings of 33 kg of maize per household, valued at around US$21, with additional implications for resource conservation and national food system stability [90].

Cold storage

Interventions in cold chain infrastructure and services have shown significant effects on product quality, prices, post-harvest losses, and incentive structures across various agricultural and fisheries contexts.

In India, the installation of bulk milk coolers (BMCs) aimed to reduce spoilage during transport and facilitate the integration of remote villages into the formal dairy industry. While the intervention led to an increase in milk production, it was accompanied by a significant decline in milk quality, with a 2.09% reduction in fat content and a 0.61% drop in solids-not-fat (SNF), as well as a decrease in the breeding of higher-quality crossbred cows. The decentralization of quality monitoring to BMCs created incentives to manipulate quality measurements, especially in villages with social ties to BMC staff, which reduced penalties for adulterated milk and encouraged opportunistic practices [30].

In Indonesia, the CCDP project implemented cooling and processing infrastructure in fishing communities, including basic equipment such as smokehouses and insulated boxes. These investments reduced post-harvest losses by 5%, increased the value of fish sales by 28%, and raised the prices received by beneficiaries by 35%. Fishery productivity rose by 79%, and net fishing income increased by 54.2%. However, limitations persisted in the broader cold chain due to problems with access to ice, electricity, and equipment maintenance, suggesting the need to strengthen these components in future project phases [373].

Finally, a study in Bihar, India, documents (though does not quantify impacts) how potato cold storage facilities have evolved beyond their conservation function. They now act as nodes for marketing, financing, and speculation. About 65.7% of farmers and 94% of commission agents sell their products directly at the cold storage facility, many receiving advance payments— reflecting the use of informal, collateralized credit. This concentration of functions creates new income opportunities but also risks for less-capitalized or less-informed farmers, reinforcing the need for regulation and inclusion in the institutional design of these services [198].

3.2 Transportation

Two studies provide empirical evidence on the impact of transportation-related interventions in agricultural value chains, underscoring their significant potential for improving smallholder incomes while also revealing important adoption constraints.

In China's Guizhou province, transportation services offered by tobacco cooperatives had a strong positive effect on farm income. The evaluation showed that access to cooperative transport services increased annual net income by an average of US$ 670. The income gains stemmed from reduced transportation costs, more timely delivery of perishable tobacco leaves—critical for preserving quality and securing higher prices at government-controlled collection centers—and improved access to market information. The study also found that households were more likely to adopt these services when cooperatives were located nearby and perceived to offer lower service prices [455].

In Nigeria, a pilot refrigerated transport program for tomatoes demonstrated highly positive impacts. In a randomized controlled trial involving 600 traders, refrigerated trucks led to a 112% increase in destination sale prices and a 256% rise in net profits. Post-harvest losses—previously around 20% with traditional transport—were nearly eliminated. Moreover, 70% of the price increase was attributed to quality preservation from refrigeration, while the remaining 29.6% came from access to more profitable markets. Despite these benefits, initial adoption was very low (only 4.67%) due to high costs and lack of infrastructure, highlighting the need for subsidies and certification schemes to support the expansion of such services [164].

3.3 Processing

Two studies offer complementary insights into interventions aimed at strengthening agro- processing among smallholder producers, focusing on Nigeria's cassava sector and Ethiopia's agro-industrial strategy.

In Nigeria, the adoption of improved post-harvest technologies—such as mechanical graters, pressers, and dryers—significantly boosted output and income among smallholder cassava starch processors. The study found that adopters earned about 50% more than traditional processors. Gains stemmed from higher efficiency, reduced labor demands, and better product quality. However, uptake remained limited due to high costs and limited access to credit. Key drivers of adoption included household income, processing experience, and the technology's capacity. The findings suggest that expanding access to affordable technologies through targeted financial support could improve welfare among small-scale processors [380].

In Ethiopia, the Yirgalem Integrated Agro-Industrial Park (YIAIP) illustrates the impact of centralized processing hubs in transforming rural economies. The park has supported value addition in avocado, milk, and coffee, benefiting over 109,000 smallholder farmers through better prices, technical assistance, and access to premium export markets. Some key medium sized companies have helped farmers adopt regenerative practices, obtain organic certification, and improve incomes. The park has also created more than 700 direct and 6,000 indirect jobs, while driving investment in infrastructure and services. Its success reflects effective public-private partnerships, robust infrastructure, and full value chain integration [161].

3.4 Contract Farming

This section draws on one Systematic Review [146] and 35 Impact Evaluations, all focused on contractual arrangements between farmers and buyers across a range of commodities and contexts. The Systematic Review synthesizes 26 quantitative effectiveness studies and conducts a meta-analysis on 13 of them. The Impact Evaluations span Africa, Asia, and Latin America, and include cases from staple crops (e.g., rice, maize) to high-value chains (e.g., honey, vegetables, dairy). The combined evidence confirms that contract farming can deliver positive outcomes for smallholders—but also highlights risks, limitations, and uneven impacts that depend on contract design, farmer selection, and value chain context.

Effects on Income and Food Security

The Systematic Review finds that most contract farming schemes generate income gains for smallholders, although the magnitude of those gains varies depending on the nature of the contract, the commodity, and market conditions. These effects are generally stronger when contracts include bundled services, guaranteed markets, and fair pricing mechanisms.

This is confirmed by a number of evaluations. In Ethiopia, a program linking smallholders to beer companies increased incomes through improved barley prices, quality, and yields [168]. In Uganda, quality-based incentives and access to export markets also led to measurable income gains and spillover productivity benefits [76]. Nepalese farmers working under contracts in remote areas reported a 58% increase in net income [83].

Not all cases were positive. In Vietnam, contract farmers saw no short-term income gains, though they experienced fewer production difficulties and anticipated future improvements [175]. In Kenya, a contract farming initiative initially raised income by 32%, but ultimately collapsed due to quality compliance failures, resulting in long-term disengagement and income loss [60].

Several evaluations also highlight inequality in outcomes. In Indonesia, wealthier and better-connected farmers benefited disproportionately from contracts, while poorer households were left behind [53]. In Senegal, productivity-oriented contracts increased incomes but at the expense of food consumption diversity, while marketing contracts reduced food insecurity [140]. The SR flags these trade-offs and stresses the need to assess both income and food security impacts simultaneously.

Bundled Services and Coordination

The SR emphasizes that bundled services—such as access to inputs, credit, extension, and logistical support—are essential to making contracts effective, especially for smallholders. Their presence often explains the difference between successful and failed schemes.

Evidence from Ethiopia supports this claim: honey producers engaged in contracts benefitted from improved technology access, which in turn raised product quality and yields [7]. In Vietnam, contract farmers increased input use by 12% and achieved corresponding output gains [132]. In Kenya, a study found that farmers exposed to supermarket channels used more fertilizer even on non-contracted crops, showing spillover effects [199].

Participation and Inclusion

The SR documents that better-off, more educated or market-oriented farmers are more likely to participate in contracts, often excluding vulnerable or resource-poor producers. However, some programs have actively promoted inclusion.

In Ghana, participation in rice contracts was higher among educated farmers, and those producers also reported greater gains in yield and gross margins [172]. In Senegal, contracts managed by women achieved stronger seasonal delivery outcomes in dairy production [22]. In Colombia, the PAAP program successfully linked smallholders—including vulnerable groups—to markets with similar performance across categories [180].

Conversely, a study in Nicaragua showed that supermarket contracts favored farmers in already well-endowed regions, highlighting geographic inequities [98].

Enforcement, Risk, and Power Asymmetries

The SR stresses that weak enforcement, opportunism, and unbalanced power dynamics frequently undermine the benefits of contract farming. Informal arrangements, unclear terms, or lack of legal recourse can lead to side-selling, payment delays, or breach of contract.

In Ghana, written and verbal contracts outperformed spot market transactions, improving rice farm performance through increased predictability [169]. In Madagascar, contract farming reduced income volatility by 0.2 standard deviations, acting as a form of partial insurance [170].

However, not all contract innovations yield results. In Zambia, efforts to improve market access through interlocked contracts failed to produce measurable income or milk revenue gains, despite the logistical improvements [177]. This echoes the SR's point that formalization alone is not enough: design, transparency, and enforcement capacity matter.

Conclusion

Contract farming, when well-designed and supported, can improve income, productivity, and market access for smallholders. But impact is uneven and context-specific. As confirmed by both the SR and the curated Impact Evaluations, the presence of bundled services, inclusive recruitment strategies, enforceable contracts, and local institutional support are all key determinants of success. Without these, contracts risk excluding vulnerable farmers or exposing them to new forms of insecurity.

3.5 Intermediation/Wholesale

Intermediaries —whether informal traders, aggregators, or formal wholesalers—are central to the functioning of agrifood value chains. They facilitate the flow of goods, credit, and information between producers and downstream markets. Despite this critical role, they are often overlooked in policy and research or portrayed as extractive. A review by Reardon [166] argues that intermediaries should instead be seen as adaptive actors that co-evolve with growing markets. This view is supported by evidence from Myanmar's maize value chain, where wholesalers provided tied credit without distorting prices, operated competitively, and developed in tandem with logistics providers [159]. At the same time, many intermediaries continue to face structural vulnerabilities, operating informally, with limited access to finance and high exposure to risk [158].

Impacts of Public Goods and Technology

Several interventions have attempted to reshape the producer–intermediary relationship by strengthening public goods or enabling access to market-supporting technologies. In India, the construction of the North-South-East-West (NS-EW) highway corridor raised rice prices in nearby markets by 4%, suggesting that improved infrastructure reduced intermediation costs and increased competition [119]. In a different context, smallholder vegetable growers in peri-urban Kenya who adopted irrigation technologies gained greater access to markets, reduced dependence on farm-gate sales, and increased their bargaining power relative to intermediaries. However, these benefits were unevenly distributed, favoring male-headed households and those with off- farm income [438]. By contrast, an information-based intervention in West Bengal that provided farmers with daily wholesale prices failed to reduce intermediary margins; in some cases, it even led to lower farm-gate prices. This highlights that information alone may not be sufficient when farmers lack physical access to alternative buyers and remain structurally dependent on local traders [456].

Removing Intermediaries

Some reforms have sought to bypass intermediaries altogether, with mixed results. In Turkey, a policy change allowed farmers to sell directly to retailers, bypassing wholesale markets. This led to a significant drop in wholesale prices, but retail prices remained unchanged—suggesting that retailers absorbed the margins, and consumers saw no benefit [18]. This case supports Reardon's warning: removing intermediaries without addressing scale, coordination, and transaction complexity may simply shift market power rather than improve outcomes for producers or consumers.

Improving Wholesale Systems

Instead of eliminating intermediaries, the most promising strategies focus on modernizing and integrating them. India's Unified Market Platform (UMP), a digital marketplace linking wholesale markets across the state, led to 3–5% increases in modal prices for key crops and improved farmer profitability—especially for higher-quality producers [89]. This case illustrates how investments in bidding systems, price transparency, and logistical coordination can enhance both efficiency and equity. As Reardon argues, upgrading the institutional and physical infrastructure of intermediation—rather than liberalizing markets without safeguards—is a more effective path to system-wide improvement.

Conclusion

Intermediaries—whether formal or informal—are not residual or peripheral actors. They are integral to how agrifood systems function and evolve. The challenge for policy is not to bypass or displace them, but to modernize, regulate, and support them as part of inclusive and efficient value chains. Intermediation reforms that combine infrastructure investment, institutional innovation, and coordinated logistics offer the most promise for equitable and sustainable food system transformation.

3.6 Multi-Stakeholder Partnerships

Multi-stakeholder partnerships (MSPs) have become instrumental in driving agricultural development across the Global South. A systematic review of 147 studies reveals both their transformative potential and persistent challenges, offering valuable lessons for sustainable development. [94]

At their best, MSPs create powerful synergies between farmers, markets, and technology. In Ecuador, coffee farmers in MSPs secured 30% higher prices, while Rwandan dairy producers achieved remarkable 900% price increases through quality improvements and collective bargaining. Technological adoption flourished where solutions matched local needs - Rwandan potato yields tripled with improved varieties and storage, while Filipino rice farmers cut irrigation costs by 39% through water-saving techniques.

The social impacts are equally noteworthy. Women farmers in India gained economic independence and confidence through mushroom-production collectives, while Nigerian cassava growers doubled their access to extension services. These platforms excel at building social capital, though their effectiveness diminishes when they become overly complex or bureaucratic.

However, significant gaps remain. Environmental outcomes are strikingly underreported, with only 21 studies measuring ecological impacts. While successes like Burkina Faso's 82% adoption of soil conservation practices exist, many MSPs prioritize short-term economic gains over sustainability. Geographic imbalances in research - with 67% of studies focused on Africa - leave critical knowledge gaps about MSP effectiveness elsewhere.

The evidence suggests MSPs work best when they: 1) combine technical solutions with market access, 2) maintain manageable scales, and 3) remain responsive to local contexts. As these partnerships evolve, addressing equity concerns, environmental trade-offs, and regional knowledge gaps will be crucial for achieving truly sustainable agricultural transformation.

3.7 Commercialization (Other)

Quality Incentives and Loss Reduction

Evidence from Guatemala, Honduras, and Ghana suggests that market-based quality incentives can reduce post-harvest losses and improve agricultural practices, though effects on income or prices are not always consistent.

In Guatemala and Honduras, a pilot program that provided information on buyer-required quality attributes reduced bean losses by 6% to 7% [367]. The study argues that such incentives may be more effective than simply providing inputs, as they align production practices with commercial standards.

In Ghana, a combination of training, the distribution of drying tarpaulins, and a price premium for quality led to a significant reduction in aflatoxin levels in groundnuts [385]. Improvements were greatest in households with young children and initially high contamination levels, although price incentives did not lead to statistically significant income gains.

Direct Sales and Commercial Linkages

Promoting more direct linkages between small producers and markets—through institutional buyers, specialized trade, or associative schemes—can improve income, product quality, and production practices, although impacts on food security are mixed.

In Colombia, a pilot program for producers in areas at risk of illicit crop cultivation facilitated the marketing of alternative products, resulting in increased total sales and improved product quality [130]. Impacts were stronger when combined with complementary programs.

In Ecuador, small cocoa producers linked to direct trade schemes accessed better prices, technical training, stronger social networks, and more sustainable practices [182]. However, overlap with organic certification schemes made it difficult to isolate the specific effects of direct trade.

In Tanzania, farmers integrated into value chains through cooperatives or contracts obtained higher prices and greater agricultural income [195]. Nonetheless, these benefits did not translate into significant improvements in food security, suggesting that additional income does not automatically lead to better nutrition or well-being outcomes.

Agricultural Clusters (Ethiopia)

In recent years, the Government of Ethiopia has promoted a national cluster farming strategy aimed at transforming smallholder agriculture from subsistence-based to market-oriented systems. This policy seeks to geographically organize producers around high-potential crops, facilitating access to inputs, mechanization, extension services, and markets. The approach prioritizes collective action, economies of scale, and integration into value chains. Clusters have been implemented across different regions and commodities, including teff, malt barley, and horticultural crops, with the goal of boosting productivity, commercialization, and farmer incomes.

Evidence from the evaluation of teff clusters shows clearly positive results. Farmers who participated in cluster farming reported significantly higher levels of commercialization compared to non-participants, across all priority regions where the program was implemented. The findings indicate that the clustering approach effectively facilitated market access and strengthened producer integration into the value chain, with clear benefits in terms of increased sales and income [330].

Similarly, in the case of malt barley, the cluster approach also yielded positive outcomes. Farmers involved in barley clusters achieved higher yields per hectare and had better access to markets and agricultural services. The study concludes that expanding barley cluster farming could contribute to national goals for increased production and reduced reliance on imports of malt barley, which is in high domestic demand [333].

In contrast, the evidence from horticultural clusters is more mixed. While some farmers benefited from improved production practices and support structures, the evaluation found inconsistent effects on commercialization and income generation. The outcomes varied depending on the crop and the quality of local implementation, suggesting that cluster effectiveness is contingent on contextual factors and the strength of institutional support [143].

3.8 Food Retail

Despite the importance of food retail in shaping food systems in low- and middle-income countries, rigorous impact evaluations of interventions in this segment remain extremely limited. Among the few studies available, only four were identified that meet minimum standards for methodological robustness, each focusing on different aspects of retail reform—from producer access to markets, to vendor behavior, and pricing outcomes.

In Colombia, the Mercados Campesinos initiative (2004–2015) sought to improve smallholder access to urban food markets through biweekly farmers' markets in Bogotá. The program enabled direct sales to consumers, improved price-setting capacity, and fostered organizational and political engagement among participants. Quantitative and qualitative analyses found modest but meaningful gains in commercialization and economic efficiency—particularly within the program's controlled spaces. However, these benefits did not extend far beyond the created markets, and the initiative struggled to achieve financial sustainability [129].

Turkey's 2012 supply chain reform provides evidence from a national-level intervention targeting the interface between wholesale and retail. By legalizing direct sales from farmers to retailers and reducing transaction costs, the reform aimed to eliminate informal intermediaries and improve supply chain efficiency. Using a regression discontinuity design, the study found that wholesale prices for fruits and vegetables fell by 22–28%. Yet these reductions did not pass through to retail prices, likely due to the market power of dominant retail chains. Thus, while the reform increased traceability and competition at the intermediary level, its benefits did not reach consumers directly [18].

Two other studies examine interventions at the informal vendor level. In Bogotá, a pilot mobile- based ordering and delivery system connected small fruit and vegetable vendors directly to farmers. The system reduced vendors' travel time and input costs, improving profit margins. Nonetheless, most vendors abandoned the service within a year due to limited product variety and a preference for traditional sourcing practices, revealing significant challenges in scalability and adoption [69]. In Kolkata, a food safety training program for street food vendors improved hygiene knowledge but had minimal impact on observed behavior or economic outcomes. The absence of consumer demand for safer food and the perceived costs of hygienic improvements limited the intervention's effectiveness [43].

3.9 Hidden Middle-related interventions: Summary

Number of studies found, by intervention category and type of impact*

Intervention	Impact assessment			Total
	Positive	Mixed/ Inconclusive	Null/ Negative	
Hidden Middle				
Value chain	4 (4)	2 (2)		6
Storage	2	1		3
Cold storage		1		1
Cold transport	1			1
Transportation	2			2
Processing	1			1
Processing + [Storage, Cold storage]	1	1		2
Contract farming	26	6 (1)	1	33
Contract farming + [Training, Storage, Commercialization, Organization]	3	1		4
Wholesale/Intermediation	1		1	2
Wholesale + [Commercialization, Retail]	1	1		2
Multi-Stakeholder partnerships	2	2		4
Direct sales	2	1		3
Price incentives	1	1		2
Clusters	1	1		2
Food retail	1	2	1	4

* Number of systematic reviews in parentheses.
Note: Each study could be included in more than one intervention category.
Own elaboration

4. CONCLUSIONS

The review of impact evaluations and systematic reviews conducted in this report reveals a markedly uneven distribution of rigorous empirical evidence across both broad domains and specific categories of intervention. The majority of studies concentrate on interventions targeting producers, with particularly high density in subtopics such as training, input provision, and small-scale irrigation. In contrast, the domain of public goods—notably rural roads, electrification, and large- scale irrigation—shows fewer studies but with relatively consistent patterns of evaluation. The most underrepresented domain is the hidden middle, which includes critical midstream and downstream activities such as storage, processing, transport, intermediation, and retail. Even within this domain, the available evidence is heavily skewed: for example, almost half of the studies classified under the hidden middle relate exclusively to contract farming, leaving most other components with only one or two impact evaluations or none at all.

The density of evidence within producer-focused interventions is not only greater but also more diversified in terms of geographical and methodological coverage. This reflects longstanding policy and research priorities that emphasize improving smallholder productivity and market access. However, it also suggests an important limitation: evaluations of interventions that support post-harvest activities, food distribution, and rural enterprise development remain scarce. This narrow scope constrains our understanding of how to strengthen the full agrifood value chain, particularly in countries where off-farm segments are growing in importance.

Despite these gaps, the review identifies a set of interventions with strong and relatively consistent positive impacts on agricultural production, income, and household welfare. Public investment in rural roads stands out as a foundational enabler, with multiple studies showing effects on input use, productivity, income diversification, and market participation. Although results are context-specific, the direction and magnitude of impact are generally positive. Rural electrification also shows robust effects—not only by enabling income-generating activities but also by enhancing access to storage, agro-processing, and ICT-based services.

Among producer-oriented interventions, small-scale irrigation has demonstrated highly consistent effects on yields and income, especially when schemes are participatory and include training or market access components. Similarly, input support programs—such as improved seed distribution or fertilizer subsidies—can lead to significant productivity gains, although their effectiveness depends strongly on proper targeting, availability of complementary services, and timing. Training emerges as a particularly flexible and effective intervention: when linked to good-quality information, demonstrations, or advisory support, training can improve farming practices, reduce post-harvest losses, and promote commercialization. These gains are magnified when training is bundled with access to inputs, credit, or aggregation services.

The review also highlights categories where evidence is growing but still insufficient for broad generalization. ICT-based information services, for example, show potential to enhance decision-making and market access but suffer from design challenges and low adoption when deployed as standalone tools. Similarly, inventory credit schemes and value chain integration efforts— including outgrower models and cluster initiatives—offer promising results in some settings but require more evaluations that isolate their effects and account for institutional heterogeneity. In many of these cases, a key constraint to effectiveness is the absence of supportive ecosystems: interventions that rely on infrastructure, coordination, or sustained private sector engagement often underperform when implemented in isolation or without attention to local conditions.

Most critically, the review finds a substantial evidence gap in interventions targeting the midstream and downstream segments of agrifood systems. Very few impact evaluations directly assess programs aimed at strengthening private storage, processing enterprises, transport services, intermediation platforms, or food retail networks. Where studies do exist, they are often limited in scope, or analyze outcomes only in terms of producer behavior. This persistent neglect of the hidden middle in both research and policy programming is especially concerning given that these segments are responsible for an increasing share of value added and employment in transforming agrifood systems. Moreover, they often serve as the connective tissue linking smallholders to markets and consumers—especially in urbanizing contexts.

In conclusion, the existing body of evidence provides useful guidance on which interventions can improve productivity and welfare at the producer level, and confirms the foundational importance of infrastructure investment. However, the limited coverage of midstream and downstream interventions highlights a critical blind spot that undermines efforts to build inclusive and resilient agrifood systems. Future research and evaluation efforts should prioritize filling this gap —not only to broaden our empirical understanding—, but also to inform the design of strategies that leverage the full potential of agrifood systems to support rural transformation, employment, and food security.

REFERENCES

Abass, A. B., Fischler, M., Schneider, K., Daudi, S., Gaspar, A., Rüst, J., & Kabula, E. (2018). On- farm comparison of different postharvest storage technologies in a maize farming system of Tanzania central corridor. Journal of Stored Products Research, 77, 55–65. [1]

Abera, D., Bijman, J., Slingerland, M., Van Der Velde, G., & Onno Omta, P. (2018). Beer multinationals enhance agricultural commercialization in Africa: Empirical evidence from Ethiopia. Ethiopian Economics and Ethiopian Strategy S (ESSP) of, 182. [168]

Acheampong D; Balana, Bedru B.; Nimoh, Fred; Abaidoo, Robert C. (2018). Assessing the Effectiveness and Impact of Agricultural Water Management Interventions: the Case of Small Reservoirs in Northern Ghana. Agricultural Water Management. [411]

Adejumo, O., Okoruwa, V., & Abass, A. (2018). Improved post-harvest technology: What impact on Nigeria's smallholder cassava starch processors welfare? International Conference of Agricultural Economists (ICAE) 2015. [380]

Adong, A., Ambler, K., & Jones, K. (2022). Financial needs of intermediary firms in agri-food value chains: Evidence from Uganda. International Food Policy Research Institute (IFPRI). [158]

Aggarwal, S. (2018). Do rural roads create pathways out of poverty? Evidence from India. American Economic Journal: Applied Economics, 10(3), 1–36. (ID 3)

Ainembabazi, John Herbert; Abdoulaye, Tahirou; Feleke, Shiferaw; Alene, Arega; Dontsop- Nguezet, Paul M.; Ndayisaba, Pierre Celestin; Hicintuka, Cyrille; Mapatano, Sylvain; Manyong, Victor (2018). Who benefits from which agricultural research-for-development technologies? Evidence from farm household poverty analysis in Central Africa. World Development. [404]

Akoyi, Kevin Teopista; Maertens, Miet (2018). Walk The Talk: Private Sustainability Standards In The Ugandan Coffee Sector. Journal of Development Studies . [4]

Aku, A., Mshenga, P., Afari-Sefa, V., & Ochieng, J. (2018). Effect of market access provided by farmer organizations on smallholder vegetable farmer's income in Tanzania. Cogent Food & Agriculture, 4 (1), 1560596. https://doi.org/10.1080/23311932.2018.1560596 [5]

Akudugu, Mamudu; Nyamadi, Ben Vas; Dittoh, Saa (2016). Transforming Smallholder Agriculture in Africa Through Irrigation: An Assessment of Irrigation Impact Pathways in Ghana. Not specified. [440]

Alemnew, T., & Taffesse, A. S. (2025). Integrated agro-industrial parks in Ethiopia: Status, success and challenges. National Policies and Strategies Initiative Working Paper. [161]

Alemu, A. E., & Adesina, J. (2015). Effects of cooperatives and contracts on rural income and production in the dairy supply chains: Evidence from Northern Ethiopia. African Journal of Agricultural and Resource Economics, 10 (4), 1–16. https://doi.org/10.22004/ag.econ.229812 [6]

Alemu, A. E., Maertens, M., Deckers, J., Bauer, H., & Mathijs, E. (2016). Impact of supply chain coordination on honey farmers' income in Tigray, Northern Ethiopia. Agricultural and Food Economics, 4 (9), 1–21. https://doi.org/10.1186/s40100-016-0053-x [7]

Ali, R., Barra, A. F., Berg, C., Damania, R., Nash, J. D., & Russ, J. (2015). Transport infrastructure and welfare: An application to Nigeria. World Bank Policy Research Working Paper No. 7271. (ID 8)

Amadu, Festus O.; McNamara, Paul E (2019). Performance Incentives and Information Communication Technologies in Ugandan Agricultural Extension Service Delivery. African Journal of Food, Agriculture, Nutrition and Development. [9]

Amadu, Festus O.; McNamara, Paul E. (2024). Do Agricultural Stakeholder Panels Enhance Post-Harvest Loss Reduction? Evidence from Malawi. Agriculture & Food Security. [452]

Ambler, Kate; de Brauw, Alan; Godlonton, Susan (2017). Cash Transfers And Management Advice For Agriculture: Evidence From Senegal. IFPRI Discussion Paper Series. [10]

Anand, Paul; Saxena, Swati; Gonzalez, Rolando; Dang, Hai-Anh, H. (2019). Can Women's Self- Help Groups Contribute To Sustainable Development? Evidence Of Capability Changes From Northern India. World Bank Policy Research Working Paper. [11]

Andersson, C. I.; Chege, C. G.; Rao, E. J.; Qaim, M. (2015). Smallholder farmers and supermarkets in Kenya. American Journal of Agricultural Economics. [196]

Anh Tru Nguyen (2020). Does Contract Farming Enhance Income of Farmers? Evidence in Tea Production of Vietnam. Journal of Agricultural Sciences - Sri Lanka. [12]

Aramburu, Julián; Flores, Mario González; Salazar, Lina; Winters, Paul (2014). When A Short- Term Analysis Is Not A Short-Term Approach: Impacts Of Agricultural Technology Adoption In Bolivia. IDB Working Paper Series. [13]

Aramburu, Julián; Garone, Lucas Figal; Maffioli, Alessandro; Salazar, Lina; Lopez, Cesar Augusto (2019). Direct And Spillover Effects Of Agricultural Technology Adoption Programs: Experimental Evidence From The Dominican Republic. Inter-American Development Bank (IDB) Working Paper Series. [414]

Ariane, Zingiro; Okello, Julius; Guthiga, Paul (2012). An Assessment Of The Impact Of Rainwater Harvesting Ponds On Farm Income In Rwanda. 8th AFMA Congress Peer Reviewed Papers. [407]

Arouna, Aminou; Michler, Jeffrey D.; Lokossou, Jourdain C. (2021). Contract Farming And Rural Transformation: Evidence From A Field Experiment In Benin. Journal of Development Economics. [14]

Arouna, Aminou; Yergo, Wilfried G.; Saito, Kazuki; Michler, Jeffrey D. (2021). One Size Fits All? Experimental Evidence on the Digital Delivery of Personalized Extension Advice in Nigeria. American Journal of Agricultural Economics. [15]

Arslan, Cansın; Wollni, Meike; Oduol, Judith; Hughes, Karl (2022). Who Communicates the Information Matters for Technology Adoption. World Development. [16]

Asher, S., & Novosad, P. (2018). Rural roads and local economic development. NBER Working Paper No. 24891. (ID 17)

Asian Development Bank (ADB). (2020). Effects of access to electricity interventions on socioeconomic outcomes in low- and middle-income countries (Independent Evaluation SR-01). Manila: ADB. [190]

Aslihan, Arslan; Daniel, Higgins; Fabrizio, Bresciani (2018). Irrigated Rice Production Enhancement Project (IRPEP): Philippines. IFAD. [428]

Awal, Abdul-Rahaman; Abdulai, Awudu(2019). Vertical Coordination Mechanisms and Farm Performance. Agribusiness. [169]

Aysoy, C., Kirli, D. H., & Tumen, S. (2015). How does a shorter supply chain affect pricing of fresh food? Evidence from a natural experiment. Food Policy, 57, 104–113. [18]

Basu, K., & Wong, M. (2015). Evaluating seasonal food storage and credit programs in East Indonesia. Journal of Development Economics, 115, 200–216. [19]

Bellemare, Marc F.; Lee, Yu Na; Novak, Lindsey (2021). Contract farming as partial insurance. World Development. [170]

Belton, B., Cho, A., Hall, M., Minten, B., & Reardon, T. (2025). Wholesalers and Myanmar's maize value chain transformation. Applied Economic Perspectives and Policy, 47(1), 125–153. [159]

Benali, Marwan (2017). Export Vegetable Supply Chains and Poverty Effects. Thesis. [171]

Bensch, G., Munyehirwe, A., Peters, J., & Sievert, M. (2016). Effects and mechanisms of market- based reforms on access to electricity in developing countries (3ie Systematic Review 31). London: International Initiative for Impact Evaluation (3ie). [184]

Berdegué, Julio A.; Trivelli, Carolina; and Vos, Rob. 2025. Employment impacts of agrifood system innovations and policies: A review of the evidence. Global Food Security 44. [160]

Bergquist, Lauren Falcao; Mcintosh, Craig (2021). Search Cost, Intermediation, and Trade: Experimental Evidence from Ugandan Agricultural Markets. Center for Effective Global Action (CEGA) Working Paper Series . [21]

Bernard, Tanguy; Hidrobo, Melissa; Le Port, Agnes; Rawat, Rahul (2019). Nutrition-Based Incentives in Dairy Contract Farming in Northern Senegal. American Journal of Agricultural Economics. [22]

Berthelemy, J.-C., & Millien, A. (2018). Impact of decentralized electrification projects on sustainable development: A meta-analysis (Documents de travail du Centre d'Économie de la Sorbonne). Paris: Université Paris 1 Panthéon-Sorbonne. [185]

Bezabeh, Addisu; Beyene, Fekadu; Haji, Jema; Lemma, Tesfaye(2020). Impact of contract farming on income of smallholder malt barley farmers in Arsi and West Arsi zones of Oromia region, Ethiopia. Cogent Food & Agriculture. [23]

Bhandari, H., Chakravorty, U., Habib, M. A., & Emerick, K. (2022). Targeted subsidies for water conservation in smallholder agriculture: Evidence from Bangladesh. American Journal of Agricultural Economics, 104(5), 1623–1647. https://doi.org/10.1111/ajae.12287 [435]

Bidzakin, John Kanburi; Fialor, Simon C.; Awunyo-Vitor, D.; Yahaya, I. (2019). Impact of Contract Farming on Rice Farm Performance. Cogent Economics & Finance. [172]

Bijarniya, Deepak; Parihar, C.M.; Jat, R.K.; Kalvania, Kailash; Kakraliya, S.K.; Jat, M.L. (2020). Portfolios of climate smart agriculture practices in smallholder rice-wheat system of eastern Indo-Gangetic Plains - crop productivity, resource use efficiency and environmental foot prints. Agronomy. [432]

Bishop, D. (2012). Effectiveness Review: Copperbelt Livelihoods Project, Zambia. Oxfam GB. [25] Boucher, Stephen R.; Carter, Michael R.; Flatnes, Jon Einar; Lybbert, Travis J.; Malacarne, Jonathan G.; Marenya, Paswel; Paul, Laura A. (2021). Bundling Genetic and Financial Technologies for More Resilient and Productive Small-scale Agriculture. NBER Working Paper Series. [309]

Bizikova, L., Nkonya, E., Minah, M., Hanisch, M., Turaga, R. M. R., Speranza, C. I., Karthikeyan, M., Tang, L., Ghezzi-Kopel, K., Kelly, J., Celestin, A. C., & Timmers, B. (2020). A scoping review of the contributions of farmers' organizations to smallholder agriculture. Nature Food, 1 (10), 620–630. https://doi.org/10.1038/s43016-020-00164-x [462]

Blackmore, E., Vorley, B., & Molenaar, J. W. (2012). Sustainable agriculture: Impact of certification on smallholder farmers in developing countries. IIED. [117]

Blankespoor, B., Emran, M. S., Shilpi, F., & Xu, L. C. (2022). Bridge to big push or backwash? Market integration, reallocation, and productivity effects of Jamuna Bridge in Bangladesh. Journal of Development Economics, 158, 102901. (ID 26)

Bodnár, Ferko; Piters, Bart de Steenhuijsen (2011). Improving Food Security: A Systematic Review Of The Impact Of Interventions In Agricultural Production, Value Chains, Market Regulation, And Land Security. Ministry of Foreign Affairs, The Netherlands, No. 363. [27]

Bonjean, Isabelle (2019). Innovation Adoption and Segmented Markets. Food Policy. [173]

Boucher, Stephen R.; Carter, Michael R.; Flatnes, Jon Einar; Lybbert, Travis J.; Malacarne, Jonathan G.; Marenya, Paswel; Paul, Laura A. (2021). Bundling Genetic and Financial Technologies for More Resilient and Productive Small-scale Agriculture. NBER Working Paper Series. [309]

Brander, M., Bernauer, T., & Huss, M. (2021). Improved on-farm storage reduces seasonal food insecurity of smallholder farmer households – Evidence from a randomized control trial in Tanzania. Food Policy, 98, 102093. [29]

Breza, Emily; Chandrasekhar, Arun G.; Shenoy, Ashish (2012). Skimming Off The Top: The Unintended Consequences Of Market Expansion In The Indian Dairy Industry. Working paper, Agricultural Technology Adoption Initiative (ATAI). [30]

Burke, M., Bergquist, L. F., & Miguel, E. (2018). Sell low and buy high: Arbitrage and local price effects in Kenyan markets. Quarterly Journal of Economics, 133(2), 785–842. [186]

Burney, Jennifer A.; Naylor, Rosamond L. (2011). Smallholder Irrigation as a Poverty Alleviation Tool in Sub-Saharan Africa. World Development. [434]

Byiringiro, Esdras; Jones, Maria; Kondylis, Florence; Loeser, John; Magruder, Jeremy; Ndahimana, Christophe (2020). Impacts, maintenance and sustainability of irrigation in Rwanda. 3ie Series Report. [427]

Campenhout, Bjorn Van (2021). The Role of Information in Agricultural Technology Adoption: Experimental Evidence from Rice Farmers in Uganda. Economic Development and Cultural Change. [31]

Casaburi, L., Glennerster, R., Suri, T., & Kamara, S. (2014). Providing collateral and improving product market access for smallholder farmers: A randomized evaluation of inventory credit in Sierra Leone. 3ie Impact Evaluation Report 17. International Initiative for Impact Evaluation (3ie). [32]

Cavatassi, R., González-Flores, M., Winters, P., Andrade-Piedra, J., Espinosa, P., & Thiele, G. (2016). Linking smallholders to the new agricultural economy: The case of the plataformas de concertación in Ecuador. In A. Devaux, M. Torero, J. Donovan, & D. Horton (Eds.), Innovation for inclusive value-chain development: Successes and challenges (pp. 375–410). International Food Policy Research Institute (IFPRI). [33]

Cavatassi, R., Mabiso, A., & Brueckmann, P. (2019). IFAD Impact Assessment: The Coastal Community Development (CCDP). IFAD. [373]

Channa, H., Ricker-Gilbert, J., Feleke, S., & Abdoulaye, T. (2022). Overcoming smallholder farmers' post-harvest constraints through harvest loans and storage technology: Evidence from Nigeria. Journal of Development Economics, 156, 102–118. [35]

Charlery, L. C., Qaim, M., & Smith-Hall, C. (2015). Impact of infrastructure on rural household income and inequality in Nepal. Journal of Development Effectiveness, 7(4), 463–486. (ID 36)

Charles, A. U. P. (2010). Rural roads, education, and agriculture: Trinidad and Tobago. The Journal of Developing Areas, 43(2), 45–61. (ID 37)

Cheffo, A., Shumeta, Z., Mehare, A., Ketema, M., & Habte, E. (2023). Impact of malt-barley commercialization clusters on productivity at household level: The case of selected districts of Oromia region, Ethiopia. Journal of Economics and Sustainable Development, 33(1), 35–48. [333]

Chegere, M. J., Eggert, H., & Söderbom, M. (2022). The effects of storage technology and training on postharvest losses, practices, and sales. Economic Development and Cultural Change, 70(2), 729–761. [39]

Chegere, Martin Julius; Lokina, Razack; Mwakaje, Agnes G. (2020). The impact of hermetic storage bag supply and training on food security in Tanzania. Food Security. [399]

Cohen Craig R; Weke Elly; Frongillo Edward A; Sheira Lila A; Burger Rachel; Mocello Adrienne Rain; Wekesa Pauline; Fisher Martin; Scow Kate; Thirumurthy Harsha; Dworkin Shari L; Shade Starley B; Butler Lisa M; Bukusi Elizabeth A; Weiser Sheri D (2022). Effect of a Multisectoral Agricultural Intervention on HIV Health Outcomes Among Adults in Kenya: A Cluster Randomized Clinical Trial. JAMA Network Open. [316]

Daidone Silvio, Benjamin Davis, Joshua Dewbre, Borja Miguelez, Ousmane Niang, Luca Pellerano (2017). Linking agriculture and social protection for food security: The case of Lesotho. Global Food Security. [42]

Dallmann, Diana; Marquis, Grace S.; Colecraft, Esi K.; Kanlisi, Roland; Aidam, Bridget A (2022). Maternal Participation Level in a Nutrition-Sensitive Agriculture Intervention Matters for Child Diet and Growth Outcomes in Rural Ghana. Current Developments in Nutrition. [337]

Daniele, G., Mookerjee, S. & Tommasi, D. (2018). Informational Shocks and Street-Food Safety: A Field Study in Urban India. The Review of Economics and Statistics, 1-47. [43]

de Castro, André Bueno Rezende (2021). Impact of Agricultural Market Linkages on Small-scale Farmers' Welfare: Evidence from Tanzania. ZEF-Discussion Papers on Development Policy. [45]

Del Prete, D., Ghins, L., Magrini, E., & Pauw, K. (2019). Land consolidation, specialization and household diets: Evidence from Rwanda. Food Policy, 83, 139–149. https://doi.org/10.1016/j.foodpol.2018.12.007 [46]

Delavallade, C., & Godlonton, S. (2015). The impact of inventory credit on food security and rural livelihoods in Burkina Faso. World Bank Policy Research Working Paper 7301. [47]

Delgado, L., Nakasone, E., & Torero, M. (2021). Can input access and market-based incentives reduce food loss? The case of bean farmers in Guatemala and Honduras (IFPRI Discussion Paper No. 02047). International Food Policy Research Institute (IFPRI). [367]

Dercon, S., Gilligan, D. O., Hoddinott, J., & Woldehanna, T. (2009). The impact of agricultural extension and roads on poverty and consumption growth in fifteen Ethiopian villages. American Journal of Agricultural Economics, 91(4), 1007–1021. (ID 48)

Dumas, C., & Jativa, X. (2025). Better roads, better off? Evidence on improving roads in Tanzania. Unpublished manuscript. (ID 49)

Dyer, Julian; Shapiro, Jeremy (2023). Pumps, Prosperity and Household Power: Experimental Evidence on Irrigation Pumps and Smallholder Farmers in Kenya. Journal of Development Economics. [433]

Dzanku, F. M.; Osei, R. D. (2018). Impact of pre– and post-harvest training reminders on crop losses and food poverty in Mali. IAAE Conference. [51]

Ebata, Ayako; Hüttel, Silke (2015). Do Development Projects Link Smallholders To Markets?. GlobalFood Discussion Papers. [52]

Eko Ruddy Cahyadi; Hermann Waibel (2013). Is Contract Farming in the Indonesian Oil Palm Industry Pro-poor? Journal of Southeast Asian Economies . [53]

Endalew, B., Elias, A., & Yasunobu, K. (2024). Impact of cluster farming on smallholder farmers teff commercialization in Ethiopia. CABI Agriculture and Bioscience, 5(1), 18. [330]

Francesconi, G. N., & Ruben, R. (2012). The hidden impact of cooperative membership on quality management. Journal of Entrepreneurial and Organizational Diversity, 1(1), 85–103. [54]

Fred Mawunyo Dzanku; Robert Osei; Isaac Osei-Akoto (2021). The impact of mobile phone voice message reminders on agricultural outcomes in Mali. Agricultural Economics. [344]

Gaddis, I., & Pieters, J. (2014). The gendered labor market impacts of trade liberalization: Evidence from Brazil (World Bank Policy Research Working Paper No. 7095). World Bank. [55]

Garbero, Alessandra; Diatta, Dieynab; Olapade, Markus (2018). Agricultural Value Chains Support Project (PAFA): Senegal. IFAD Impact Assessment Series. [56]

Garbero, Alessandra; Marion, Pierre; Brailovskaya, Valentina (2018). The Impact of the Adoption of CGIAR's Improved Varieties on Poverty and Welfare Outcomes. IFAD Research Series. [57]

Gebrehaweria Gebregziabher; Regassa E Namara; Stein Holden (2012). Technical Efficiency of Irrigated and Rain-Fed Smallholder Agriculture in Tigray, Ethiopia: A Comparative Stochastic Frontier Production Function Analysis. Quarterly Journal of International Agriculture. [436]

Gehrke, E. (2019). An employment guarantee as risk insurance? Assessing the effects of the NREGS on agricultural production decisions. The World Bank Economic Review, 33(2), 413–434. [58]

Ghosh, Saikat; Taron, Avinandan; Williams, Frances (2019). The Impact of Plant Clinics on the Livelihoods of Bangladeshi Farmers. CABI Study Brief. [59]

Gilligan, Daniel O.; Karachiwalla, Naureen; Thai, Giang (2019). An Evaluation of the Impact of E-Verification on Counterfeit Agricultural Inputs and Technology Adoption in Uganda. USAID. [365]

Gine, Xavier; Dean Karlan; Nava Ashraf (2008). Finding missing markets (and a disturbing epilogue): Evidence from an export crop adoption and marketing intervention in Kenya. World Bank Publications. [60]

Giordano, M.; Namara, R.; Bassini, E. (2019). The Impacts of Irrigation: A Review of Published Evidence. World Bank Group. [187]

Girma, Jony; Gardebroek, Cornelis (2015). The Impact of Contracts on Organic Honey Producers' Incomes in Southwestern Ethiopia. Forest Policy and Economics. [61]

Guerrero-Ortiz, P. L., Leos-Rodríguez, J. A., Palacio-Muñoz, V. H., & Ocampo-Ledesma, J. G. (2023). Guaranteed prices and their effects on small-scale farms in Mexico. Agricultura, Sociedad y Desarrollo, 20(2). [62]

Hall, C.; Knight, B.; Ringrose, S; Knox, O. (2011). What Are The Farm-Level Economic Impacts Of The Global Cultivation Of GM Crops?. Environmental Evidence. [63]

Hallward-Driemeier, M., & Gajigo, O. (2012). Strengthening economic rights and women's occupational choice: The impact of reforming Ethiopia's family law. World Development, 70, 260–273. [64]

Hamid, Ahmad Humam; Nugroho, Agus; Pospos, Tamara Husna; Suhurman, Glennice (2023). Impact of Coffee Sustainability Schemes on Rural Coffee Producer Households' Living Standard in Aceh Province, Indonesia. Acta agriculturae Slovenica . [65]

Healy, P. (2018). Transport infrastructure and agricultural markets: Evidence from India's NS- EW highway. CSAE Working Paper Series, University of Oxford, 2018–13. [119]

Hemming, D.J.; Chirwa, E.W.; Ruffhead, H.J.; Hill, R.; Osborn, J.; et al. (2018). Agricultural input subsidies for improving productivity, farm income, consumer welfare and wider growth in low- and middle-income countries: A systematic review. 3ie Systematic Review. [66]

Hermann, Raoul; Grote, Ulrike (2015). Large-scale Agro-Industrial Investments and Rural Poverty: Evidence from Sugarcane in Malawi. Journal of African Economies. [67]

Hermann, Raoul; Nkonya, Ephraim; Fabe, Anja (2018). Food value chain linkages and household food security in Tanzania. Food Security 10 pp. 827-839. [195]

Hildebrandt, N.; Nyarko, Y.; Romagnoli, G.; Soldani, E. (2021). Price Information and Networks: Evidence from Ghana. NYU Stern School of Business [201]

Hine, J., Abedin, M., Stevens, R. J., Airey, T., & Anderson, T. (2016). Does the extension of the rural road network have a positive impact on poverty reduction and resilience for the rural areas served? If so how, and if not why not? A systematic review. London: EPPI-Centre, Social Science Research Unit, UCL Institute of Education, University College London. (ID 188)

Hoang, Viet (2021). Contract Farming and Income in Vietnam. Agriculture. [175]

Hossain, Md. Emran; Hoque, Md. Ahasanul; Giorgi, Emanuele; Fournié, Guillaume; Das, Goutam Buddha; Henning, Joerg (2021). Impact of Improved Small-scale Livestock Farming on Human Nutrition. Scientific Reports. [332]

Houndolo, Deo-Gracias; Hodonou, Assogba; SOSSOU, Dislène Senan; Yacoubou, Rahamatou Hamidou (2020). A Pathway to Adoption of Yield-Enhancing Agricultural Technologies Among the Rural Poor: Evidence from a Randomized Control Trial in Benin. Partnership for Economic Policy Working Paper. [301]

Huss, M., Brander, M., Kassie, M., Ehlert, U., & Bernauer, T. (2021). Improved storage mitigates vulnerability to food-supply shocks in smallholder agriculture during the COVID-19 pandemic. Global Food Security, 28, 100468. [68]

Hussain, I.; Hanjra, M. A. (2004). Irrigation and poverty alleviation: review of empirical evidence. Irrigation and Drainage. [189]

Iacovone,L., Mckenzie, D.J. (2019) Shortening Supply Chains : Experimental Evidence from Fruit and Vegetable Vendors in Bogota (English). Impact Evaluation series, Policy Research working paper No. WPS 8977, World Bank Group. [69]

Ibanez, Marcella; Blackman, Allen (2015). Environmental And Economic Impacts Of Growing Certified Organic Coffee In Colombia . Resources for the Future Discussion Paper . [70]

Iimi, A. (2022). Agriculture production and transport connectivity: Mozambique. World Bank Policy Research Working Paper No. 10089. (ID 71)

Institute of Statistical, Social, and Economic Research (2012). An Impact Evaluation Of The MIDA FBO Training. Final Report. [73]

Islam, Abu H. M. S.; Roy, D.; Kumar, A.; Tripathi, G.; Joshi, P. K. (2019). Dairy contract farming in Bangladesh. IFPRI Discussion Papers. [176]

Jaleta, Moti; Kassie, Menale; Marenya, Paswel (2015). Impact Of Improved Maize Variety Adoption On Household Food Security In Ethiopia: An Endogenous Switching Regression Approach. International Association of Agricultural Economists. [422]

Jayne, T. S.; Yamano, T.; Nyoro, J. (2004). Interlinked credit and farm intensification in Kenya. Agricultural Economics. [199]

Jena, Pradyot Ranjan; Chichaibelu, Bezawit Beyene; Stellmacher, Till; Grote, Ulrike (2012). The Impact Of Coffee Certification On Small-Scale Producers' Livelihoods. Agricultural Economics . [75]

Jiba, Phiwe; Obi, Ajuruchukwu; Mdoda, Lelethu; Mzuyanda, Christian (2024). The Impact of Smallholder Irrigation Scheme on Household Welfare in Farm-Managed Irrigation Scheme Communities in the Eastern Cape Province, South Africa. South African Journal of Agricultural Extension. [439]

Jones, Sam; Gibbon, Peter (2011). Developing Agricultural Markets in Sub-Saharan Africa: Organic Cocoa in Rural Uganda. Journal of Development Studies. [76]

Juillard, H., Mohiddin, L., Péchayre, M., Smith, G. and Lewin, R. (2017). The influence of market support interventions on household food security: An evidence synthesis. Humanitarian Evidence Programme. Oxford: Oxfam GB. [77]

Kamala, A.; Kimanya, M.; De Meulenaer, B.; Kolsteren, P.; et al. (2018). Post-harvest interventions decrease aflatoxin and fumonisin contamination in maize and subsequent dietary exposure in Tanzanian infants. World Mycotoxin Journal. [78]

Kamande, M. W.; Nafula, N. (2016). Welfare Effects of ICTs in Agricultural Markets in East Africa. IFPRI AGRODEP Working Paper [202]

Kamwamba-Mtethiwa, J., Weatherhead, K., & Knox, J. (2015). Assessing performance of small- scale pumped irrigation systems in sub-Saharan Africa: Evidence from a systematic review. Irrigation and Drainage, 64(2), 198–209. https://doi.org/10.1002/ird.1933 [410]

Kemeze, F. H. (2018). The impact of agricultural insurance on the demand for supplemental irrigation: A randomized controlled trial in Northern Ghana. In The Climate-Smart Agriculture Papers (pp. 213–224). Springer. https://doi.org/10.1007/978-3-319-92798-5_17 [437]

Kiwanuka-Lubinda, R. N.; Ng'ombe, J. N.; Machethe, C. (2021). Contractual Arrangements and Welfare in Zambia. Agrekon. [177]

Kizito, A. M., & Kato, E. (2018). Does linking farmers to markets work? Evidence from the World Food Programme's Purchase for Progress initiative. African Journal of Agricultural and Resource Economics, 13(2), 169–181. [79]

Kizito, A. M.; Donovan, C.; Staatz, J. M. (2012). Agricultural Market Information Systems in Mozambique. MSU Working Paper. [200]

Knox, A., Daccache, A., & Hess, T. (2013). What is the impact of infrastructural investments in roads, electricity and irrigation on agricultural productivity? EPPI-Centre, Social Science Research Unit, Institute of Education, University of London. (ID 80)

KONER, Nilojyoti; LAHA, Arindam (2020). Economics of zero budget natural farming in Purulia district of West Bengal: is it economically viable?. Studies in Agricultural Economics. [315]

Kramer, B., Pattnaik, S., Ward, P. S., & Xu, Y. (2023). Impacts of a digital credit-insurance bundle for landless farmers: Evidence from a cluster randomized trial in Odisha, India. IFPRI Discussion Paper 2132. International Food Policy Research Institute (IFPRI). [334]

Kuijpers, Rob (2020). Integrated Value Chain Development: Evidence from Bangladesh. Food Policy. [82]

Kumar, Anjani; Roy, Devesh; Tripathi, Gaurav; Joshi, P.K.; Adhikari, Rajendra P. (2016). Can Contract Farming Increase Farmers' Income and Enhance Adoption of Food Safety Practices. IFPRI Discussion Paper. [83]

Kumar, Anjani; Singh, A. K.; Saroj, Sunil; Madhavan M., Misha; Joshi, Pramod Kumar (2019). The impact of India's farm science centers (Krishi Vigyan Kendras) on farm households' economic welfare. IFPRI Discussion Paper. [84]

Kumar, L., Balasubramaniam, V., & Raman, R. (2018). Effectiveness of Market Led Development Approaches in Low and Middle Income Countries: A Systematic Review. EPPI-Centre, Social Science Research Unit, UCL Institute of Education. [145]

Laajaj, Rachid (2017). Endogenous time horizon and behavioral poverty trap: Theory and evidence from Mozambique. Journal of Development Economics. [86]

Lawry, S., Samii, C., Hall, R., Leopold, A., Hornby, D., & Mtero, F. (2016). The impact of land property rights interventions on investment and agricultural productivity in developing countries: A systematic review. International Initiative for Impact Evaluation (3ie). [354]

Leavens, Laura; Bauchet, Jonathan; Ricker-Gilbert, Jacob (2021). After the project is over: Measuring longer-term impacts of a food safety intervention in Senegal. World Development. [362]

Leight, J., Awonon, J., Pedehombga, A., Ganaba, R., Martinez, E. M., & Heckert, J., et al. (2020). The impact of an integrated value chain intervention on household poultry production in Burkina Faso: Evidence from a randomized controlled trial. IFPRI Discussion Paper 01958. International Food Policy Research Institute (IFPRI). [343]

Lentz, E., & Upton, J. (2016). Benefits to smallholders? Evaluating the World Food Programme's Purchase for Progress pilot. Global Food Security, 11. https://doi.org/10.1016/j.gfs.2016.07.003 [88]

Levi, Y., & Rajan, M. (2020). The impact of unifying agricultural wholesale markets on prices and farmers' profitability. Proceedings of the National Academy of Sciences, 117(3), 2366–2371. https://doi.org/10.1073/pnas.1903619117 [89]

Loevinsohn, Michael; Sumberg, Jim; Diagne, Aliou; Whitfield, Stephen (2013). Under What Circumstances and Conditions Does Adoption of Technology Result in Increased Agricultural Productivity?. Institute of Development Studies (IDS). [448]

Luo, Y., Huang, D., Miao, H., Zhu, J., & Wu, L. (2021). Impact of advanced storage facilities on households' maize storage losses and food security in China. Environment, Development and Sustainability, 24(1), 649–671. https://doi.org/10.1007/s10668-021-01406-z [90]

Maertens, Annemie; Mhango, Wezi; Michelson, Hope C. (2020). The Effect of Demonstration Plots and the Warehouse Receipt System on Soil Fertility Management. 3ie Series Report. [91]

Maertens, Miet; Vande Velde, Katrien (2017). Contract-Farming in Rice in Benin. World Development. [178]

Magnan, N., Hoffmann, V., Gajate-Garrido, G., Akwasi, D. K., & Opoku, N. (2019). Information, technology, and market rewards: Incentivizing aflatoxin control in Ghana (IFPRI Discussion Paper No. 01834). International Food Policy Research Institute (IFPRI). [385]

Malhotra, S. K., Mantri, S., Gupta, N., Bhandari, R., Armah, R. N., Alhassan, H., Young, S., White, H., Puskur, R., Waddington, H., Sharma, E., & Masset, E. (2024). Value Chain Interventions for Improving Women's Economic Empowerment: A Mixed-Methods Systematic Review and Meta- Analysis. Campbell Systematic Reviews, 20(3), 1–49. [357]

Mannava, A., Van de Walle, D., & Nguyen, H. (2020). Gendered effects of road upgrades in Vietnam. World Bank Policy Research Working Paper No. 9317. (ID 93)

Maru, Husen; Haileslassie, Amara; Zeleke, Tesfaye (2023). Impacts of Small-scale Irrigation on Farmers' Livelihood: Evidence from the Drought Prone Areas of Upper Awash Sub-basin, Ethiopia. Heliyon. [425]

Maryono, Maryono; Killoes, Aditya Marendra; Adhikari, Rajendra; Aziz, Ammar Abdul (2024). Agriculture Development through Multi-stakeholder Partnerships in Developing Countries: A Systematic Literature Review. Agricultural Systems, 213. [94]

Masset, Edoardo; Haddad, Lawrence; Cornelius, Alex; Isaza-Castro, Jairo (2011). A Systematic Review of Agricultural Interventions to Improve Nutritional Status of Children. EPPI-Centre, University of London. [95]

Matavel, C., Kächele, H., Steinke, J., Rybak, C., Hoffmann, H., Salavessa, J., Sieber, S., & Müller, K. (2022). Effect of passive solar drying on food security in rural Mozambique. Scientific Reports, 12, 17154. [371]}

Meemken, E. M. (2020). Do smallholder farmers benefit from sustainability standards? A systematic review and meta-analysis. Global Food Security. [442]

Meemken, Eva-Marie; Qaim, Matin (2018). Can Private Food Standards Promote Gender Equality in the Small Farm Sector . Journal of Rural Studies . [96]

Melecky, M., Serebrisky, T., & Cordoba, J. P. (2018). Transport corridors and inclusive growth in India. Journal of Development Economics, 134, 324–339. (ID 97)

Melese Alemu; Moges Dessale (2022). Impacts of Small-Scale Irrigation on Rural Households' Income in North Eastern Ethiopia. Other. [426]

James E.; Hoffman, Daniel J. (2023). An Evaluation of Nutrition, Culinary, and Production Interventions on the Consumption of African Indigenous Vegetables in Western Kenya. Frontiers in Nutrition. [364]

Mgendi, George; Mao, Shiping; Qiao, Fangbin (2021). Is a Training Program Sufficient to Improve the Smallholder Farmers' Productivity in Africa? Empirical Evidence From a Chinese Agricultural Technology Demonstration Center in Tanzania. Sustainability. [429]

Michelson, Hope C.(2013). Small Farmers, NGOs, And A Walmart World: Welfare Effects Of Supermarkets In Nicaragua. American Journal of Agricultural Economics. [98]

Middendorp, R. S., Boever, O., Rueda, X., & Lambin, E. F. (2020). Improving smallholder livelihoods and ecosystems through direct trade relations: High-quality cocoa producers in Ecuador. Business Strategy & Development, 3(2), 165-184. [182]

Minten, B., et al. (2024). Food processing: A stalled transformation. In Myanmar's Agrifood System (IFPRI), 341–372. [167]

Minten, B., Reardon, T., Singh, K. M., & Sutradhar, R. (2014). The new and changing roles of cold storages in the potato supply chain in Bihar. Economic and Political Weekly, 98-108. [198]

Minten, Bart; Dereje, Mekdim; Engida, Ermias; Tamru, Seneshaw (2018). Tracking the Quality Premium of Certified Coffee: Evidence from Ethiopia. World Development . [99]

Mishra, Ashok K.; Kumar, Anjani; Joshi, Pramod K.; D'Souza, Alwin; Tripathi, Gaurav (2018). How can Organic Rice be a Boon to Smallholders? Evidence from Contract Farming in India. Food Policy. [100]

Mitiku, Fikadu; de Mey, Yann; Nyssen, Jan; Maertens, Miet (2017). Private Sustainability Standards and Poverty Alleviation. Sustainability . [179]

Mitra, S., Mookherjee, D., Torero, M., & Visaria, S. (2013). Asymmetric information and middleman margins: An experiment with West Bengal potato farmers. The Bureau for Research and Economic Analysis of Development (BREAD) Working Paper, 401. [456]

Mottaleb, K. A., & Rahut, D. B. (2019). Jamuna Bridge in Bangladesh. The European Journal of Development Research, 31(4), 750–778. (ID 101)

Mu, R., & van de Walle, D. (2011). Rural roads and local market development in Vietnam. Journal of Development Studies, 47(5), 709–734. (ID 102)

Mullally, C., & Chakravarty, S. (2018). Are matching funds for smallholder irrigation money well spent? Evidence from a randomized evaluation in Nepal. Food Policy, 76, 28–41. [409]

Mullally, Conner; Chakravarty, Shourish (2018). Are Matching Funds for Smallholder Irrigation Money Well Spent?. Food Policy. [409]

Mupaso, N.; Makombe, G.; Mugandani, R. (2023). Smallholder Irrigation and Poverty Reduction. Heliyon. [193]

Mutuc, María; Roderick M. Rejesus; Jose M. Yorobe, Jr. (2013). Which farmers benefit the most from Bt corn adoption? Estimating heterogeneity effects in the Philippines. Agricultural Economics. [103]

Mwambi, Mercy M.; Oduol, Judith; Mshenga, Patience; Saidi, Mwanarusi (2016). Does contract farming improve smallholder income? The case of avocado farmers in Kenya. Journal of Agribusiness in Developing and Emerging Economies . [104]

Mwambi, Mercy; Depenbusch, Lutz; Bonnarith, Uon; Sotelo-Cardona, Paola; Kieu, Khemrin; di Tada, Nicola; Srinivasan, Ramasamy; Schreinemachers, Pepjin (2023). Can Phone Text Messages Promote the use of Integrated Pest Management? A study of Vegetable Farmers in Cambodia. Ecological Economics. [311]

Mwangi, J. K., & Crewett, W. (2019). The impact of irrigation on small-scale African indigenous vegetable growers' market access in peri-urban Kenya. Agricultural Water Management, 212, 295–305. [438]

Nagwekar, N. N., Tidke, V. B., & Thorat, B. N. (2020). Seasonal Nutritional Food Security to Indian Women through Community-level Implementation of Domestic Solar Conduction Dryer. Ecology of Food and Nutrition. [105]

Nakamura, S., Bundervoet, T., & Nuru, M. (2020). Rural roads and resilience in Ethiopia. Journal of Development Studies, 56(10), 1838–1855. (ID 106)

Nakano, Yuko; Tsusaka, Takuji W.; Aida, Takeshi; Pede, Valerien O. (2018). Is Farmer-To- Farmer Extension Effective? The Impact Of Training On Technology Adoption And Rice Farming Productivity In Tanzania. World Development. [430]

Nankhuni, F., & Paniagua, G. (2013). Meta-Evaluation of Private Sector Interventions in Agribusiness: Finding Out What Worked in Access to Finance and Farmer/Business Training. World Bank Working Paper. [107]

Nankhuni, Flora; Paniagua, Gloria (2013). Meta-Evaluation of Private Sector Interventions in Agribusiness. World Bank Working Papers.. [107]

Naresh, R. K., Singh, S. P., Chauhan, U. K., & Kumar, V. (2022). Improving smallholder and marginal farmers' access to irrigation in South Asia: A systematic review. Heliyon, 8(9), e10656. https://doi.org/10.1016/j.heliyon.2022.e10656 [193]

Ndegwa, M. K., De Groote, H., Gitonga, Z. M., & Bruce, A. Y. (2016). Effectiveness and economics of hermetic bags for maize storage. Crop Protection, 90, 17–26. [108]

Nhan, Tran Quoc; Gillette, Raulston; Yutaka, Tomoyuki; Can, Nguyen Duy (2020). Impact of Outgrower Scheme on Yield, Output Price, and Income in Mekong Delta. Hitotsubashi University. [109]

Nindi, T., Ricker-Gilbert, J., & Bauchet, J. (2024). Incentive mechanisms to exploit intraseasonal price arbitrage opportunities for smallholder farmers. American Journal of Agricultural Economics, 106(1), 330–353. [110]

Nkonya, Ephraim; Magalhaes, Marilia; Kato, Edward; Diaby, Mahamadou; Kalifa, Traore (2022). Pathways from Irrigation to Prosperity, Nutrition and Resilience: The Case of Smallholder Irrigation in Mali. IFPRI - Discussion Papers. [431]

Ogundari, K.; Bolarinwa, O. D. (2019). Does adoption of agricultural innovations impact farm production and household welfare? A meta-analysis. Agricultural and Resource Economics Review. [111]

Ojwang, Sylvester O; Otieno, David J; Okello, Julius J; Muoki, Penina; Nyikal, Rose A. (2021). Do Nutrition Education Approaches with Preschoolers and Their Caregivers Influence Retention of Biofortified Orange-Fleshed Sweet Potato on Farms? Evidence from Homa Bay County, Kenya. Food and Nutrition Bulletin. [314]

Omole, F. O., Olajiga, O. K., & Olatunde, T. M. (2024). Challenges and successes in rural electrification: A review of global policies and case studies. Engineering Science & Technology Journal, 5(3), 1031–1046. [112]

Omotilewa, O. J., Ricker-Gilbert, J., & Ainembabazi, J. H. (2019). Subsidies for agricultural technology adoption: Evidence from grain storage bags in Uganda. American Journal of Agricultural Economics, 101(3), 753–772. [114]

Omotilewa, O. J., Ricker-Gilbert, J., Ainembabazi, H., & Shively, G. (2016). Impacts of improved storage technology among smallholder farm households in Uganda. Proceedings of the 5th International Conference of the African Association of Agricultural Economists (AAAE), Addis Ababa, Ethiopia, September 23–26. [378]

Omotilewa, O. J., Ricker-Gilbert, J., Ainembabazi, J. H., & Shively, G. E. (2018). Does improved storage technology promote modern input use and food security? Evidence from Uganda. Journal of Development Economics, 135, 176–198. [113]

Omotilewa, O.J.; Ricker-Gilbert, J.; Ainembabazi, J.H.; Shively, G.E. (2018). Does improved storage technology promote modern input use and food security? Evidence from Uganda. Journal of Development Economics. [113]

Oparinde, A.; Banerjee, A.; Birol, E.; Ilona, P. (2016). Information and Consumer Willingness to Pay for Biofortified Yellow Cassava in Nigeria. Agricultural Economics. [115]

Osei, Robert Darko; Dzanku, Fred M.; Osei-Akoto, Isaac; et al. (2018). Impact of voice reminders to reinforce harvest aggregation services in Mali. 3ie Series Report. [116]

Osewe, Maurice; Liu, Aijun; Njagi, Tim (2020). Farmer-Led Irrigation and Its Impacts on Smallholder Farmers' Crop Income: Evidence from Southern Tanzania. International Journal of Environmental Research and Public Health. [418]

Owusu-Sekyere, Enoch; Bibariwiah, Cindy; Owusu, Victor; Donkor, Emmanuel (2021). Farming Under Irrigation Management Transfer Scheme and its Impact on Yield and Net Returns in Ghana. Land Use Policy. [419]

Oya, C., Schaefer, F., & Skalidou, D. (2018). The effectiveness of agricultural certification in developing countries: A systematic review. World Development. [446]

Pamuk, H., van Asseldonk, M., & Wattel, C. (2021). Farmer Field Business Schools and Village Savings and Loan Associations for promoting climate-smart agriculture practices: Evidence from Tanzania. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). [118]

Parra-Peña, Rafael I.; Lundy, M.; Bischler, J.; Astorquiza, B. A.; Hurtado, J. J. (2016). Public- private partnerships in Colombia. Other. [180]

Paul, H. (2018). NS-EW highway impact in India. CSAE Working Paper Series 2018-13, Centre for the Study of African Economies. (ID 119)

Phillips, Daniel; Waddington, Hugh; White, Howard (2015). Why Targeting Matters: A Systematic Review of Farmer Field Schools Targeting. 3ie Systematic Review. [120]

Piza, C., Cravo, T., Taylor, L., Gonzalez, L., Musse, I., Furtado, I., Sierra, A.C., & Abdelnour, S. (2016). Business support for small and medium enterprises in low- and middle-income countries. 3ie Systematic Review 25. [121]

Pretari, Alexia; Hoffmann, Vivian; Tian, Lulu (2019). Post-harvest practices for aflatoxin control: Evidence from Kenya. Journal of Stored Products Research. [389]

Priyono, N., Nurmalina, R., Burhanuddin, & Ilham, N. (2023). Impact of import restrictions policy on dairy supply and demand in Indonesia. Tropical Animal Science Journal, 46(3). [122]

Purohit, P., Imai, K. S., & Sen, K. (2017). Do agricultural marketing laws matter for rural growth? Evidence from the Indian states (Discussion Paper Series DP2017-17). Research Institute for Economics & Business Administration, Kobe University. [369]

Qin, Y., & Zhang, X. (2012). The road to specialization in agricultural production: Evidence from rural China. IFPRI Discussion Paper No. 01221. (ID 123)

Ragasa, Catherine; Amewu, Sena; Agyakwah, Seth Koranteng; Mensah, Emmanuel Tetteh-Doku; Asmah, Ruby (2022). Impact of Aquaculture Training on Farmers' Income: Cluster Randomized Controlled Trial Evidence in Ghana. Agricultural Economics. [329]

Rand, J. (2011). Evaluating the employment-generating impact of rural roads in Nicaragua. Journal of Development Effectiveness, 3(1), 28–43. (ID 125)

Rao, E. J.; Qaim, M. (2011). Supermarkets and farm household income: Kenya. World Development. [197]

Rauniyar, G., Morales, A., & Melo, V. (2012). Shallow tubewell irrigation in Nepal: Impacts of the Community Groundwater Irrigation Sector Project. ADB Economics Working Paper Series. (ID 127)

Reardon, Thomas. 2024. Wholesalers, wholesale markets, and symbiosis with the emerging logistics sector. Rethinking Food Markets Initiative Note. Washington, DC: International Food Policy Research Institute. [166]

Rijsbergen, Bart van; Elbers, Willem; Ruben, Ruerd; Njuguna, Samuel N. (2016). Coffee Certification and Farmers' Welfare: Evidence from Kenya . World Development . [128]

Robinson, Jonathan et al. (2020). The Value of Linking Farmers to Maize Value Chains in Rwanda.Other. [181]

Romagnoli, Federica; Molina, Juan; Parrado, Alvaro (2018). How To Improve Smallholder Market Access: Evaluation Of Mercados Campesinos In Colombia. Agronomía Colombiana 36 (1) pp. 79-87. [129]

Rutherford, D.D., Burke, H.M., Cheung, K.K., & Field, S.H. (2016). Impact of an Agricultural Value Chain Project in Liberia. World Development. [131]

Saenger, Christoph; Torero, Máximo; Qaim, Matin (2014). Third-party Contract Enforcement in Agricultural Markets: Field Experiment in Vietnam. American Journal of Agricultural Economics. [132]

Salazar, C., & Jones, S. (2017). New bridge, price gaps, and transport costs in developing countries. Unpublished manuscript. (ID 133)

Sánchez-Ortiz, N. A., Unar-Munguía, M., Bautista-Arredondo, S., et al. (2022). NAFTA and apparent staple food consumption changes in Mexico. PLOS Global Public Health, 2(11). [134]

Schöll, K.; Markemann, A.; Megersa, B.; Birner, R.; Valle Zárate, A. (2016). Group Marketing Initiatives among Pig Producers in Vietnam. Journal of Co-operative Organization and Management. [135]

Seba, S; Lyne, M; Old, K (2018). Who Gets Supply Contracts? Chickpea Growers in Ethiopia's Oromia Region. ISHS Acta Horticulturae. [136]

Setboonsarng, Sununtar; PingSun, Leung; Stefan, Adam (2008). Rice Contract Farming in Lao PDR: From Subsistence to Commercial Agriculture. ADBI Working Paper. [137]

Shah, M., Ricker-Gilbert, J., & Omotilewa, O. (2021). Longer run effects of one-time subsidy on adoption of a new agricultural technology: Evidence from a randomized control trial in Uganda. Proceedings of the 6th International Conference of the African Association of Agricultural Economists (AAAE), Addis Ababa, Ethiopia, September 23–26. [386]

Shamdasani, Y. (2021). Rural road infrastructure and agricultural production: Evidence from India. Journal of Development Economics, 152, 102685. (ID 138)

Shukla, P., Pullabhotla, H. K., & Baylis, K. (2023). Reducing food losses: Experimental evidence from storage tech in India. Food Policy, 117, 102405. [139]

Soullier, Guillaume; Moustier, Paule (2018). Contract Farming in Domestic Grain Chains: Evidence from Senegal.Food Policy. [140]

Stewart, Ruth et al. (2015). The Effects Of Training, Innovation And New Technology On African Smallholder Farmers' Economic Outcomes And Food Security: A Systematic Review. Campbell Systematic Reviews. [141]

Subervie, J.; Vagneron, S. (2023). A Drop Of Water In The Indian Ocean? The Impact Of Globalgap Certification On Lychee Farmers In Madagascar . World Development . [142]

Sun, Xiaoyan; Wang , Youchao; Zhu, Fengying; Liu, Xiaoyu; Liu, Jianxu; Sriboonchitta, Songsak (2023). Promotion Effect of Agricultural Production Trusteeship on High-Quality Production of Grain—Evidence From the Perspective of Farm Households. Agronomy. [390]

Tabe-Ojong, Martin Paul; Godana Dureti, Guyo (2022). Are Agro-Clusters Pro-Poor? Evidence from Ethiopia. Journal of Agricultural Economics 74 pp. 100-115. [143]

Tesfay, Menasbo Gebru (2020). Impact of irrigated agriculture on welfare of farm households in northern Ethiopia: panel data evidence. Irrigation and Drainage Systems. [423]

Thomas, E., Bradshaw, A., Mugabo, L., MacDonald, L., Brooks, W., & Dickinson, K. (2021). Engineering environmental resilience: A matched cohort study of the community benefits of trailbridges in rural Rwanda. Science of the Total Environment, 771, 145256. (ID 144)

Ton, G.; Desiere, S.; Vellema, W.; et al. (2017). The effectiveness of contract farming on income and food security: A mixed-method review.3ie Systematic Review, 38. [146]

Ton, Giel; de Grip, Karin; Klerkx, Laurens; Rau, Marie-Luise; Douma, Marieke; Friis-Hansen, Esbern; Triomphe, Bernard; Waters-Bayer, Ann; Wongtschowski, Mariana (2013). Effectiveness Of Innovation Grants To Smallholder Agricultural Producers (Review). EPPI-Centre. [145]

Tossou, Dagbegnon Armand (2021). Drivers of Adoption and Impacts of Smallholder Climate Resilient Agricultural Technologies. Unpublished report. [416]

Tran, Duc; Goto, Daisaku (2019). Sustainability Certification And Farm Income: Green Tea Farmers In Vietnam. Food Policy . [147]

United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP). (2021). Systematic review of the socio-economic impacts of rural electrification. Retrieved from https://hdl.handle.net/20.500.12870/3524. [194]

Urquieta-Salomón, José E.; Tepichin-Valle, A. M.; et al. (2009). Poverty and Gender Perspective in Productive Projects for Rural Women in Mexico. Evaluation Review. [148]

van den Bold, Mara; Bliznashka, Lilia; Ramani,Gayathri; Olney, Deanna; Quisumbing, Agnes; Pedehombga, Abdoulaye; Ouedraogo, Marcellin (2021). Nutrition-Sensitive Agriculture Programme Impacts On Time Use And Associations With Nutrition Outcomes. Maternal and Child Nutrition. [340]

van Rijsbergen, B. J., Elbers, W., Ruben, R., & Njuguna, S. N. (2016). The Ambivalent Impact of Coffee Certification on Farmers' Welfare: A Matched Panel Approach for Cooperatives in Central Kenya. World Development. [447]

Visser, M. E., Schoonees, A., Ezekiel, C. N., Randall, N., & Naude, C. E. (2020). Agricultural and Nutritional Education Interventions for Reducing Aflatoxin Exposure to Improve Infant and Child Growth in Low- and Middle-Income Countries. Cochrane Database of Systematic Reviews, 4(4). [358]

Visser, Marianne E.; Schoonees, Anel; et al. (2020). Agricultural and Nutritional Education To Reduce Aflatoxin Exposure. Cochrane Database of Systematic Reviews. [150]

Waddington, Hugh; Snilstveit, Birte; et al. (2014). Farmer Field Schools: Systematic Review Of Farming Practices And Outcomes. Campbell Systematic Reviews. [151]

Walls, Helen L.; Johnston, D.; Tak, M.; et al. (2018). Impact of Agricultural Input Subsidies on Food and Nutrition Security. Food Security. [152]

Wang, G., & Sun, Y. (2016). Infrastructure investment, transport connectivity and agricultural productivity: Evidence from China. Applied Economics, 48(28), 2685–2702. (ID 153)

Weng, Y., Zeng, Y., & Lin, W. (2021). Do rural highways narrow Chinese farmers' income gap among provinces? Journal of Integrative Agriculture, 20(4), 905–914. (ID 155)

Xie, L., Liao, J., Chen, H., Yan, X., & Hu, X. (2021). Is futurization the culprit for price fluctuation in apple spot market? Agriculture, 11(4), 342. [154]

Yitayew, Asresu; Abdulai, Awudu; Yigezu, Yigezu A. (2022). Improved agricultural input delivery systems for enhancing technology adoption: evidence from a field experiment in Ethiopia. European Review of Agricultural Economics. [335]

Yitayew, Asresu; Abdulai, Awudu; Yigezu, Yigezu A.; Deneke, Tilaye T.; Kassie, Girma T. (2021). Impact of agricultural extension services on the adoption of improved wheat variety in Ethiopia: A cluster randomized controlled trial. World Development. [328]

Yu, G., & Hu, X. (2021). Rural e-commerce and farmers' digital credit behavior in China. PLoS ONE, 16(6), e0253458. [156]

Yuya, Beyan Ahmed; Daba, Nano Alemu (2018). An Evaluation of Climate Mitigation Adoption Technologies in Improving Rural Households' Livelihood Outcomes: The Case of Eastern Oromia, Ethiopia. Turkish Journal of Agriculture - Food Science and Technology. [408]

Zant, W. (2012). Is EU support to Malawi agriculture effective? Tinbergen Institute Discussion Paper, 12-090/v, 1–35. [157]

Zeweld, Woldegebrial; Huylenbroeck, Guido V.; Hidgot, Assefa; Chandrakanth, M. G.; Speelman, Stijn (2015). Adoption of Small-Scale Irrigation and Its Livelihood Impacts in Northern Ethiopia. Other. [406]

ANNEXES

Annex 1. Intervention/search categories

1) Public goods

- Roads
- Telecomunication
- Electrification
- Irrigation
- Collection centers (run by government)
- Wholesale markets (run by government)
- Regulations (land, tariffs, futures markets, liberalization, rights, price control, empowermente, etc.)
- Clusters (run by government)

2) Producers

- Inputs
- Information and ICT
- Innovation
- Smallholder irrigation
- Credit
- Insurance
- Training
- Organization (such as cooperatives)
- Contract farming
- Certification
- Post-harvest
- Commercialization

3) Hidden middle

- Collection and sorting (private)
- Distribution (private)
- Storage
- Cold storage
- Cold transport
- Processing
- Intermediation
- Wholesale
- Food retail
- Transportation services
- Information services
- Post-harvest services
- Organization (of value chain)
- Value chain

- Non-farm jobs
- SMEs
- Clusters (private)
- Commercialization services

Annex 2. Methodological composition of the sample

The 47 systematic reviews included in this analysis collectively examine nearly 2,500 individual studies, with a median of 35 studies per review. It is important to note, however, that a significant number of studies are reviewed in more than one systematic review.

Regarding the methodological approach of the selected impact evaluations, Figure 8 summarizes the distribution of the main strategies and analytical tools used across the studies in the sample.

Figure 8. Methodological approach of selected impact evaluations

Method	#	%
Quasi-Experimental	**172**	**75%**
Instrumental Variables	97	42%
Propensity Score Matching	56	24%
Difference-in-Differences	17	7%
Regression Discontinuity	2	1%
Experimental desigh	**44**	**19%**
RCT	31	14%
Randomized Experiment (non-RCT)	4	2%
Field Experiment (non-randomized)	9	4%
Mixed Methods	**13**	**6%**
Total	**229**	**100%**

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