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Developing Inclusive Markets in India: Evaluation of the Agriculture Production Cluster (APC) Project in Odisha

Endline Evaluation Report

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Contents

Acronyms

AE	Agri-entrepreneur
APC	Agriculture production cluster
APICOL	Agriculture Promotion and Investment Corporation of Odisha Limited
CEM	Coarsened exact matching
CEO	Chief executive officer
DA&FW	Department of Agriculture and Farmer's Welfare
DCOR	Development Corner
DOH	Department of Horticulture
DMF	District Mineral Foundation
eNAM	e-National Agricultural Market
FGD	Focus group discussion
FPO	Farmer producer organization
FY	Fiscal year
GoI	Government of India
IBCB	Institution Building and Capacity Building
IFFCO	Indian Farmers Fertiliser Cooperative
ITDA	Integrated Tribal Development Agency
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MIDH	Mission for Integrated Development of Horticulture
MMJJM	*Mukhya Mantri Janajati Jeevika* Mission
NBFC	Non-bank financial company
NGO	Non-governmental organization
OAIC	Odisha Agro Industries Corporation Limited
OLIC	Odisha Lift Irrigation Corporation
OLM	Odisha Livelihoods Mission
PC	Farmer producer company

PG	Farmer producer group
PMKSY	*Pradhan Mantri Krishi Sinchayee Yojana* scheme
PRADAN	Professional Assistance for Development Action
PSFPO	Promotion and Stabilization of Farmer Producer Organizations program
SEWA	Social Education for Women's Awareness
SHG	Self-help group
SSP	Small-scale producer
UM	*Udyog Mitra*

Glossary of key terms

Agri-entrepreneur (AE): A role established by the APICOL in partnership with the APC project. AEs are intended to launch micro-enterprises providing one or two specific types of horticulture or livestock support to SSPs (such as input supply, nurseries for winner crops, and livestock vaccination and de-worming) at the PC level, with three or four AEs per PC.

Convergence: Coordination of the APC project with complementary government schemes such as input subsidies or infrastructure financing that could benefit APC-affiliated SSPs.

Cluster (or agri-cluster): a geographic area where synchronized production and primary-level value addition activities for a crop are undertaken by multiple farmers, often organized through groups of farmer producer organizations. In the APC model, each cluster consists of about 23-25 PGs.

Custom hire service centers: centers established by FPOs or NGOs in India to provide farmers, especially small and marginal ones, with access to agricultural machinery and equipment on a rental basis.

Godown: A warehouse or collective storage facility.

Haat: An open-air, local, usually rural market, daily or weekly, dealing in a variety of consumer goods, including agricultural produce in wholesale and retail quantities.

Highly engaged treatment sample: A sub-sample of treatment SSPs in the impact evaluation (about one-quarter of the full sample) who were the most highly engaged with PGs. We define high engagement those who accessed inputs and/or equipment through a PC, or reported selling crops with the support of the PC

Kharif: The rainy or monsoon season in India. Kharif crops are typically planted at the beginning of the first monsoon rains and harvested in September or October.

***Kuchia*:** Local commission agents or intermediaries who trade directly with farmers at the village-level or farmgate.

Mandi: Agricultural market, may be regulated or unregulated

Producer group (PG): Groups of 100-150 SSP members who practice synchronized production of a small number of winner crops (typically two or three) each season. These SSPs are recruited from existing female SHGs who are active in agriculture.

Producer company (PC): Groups of about 2,000 SSP shareholders who collectively aggregate, process and sell produce. PCs are comprised of multiple PGs within one or two blocks.

Rabi: The dry winter season in India. Rabi crops are typically grown in October or November and harvested in spring.

Retailer: A person or company that sells agricultural products directly to consumers typically in small quantities for use or consumption rather than for resale.

Self-help group (SHG): A community-based group of between 12-25 adult women who typically function as an informal savings and credit association. SHGs often serve as a platform or conduit for other community-based programming.

Small-scale producer (SSP): Agricultural participants or farmers who cultivate small volumes of crops, typically only for their own consumption.

Trader: A person or company who purchases agricultural crops and then re-sells to other buyers (either other traders or retailers). In this report, we refer to traders by their geographical reach: local traders typically trade just within the village or block; district traders trade within the wider district; and regional traders trade across districts and/or states.

***Udyog Mitra* (UM):** A generalist role established by the APC project to provide "handholding support" to SSPs during crop cultivation, harvest, post-harvest processing, and sales. UMs are funded through Mission Shakti for a three-year period, with one UM per PG.

Wholesaler: A type of trader who typically purchases large quantities for resale to retailers.

Winner crop: A crop selected by PGs in the APC project for collective production across multiple SSPs. Winner crops are selected based on specific criteria related market demand, SSP suitability, and agro-ecological compatibility.

Zaid: The short summer season in India that bridges the *rabi* and *kharif* seasons. Zaid crops are typically sown and harvested between March and June.

Executive Summary

This report presents findings from a four-year evaluation of the Agriculture Production Clusters (APC) project implemented by PRADAN and its partners from 2020-2024 in 40 blocks across 12 districts of Odisha, India, in close collaboration with the Department of Agriculture and Farmers' Empowerment and Mission Shakti. The Gates Foundation provided funding to support this project as part of a wider effort to develop more inclusive market systems that are accessible to and benefit small-scale producers (SSPs). The APC project organizes female SSPs into farmer producer organizations (FPOs)—producer groups (PGs) at the village level, aggregated into producer companies (PCs) at the block level—that coordinate production and sales of a basket of horticultural "winner" crops with high market demand. PRADAN and its partners, as well as the technical and administrative staff at these FPOs, provide comprehensive support to SSPs along the entire value chain. This includes access to high-quality affordable inputs; reliable market price information; training on improved agricultural practices; support for quality assurance and post-harvest management; and facilitation of transportation and aggregate sales of crops to buyers. The project coordinates closely with the government of Odisha to deliver complementary interventions including irrigation, post-harvest infrastructure, and modern farm equipment. It also provides support for poultry and goat rearing and sales. In 2024, APC was formally adopted as an Odisha government scheme and scaled to 100 blocks.

Mathematica conducted a rigorous evaluation of the APC project in the original program blocks using a mixed-methods design—comprising a **process evaluation**, a **market assessment**, and an **impact evaluation**. In this final evaluation report, we assess the APC project's longer-term impacts on the market for winner crops, as well as impacts on SSPs' lives, including agricultural revenues and income.

A. Process evaluation

The process evaluation assesses successes and challenges with the implementation of the APC project, as well as the sustainability of the model. We draw on an analysis of project monitoring data and three rounds of qualitative data collected by Mathematica staff and our local research partner, Intellecap, with between 40 to 140 participants in each round. This included focus group discussions with SSPs, and interviews with project implementing partners, PC staff, government officials, and other value chain actors.

Overall, we find that PRADAN has developed a **unique and scalable model to increase SSP market inclusion**. The project successfully **reached more than 120,000 female SSPs** in Odisha by providing diverse services along the value chain for multiple horticultural and other high-value crops. Some innovative aspects of the project model include a federated FPO structure mobilizing farmers from the bottom-up to foster community ownership, strong linkages to government support schemes, and a collaborative and rigorous method for winner crop selection. Most APC **FPOs are fully operational and financially independent**, having received critical start-up financing, technical support, and experience. Key **ongoing challenges and factors that affect long-term viability** include establishing sustainable financial mechanisms for field-level SSP support roles; securing greater FPO working capital to establish more profitable business lines in processing or value-addition; and further distinguishing the unique benefits of PC shareholding. **Table ES.1** summarizes these findings in more detail, organized by key themes.

Table ES.1. Key findings from the process evaluation

Project design and delivery model
(+) The APC project distinguishes itself from conventional FPO models through its **collaborative and rigorous approach to selecting a basket of "winner crops"** and a **cluster-based model for market engagement**.
(+) Another unique strength of the model is its strong **foundation in women's self-help group**s with existing social capital and collectivization, federated first into smaller PGs and then into larger PCs. Unlike other models where PCs are formed first, this bottom-up approach has fostered a sense of community ownership.
(+) The APC project is now recognized as a definitive **model for government convergence due to its multi-level advisory structure**, with APC blocks now receiving priority in government scheme allocation.
(-) It is important to determine **how to sustain critical field-level support to SSPs** beyond the end of the project.
Participation and inclusion of SSPs
(+) The APC project created 932 PGs with a total of 122,616 members; these PGs were organized into 30 PCs with 82,095 shareholders, **surpassing its targets for SSP participation.**
(+) SSP participation is driven by crop diversification and extensive services along the value chain, along with other **inclusive pathways for SSP income generation** such as livestock and fruit tree and mushroom cultivation.
(-) Despite the multiple pathways for project engagement and ongoing recruitment efforts, **some PG members remain inactive or are yet to become PC shareholders**.
FPO formation and performance
(+) Most project **PGs have achieved stability** after about two years of critical government start-up funds and experience in crop planning and production coordination.
(+) The project **PCs have transitioned from lean new entrants to fully-staffed businesses**, effectively managing their daily operations, finances, and governance.
(+) The PCs' financial performance is above average for Odisha: they have secured initial working capital and start-up grants and strong shareholder bases, and generated **increasing paid-up capital and revenues**, although profits have not been substantial enough to distribute dividends to shareholders.
(-) **Additional financing is needed for project FPOs**, both working capital to sustain their operations and formal financing to scale up into more profitable business lines, but **access to bank financing remains challenging**.
(-) Ongoing support will be key to **further strengthening PC governance and technical capacity**, for example through ongoing trainings and advisory boards for strategic guidance.
Crop selection strategy and uptake
(+) **Winner crop uptake has increased** substantially among SSPs, driven by the success of early adopters.
(+) **PC upstream support** for high-value crops preferred by SSPs is beneficial even if the PC does not aggregate and sell those crops.
(-) Despite the APC project's emphasis on crop diversification and rotation, **many SSPs prefer repeat cultivation** of the same limited number of winner crops, and some SSPs remain reluctant to adopt unfamiliar crops.
(~) **Environmental sustainability** will require a continued focus on climate-resilient crops, crop rotation, and water efficiency/non-pesticide management practices.
Public and private sector engagement
(+) The APC project has leveraged 6,849 million rupees ($79.8 million) from multiple government departments.
(-) **Challenges remain** with government scheme convergence, including a recent shift **requiring upfront payment for subsidies**, delays in funds disbursal, and government and NGO staff shortages.
(~) While private sector linkages were initially limited, the growth of PCs and agri-clusters has led to some private sector entrants such as input and transport companies.

NGO= non-governmental organization; PG= Producer Group; PC= Producer Company; SSP= small-scale producer.

Note: Key successes are noted with a green + symbol; ongoing challenges and critical considerations for sustainability are noted with a red - symbol; and mixed or neutral findings are noted with a gold ~ symbol.

B. Market assessment

The market assessment examines the influence of the APC project on the development of inclusive markets for SSPs. We assess changes in market actors since the beginning of the APC project—and the extent and nature of SSPs' engagement with them—using two case studies: cauliflower in Laikera block, Jharsuguda district; and brinjal in Kolnara block, Rayagada district. (A third case study of tomato in Khaprakhol block, Bolangir district was conducted at interim but given similarities with the brinjal case study we did not extend it to endline.) The market assessment draws primarily on a participatory market mapping exercise that Intellecap conducted with SSPs and with PC staff and project implementing partners, but also on focus group discussions and interviews conducted for the process evaluation.

We find that the **APC project fundamentally changed the agricultural market for SSPs** by **increasing winner crop production volumes** and expanding the number and quality of **input sellers and crop buyers to whom SSPs are connected**. The project also improved the ways in which SSPs engage in the market, including through synchronized production and sales, **better quality assessment practices**, and better access to **higher-quality inputs and accurate market price information.** As a result, SSPs perceive they have **increased agricultural income** (due to greater sales volumes rather than higher prices), and **buyers are satisfied** with the relatively higher quality and consistent quantity of produce. Although these benefits are more pronounced in cases where the PC continuously promotes a winner crop over multiple seasons/years, some benefits can be sustained even if the PC stops promoting a winner crop. **Table ES.2** describes the key cross-case findings from the market assessment in more detail.

Table ES.2. Key endline findings from the market assessment

***Market structure:* Basic conditions of supply, demand, and the enabling environment**
⊕ Since the launch of the APC project, SSPs now **synchronize their production** and **cultivate larger volumes of winner crops through PGs**, having previously cultivated small volumes for home consumption and sales to local markets and traders.
⊕ Production increases were driven by **increased area cultivated** and/or **increased off-season production** facilitated by linkages to government subsidies and infrastructure investments for irrigation in some areas.
⊖ Nonetheless, many SSPs describe **lack of access to perennial water sources and irrigation** as an ongoing barrier to cultivating crops in the off-seasons in some areas.
⊕ SSPs now rely **less on local traders and markets** who offered less favorable terms for both input purchases and output sales. Instead, SSPs now have greater access to **more bulk input suppliers** located further away and better connections to government subsidy schemes for inputs, while PGs and PCs coordinate collective sales of winner crops to **larger and more distant output market actors**.
~ One case study illustrates that **even when a PC discontinues promotion of a winner crop, SSPs can sustain increased production and sales** directly to buyers, provided there is ongoing upstream support from the PC. However, the long-term sustainability of this arrangement without PC marketing support is uncertain.
***Market conduct:* Value chain actors' engagement in the input and output markets**
⊕ SSPs now have access to **more accurate and reliable market price information** through PGs and PCs, which enables both PCs and SSPs to negotiate prices and sales volumes.
⊕ SSPs also now have **better access to higher-quality seeds and organic fertilizer** and have improved their quality assessment practices.
~ The APC project has **not substantially changed SSPs' storage practices**, with most SSPs continuing to store their produce at home for just a day or two prior to sale, if at all. Some stakeholders felt that there **were limited returns to investments in cold storage for perishable horticultural crops**.

***Market performance:* Extent to which the market serves buyers' and sellers' interests**
+ SSPs **perceive that their income has increased** due to larger volumes of winner crop sales and more reliable prices, motivating them to continue engaging in the market, although SSPs do not perceive PC prices to be systematically higher than those offered by other buyers and no PC profit sharing has taken place.
+ **Production gluts and associated market price drops** due to synchronized production **did not appear to be occurring** in our case studies, and most PCs were pursuing some mitigation measures.
+ **Buyer demand is being met by the PCs** in terms of **quantity, quality, and convenience.** Across all three markets, buyers perceive that SSPs engaged in the APC project provide higher-quality produce than other producers, primarily due to good quality assessment practices.
~ Although some buyers are willing to transact with individual SSPs at the village-level once a PC stops promoting a winner crop, they still **prefer the PCs' aggregation model as it is more convenient.**

Note: Key successes are noted with a green + symbol; ongoing challenges and critical considerations for sustainability are noted with a red – symbol; and mixed or neutral findings are noted with a gold ~ symbol.

C. Impact evaluation

The impact evaluation estimates the APC project's impacts on SSPs' outcomes. It uses a quasi-experimental matched comparison group design to compare outcomes of PG members at the end of the project in 74 project villages in which PGs were formed through the project in late 2020 and early 2021 (treatment) to those of similar SSPs in 97 non-project villages (comparison). We note that the treatment villages are only representative of late-forming PGs and not the full set of PGs formed by the project and that the impact evaluation findings therefore might not generalize to all project PGs. Mathematica's local data collection partner, Development Corner (DCOR), conducted an endline survey of 2,015 SSPs in the treatment and comparison villages (PG members and SHG members, respectively). This endline survey captured information about a full agricultural year between three and four years after these PGs were formed. We analyzed impacts for both the full sample of treatment SSPs and for a smaller group of SSPs (about 40 percent of the total) who were highly engaged with the PGs/PCs at endline.

Overall, we find evidence of positive project impacts for many key outcomes at endline (**Table ES.3**). About four years after their PGs were formed, **PG members had an average annual net agricultural cash income (revenues minus costs) about 40 percent higher than the comparison group, and 70 percent higher than the comparison group for PG members who were highly engaged in the project**. Increased production volumes and sales of **winner crops contributed meaningfully** to these gains but so did that of other crops—pointing to the **broader positive impacts** of the project and associated government convergence on the cultivation and commercial orientation of SSPs. Impacts were greatest in the dry season, where the **increased access to irrigation facilitated by convergence proved critical** to expanding SSPs' marketable surplus of high-value crops.

Table ES.3. Key findings from the impact evaluation (impacts relative to the comparison group)

Outcome	Dry season		Rainy season		Full agricultural year	
	Full sample	Highly engaged sample	Full sample	Highly engaged sample	Full sample	Highly engaged sample
Total area cultivated	+0.14 ha	+0.04 ha		+0.18 ha		
Area irrigated	+0.10 ha	+0.03 ha		+0.11 ha		
Area of winner crops cultivated	+0.05 ha	+0.02 ha		+0.02 ha		
Harvest amounts	Variable magnitude	Variable magnitude		Variable magnitude		
Yields						
Commercial crop sales, any crop	+14 pp	+39 pp	+9 pp	+20 pp		
Commercial crop sales, winner crops	+13 pp	+39 pp	+11 pp	+21 pp		
Total agricultural revenues[a]						+37%
Net agricultural cash income (revenues minus costs)					+41%	+71%
Women's economic empowerment[b]						
Minimum dietary diversity for women		13 pp				

ha = hectares; pp = percentage points

Note: Green cells indicate statistically significant impacts at the .05 level (magnitude of impact specified in the cells); gold cells indicate no such impacts; gray cells indicate not applicable

[a] Impacts were driven by revenues from both winner crops and other crops; there were no impacts on livestock-related revenues

[b] There were no impacts on women's input into agricultural decision-making or use of agricultural income using standard survey measures; however, qualitative data suggested more nuanced positive shifts in women's leadership and influence in decision-making

D. Conclusion

Synthesizing key findings from all three evaluation components, the APC project's innovative FPO model resulted in a fundamental shift in the agricultural market for women SSPs that has meaningfully improved their economic wellbeing. With improved access to more expansive and reliable buyer and input supplier networks—and increased access to irrigation and other support through government convergence—SSPs increased their marketable surplus and became more commercially oriented. By the end of this phase of the project, the APC project's FPOs had achieved operational and financial stability. However, longer-term sustainability and growth will require a clear financing mechanism for critical field-level SSP support roles, linkages to address FPO's needs for additional formal financing, ongoing technical support to strengthen FPO governance and technical capacity, and renewed efforts to meaningfully engage SSP members with their FPOs for those who have not done so to date.

I. Introduction

More than 90 percent of farmers in the state of Odisha, India cultivate less than two hectares (Department of Agriculture and Farmer Welfare 2022–2023). These small-scale producers (SSPs) face numerous constraints, including limited access to and inefficient use of inputs and modern farm equipment, poor access to credit, lack of agronomic and market information, and inadequate irrigation and other infrastructure. This leads SSPs to have low production volumes and only a small marketable surplus, if any. As a result, SSPs have limited market power and high per unit transaction costs, making it optimal to sell their limited volumes of produce to village-level traders who buy at the farm gate and capture most of its value by reselling to secondary buyers, or at local markets which are laborious and time-consuming to access The constraints to market inclusion are even more acute for women SSPs, due to limited decision-making power within their households, lower control over landholdings and other assets, and limited mobility in their communities (Ray et al. 2024; Kumar et al. 2021).

Gender-intentional interventions that increase market opportunities for women SSPs have the potential to empower them economically by increasing their income, productivity, and savings. Under the right conditions, they can also increase women's decision-making power in their livelihoods, control over income, and intrahousehold bargaining power (Malhotra et al., 2024). Farmer producer organizations (FPOs) are one promising intervention that can mitigate many of the constraints SSPs face. However, only 36 percent of registered FPO members in India are women (Government of India 2024).

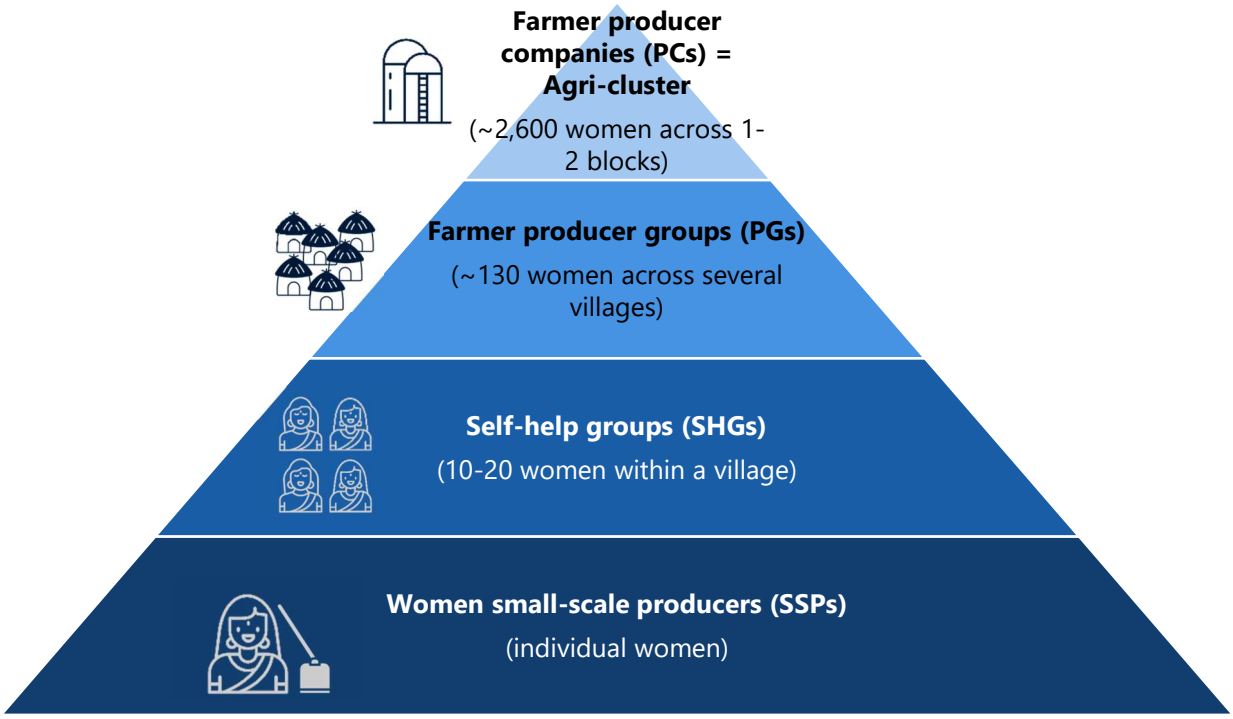
Since 2021, Mathematica has been evaluating the impact of an FPO model in Odisha co-funded by the Gates Foundation, known as the Agriculture Production Clusters (APC) project, which aims to increase women SSP market inclusion by simultaneously addressing many of the key constraints they face.[1] The overall goal of the project was to "sustainably double the income of one lakh (100,000) small and marginal self-help group (SHG) women farmers." The APC project is a collaboration between the non-governmental organization (NGO) PRADAN, the Government of Odisha and the Bharat Rural Livelihoods Foundation India.[2] The project develops production clusters in which women SHG members—a collective of women at the village-level—form farmer producer groups (PGs) that synchronize production of crops with high market demand ("winner crops," which are primarily horticultural). Each PG comprises about 100 to 150 SSPs in a handful of villages and is expected to practice synchronized production of a small number of winner crops (typically two or three) each season. These PGs are aggregated into producer companies (PCs), a type of FPO legally registered under the Indian Companies Act, which supports production and agricultural sales by PG members and PC shareholders (typically 2,600 shareholders per PC). Each APC cluster consists of about 23-25 PGs where synchronized production and primary-level value addition activities are undertaken. **Figure I.1** provides a graphical illustration of the project model. The APC project also supports livestock production. It coordinates closely with the government of Odisha to deliver

[1] During the period it was co-funded by the Gates Foundation the APC project was also known as the Augmentation in Small Holders prosperity through Agriculture production cluster (ASHA) project. However, since it is widely known in Odisha as the APC project, we use that acronym throughout this report.

[2] The Bharat Rural Livelihoods Foundation is an independent society created under the national Ministry of Rural Development to support and expand civil society initiatives in rural India, especially impoverished tribal areas. It coordinates closely with central and state governments in India, as well as private donors, to support socioeconomic development in these areas.

complementary interventions, including irrigation infrastructure, modern farm equipment, and post-harvest infrastructure.

Figure I.1. Structure of the APC model



Note: figure adapted from 3ie (2020)

In this final evaluation report, we assess the APC project's impacts on the market for winner crops faced by SSPs and on SSPs' outcomes. In the rest of this chapter we provide additional details about the implementation of the APC model and the evaluation methodology. Chapter II presents the findings from the endline process evaluation, which examines project implementation and prospects for sustainability and scalability. Chapter III presents findings from a market assessment that includes two case study geographies with distinct winner crops. Chapter IV presents findings from the endline impact evaluation, which rigorously estimates project impacts on SSPs' outcomes using a quasi-experimental matched comparison group design. In Chapter V, we conclude and discuss lessons for scaling and replicating the APC model.

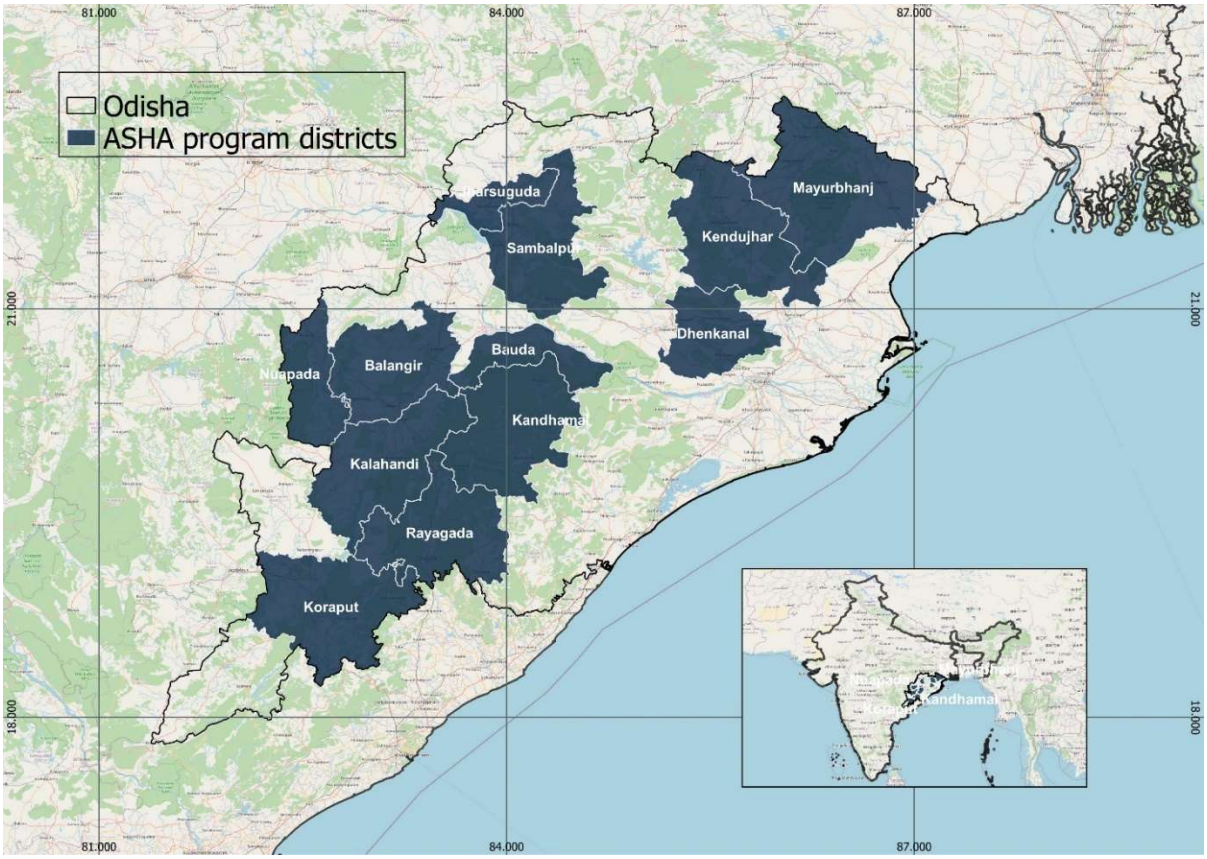
A. Implementation details

An early version of the APC project was launched by the Government of Odisha in November 2018. The Gates Foundation began co-funding it starting in October 2020, when PRADAN and its partners implemented the project in selected villages in 40 tribal-dominated blocks in 12 highland districts of Odisha ("Phase I" blocks, in PRADAN's terminology) (**Figure I.2**). The APC project focuses mainly on horticulture crops; the temperature and humidity in the highland topographies in the blocks targeted for the APC project are well-suited to the cultivation of a wide variety including brinjal, tomato, chili, cauliflower, gourds, and more. PRADAN is the lead implementation partner. In addition to directly implementing the project in 10 blocks, PRADAN provides technical support to 16 partner non-

governmental organizations (NGOs) that implement the project in the remaining 30 blocks. In addition to supporting the production of high-value horticulture crops, the project has identified livestock rearing as another channel to further improve and diversify SSPs' livelihoods.

Starting in 2022, PRADAN and its partners expanded implementation to a further 33 blocks ("Phase II" blocks); these blocks are not included in Mathematica's current evaluation, which is the focus of this endline report. Implementation in the 40 Phase I was originally scheduled to end in early 2024 but was extended by six months. PRADAN has indicated that they now expect support for PGs and PCs in these blocks to be extended for several more years—including adding new households into the project—through a combination of government of Odisha and foundation funding. Starting in late 2024, the government of Odisha began to expand implementation to a further 27 new project blocks, for a total of 100 project blocks.

Figure I.2. APC project geographic coverage (Phase I: 2019-2024)



As mentioned above, the APC project is built on the concept of agriculture production clusters, whereby groups of SSPs in a defined geographic area (typically a block) are encouraged to coordinate their crop choices and synchronize production of a basket of "winner" crops that have high market demand. These crops are mostly in horticulture value chains, but also include other high-value crops like aromatic/indigenous paddy, pulses and oilseeds; winner crops vary both across blocks and across seasons and years within a block. To facilitate production of winner crops in APCs, the project supported the

creation of PGs to practice synchronized production of a small number of winner crops (typically two or three) each season.

The project provides wide-ranging support to SSPs along the entire value chain, including access to high-quality affordable inputs; reliable market price information; training on improved agricultural "package of practices"; support for quality assurance, and post-harvest management including grading, sorting, packing, and storage; and facilitation of transportation and aggregate sales of crops to buyers. The project model also includes support for goat and poultry rearing.

PRADAN and its NGO implementing partners also provide technical support to both PGs and PCs in management, operations, and marketing to complement support provided by the Government of Odisha. The PGs formed under the APC project are intended to be largely decentralized, with PGs independently managing production of their specific winner crops and coordinating with the PC primarily for inputs, aggregation, and sales. This is expected to reduce the management burden on PCs and ensure a high level of accountability and ownership by member SSPs.

The APC structure also serves as a mechanism to coordinate complementary support for rural livelihoods through "convergence" with schemes implemented by various government entities related to irrigation, storage and post-harvest processing, modern farm equipment (including mechanized equipment), seeds and other inputs, livestock support, agri-finance, and agricultural technology adoption. PRADAN and its partner NGOs play a critical role in mobilizing the project villages to assess their needs for these interventions, formulate a plan for them to be addressed, and coordinate with the relevant government agencies for approval and implementation.

B. Evaluation approach

Mathematica conducted a rigorous, mixed methods evaluation of the APC project comprised of a process evaluation, market assessment, and impact evaluation. Below, we provide a high-level summary of these components; **Annex A** describes the data sources and analysis approach in more detail.

- The **process evaluation** explores the successes and challenges of project implementation, as well as the sustainability and scalability of the project model. The process evaluation draws primarily on an analysis of qualitative data, complemented by descriptions of program monitoring data that we received from project implementing partners.
- The **market assessment**, which assesses the influence of the APC project on developing inclusive markets for SSPs, draws on three case study geographies with distinct winner crops/value chains: cauliflower, brinjal, and tomato. We examine changes in two of these specific endline value chains (cauliflower and brinjal) since the beginning of the APC project, including shifts in market actors (buyers and input sellers) and the extent and nature of SSPs' engagement with them. We also synthesize common learnings across all three case studies, bringing in interim findings from the tomato value chain that we did not pursue at endline, and extract lessons about how the APC project can shift horticultural markets for SSPs beyond specific value chains. The market assessment draws primarily on the participatory market mapping exercise that we conducted with SSPs and with PC staff and project implementing partners in each of our case study geographies.

- The **impact evaluation** uses a matched comparison group design to compare outcomes for PG members (the treatment group) to outcomes for similar SSPs in areas where PGs were not formed (the comparison group). The endline impact evaluation draws on two rounds of a survey conducted with treatment and comparison group SSPs to estimate project impacts on key outcomes in select project geographies over all seasons in a full year, between three and four calendar years after PGs were established there.

Table II.1 presents the research questions that the evaluation seeks to answer. (The evaluation design report [Borkum et al. 2021] includes a detailed set of sub-questions under each main research question.)

Table II.1. Research questions and evaluation components

Research question	Evaluation component(s)	Baseline (2021)	Interim (2023)	Endline (2025)
RQ1. What were the main successes and challenges in project implementation? How were implementation challenges addressed?	Process	X	X	**X**
RQ2. What were the behavioral, income, and welfare impacts of the project delivery model on SSPs, including gender-specific impacts?	Process and impact		X	**X**
RQ3. What was the cost-effectiveness of the project delivery model?	Process and impact			**X**
RQ4. What were the direct and indirect impacts of the project delivery model on SSP price realization, market engagement, and private sector investment/participation?	Process, market, and impact		X	**X**
RQ5. What is the validity of these impacts beyond these specific value chains and market contexts? Are there specific opportunities or risks in sustaining or scaling the delivery model?	Process			**X**
RQ6. What were the impacts on agricultural market system dynamics in Odisha, specifically in five areas: information flows, inclusivity, transparency of interactions, value chain transactions, and macroeconomic impacts (including resilience against market and environmental shocks)?	Market		X	**X**
RQ7. How did national or state government policies and regulations influence implementation and impacts of the delivery model, both on SSPs and on market system dynamics?	Process and market		X	**X**

II. Process Evaluation Findings

In this chapter, we present the key findings from the process evaluation, drawing on key informant interviews and focus group discussions over three rounds of data collection, as well as PRADAN's monitoring data and documentation as of Q1 2025. (See **Table ES.1** in the Executive Summary for a summary of these findings.)

A. Key aspects of the project model that have driven success

The APC project distinguishes itself from other FPO models through its collaborative and rigorous approach that identifies and promotes a basket of "winner crops" that are each promoted at the cluster level. APC project areas use a systematic three-criteria framework to select specific high-value crops as "winner crops", undertaking a rigorous analysis of market attractiveness, smallholder suitability, and agro-ecological compatibility (**Box II.1**). This tailored and diversified approach reduces risk while maximizing income opportunities for small and marginal farmers. Each season, project implementing partners work with PGs and PCs to select a handful of crops per block (the level at which PCs operate) based on this comprehensive matrix, ensuring both economic viability and farmer capacity to successfully cultivate the chosen crops. PGs then select which of these crops to produce, and PCs select which of these crops to aggregate and sell. Each APC cluster consists of about 23-25 PGs in which synchronized production and primary-level value addition activities are undertaken. The promotion of winner crops at a cluster-level across multiple PGs linked to the same PC makes economies of scale possible for both the input and output markets. As described in the concluding chapter, this cluster-based model has influenced how other government schemes are implemented in Odisha.

Box II.1. Winner crop selection criteria

- **SSP suitability.** Initial investment required; labor availability; existing knowledge; storage feasibility.
- **Agro-ecological compatibility.** Weather conditions; soil compatibility; resilience to pests; rainfall/hail criticality.
- **Market attractiveness (via market assessments).** Profitability, price stability, transportation, market linkages, market demand; processing opportunities.

Another unique strength of the APC model is its federated structure organizing farmers into PCs and PGs from women's SHGs with existing social capital and collectivization. As described in the introduction, the APC project is a federated organizational model that organizes women SSPs who are already members of SHGs into PGs and PCs to increase their inclusion in agricultural markets and empower them economically. Unlike other models where PCs are formed first, the PG is the primary institution of the APC project at the village level. Its primary role is to support its members to synchronize production, increase production volumes, and collectively market produce. The PC is a secondary institution created by federating the PGs in one or two blocks; by taking advantage of its larger scale, the PC is expected to improve access to

"A big opportunity in India is that we have 7 million women farmers already mobilized into women SHG groups. Our partner NGOs take advantage of this built-in social capital by further organizing these groups into producer groups and companies. This is a strong institutional mechanism set up with support of Mission Shakti, partner NGOs, and PRADAN."

Government official

inputs and marketing opportunities for SSPs. This bottom-up approach to FPO development led by PRADAN and its partner NGOs has fostered a sense of community ownership of the project.

Government officials described that another key and unique part of this federated structure is that it builds on the foundation of women's SHGs—a collective of women at the village-level which has become a critical vehicle for rural development, poverty alleviation, and service delivery in India in the past several decades. According to implementing partners, the APC project is the only large-scale government program that builds on rural women's SHGs to establish and recognize members' identities as farmers, and build market linkages for them. The project's federated structure leverages the existing institutional social capital of SHGs, in which women are already used to working collectively, hence facilitating collective decisions and action as part of the PG and PC in terms of crop production and sales.

The APC project is now recognized as a definitive model for government convergence due to its multi-level advisory structure, with APC blocks now receiving priority in government scheme allocation. PRADAN engages the government heavily in APC project planning, monitoring, and review processes, which has fostered the government's buy-in and sense of project ownership. While the DOH is the nodal agency for the project, APC operates through multiple advisory committees at the block, district, and state-levels, which meet monthly, quarterly, and semi-annually, respectively. This enables government officials from numerous departments and at multiple levels to participate in APC planning, though some geographies experience less frequent block-level coordination than intended. This in turn has helped mobilize resources and created a strong foundation for project sustainability and scale up.

> "APC is the perfect example of how multiple government schemes can be coordinated and how we can create clusters. It is the only project where we converge with schemes from 10-12 departments."
>
> *Government official*

> "For government schemes, APC clusters are now given priority, to ensure they get access. The government has seen the benefit of providing these schemes in an integrated manner rather than scattered and sporadic."
>
> *Implementing partner*

B. SSP participation

In this section, we assess the ways in which SSPs participate in the APC project, and factors influencing engagement.

The APC project has surpassed its targets for SSP participation at a direct cost of about 4,900 rupees ($57) per beneficiary. As of Q1 2025, the APC project had formed 932 PGs with a total of 122,616 members (132 members per PG on average) in the original 40 blocks; and these PGs were organized into 30 PCs with 82,095 shareholders (2,737 shareholders per PC on average). By contrast, nearly 80 percent of the more than 700 FPOs in Odisha have fewer than 100 farmer-members (Joshi 2022). Taking into

consideration the overall direct costs of the project in the 40 blocks (about 600 million rupees, or $7.0 million), the project cost was about 4,900 rupees ($57) per PG member.[3,4]

SSP participation is driven by extensive upstream and downstream services to SSPs for a diverse set of winner crops. SSPs benefited from the APC project in a variety of ways. **Figure II.1** shows selected SSP-level indicators of SSP participation from project monitoring data; the monitoring data also include additional PG- or project-level indicators described here. According to PRADAN's monitoring data, a total of 93,191 PG members (76 percent of all PG members) cultivated winner crops over a total area of 35,480 hectares in 2024-25, while 93 percent of project PGs established synchronized production of winner crops, and 97 percent of project PGs were engaged in collective marketing (including those engaged in collective marketing of livestock and livestock products). High value vegetables accounted for about 75 percent of the area of winner crops cultivated, comprising a wide variety of specific crops, with the remaining 25 percent accounted for by high value paddy, pulses and oilseeds, which have become more of a project focus over time due to farmer demand and preferences. The project's promotion of a variety of winner crops encourages participation from a diverse group of SSPs.

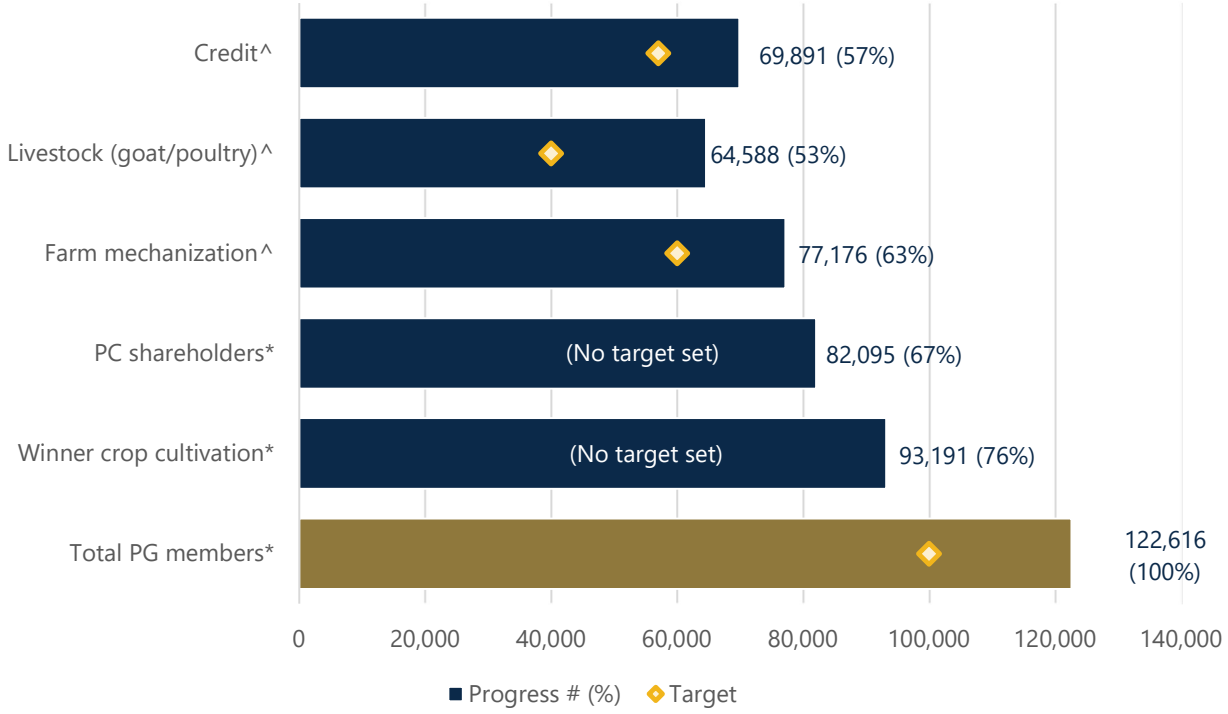
The APC project also provided wide-ranging upstream support and services to SSPs, including access to mechanized farm equipment through PC custom hire service centers (63 percent of PG members),[5] access to credit through internal loans provided by PGs (57 percent of PG members), access to critical irrigation infrastructure through linkages to government schemes (13,200 hectares of land irrigated); support for grading, sorting, and packaging (76 percent of PGs), and access to storage through partnerships with private entities and government schemes (560 units, including 92 pack houses, 157 larger storage structures, and 311 low-cost storage structures like zero energy cool chambers or *sabjee* coolers).

[3] The project also mobilized substantial government resources through convergence with government schemes, which was a cornerstone of the project model as described below. In a forthcoming scalability, cost effectiveness, and lessons learned report we will conduct a more detailed cost analysis that also considers those additional costs. Further, we will also combine cost data with estimated impacts on SSP income from the impact evaluation to estimate the project's cost effectiveness.

[4] We converted rupee amounts to dollars using the average currency conversion rate as of the date of this report, which was about 86 rupees per dollar.

[5] Custom hire service centers, also known as custom hiring centers, are established by some FPOs in India to provide farmers, especially small and marginal ones, with access to agricultural machinery and equipment on a rental basis.

Figure II.1. Number and percentage of PG members engaged in APC activities



Sources:
* PRADAN ASHA Completion Report (2025)
^ PRADAN Results Framework Tracker (2025)

Beyond horticultural winner crop cultivation and collective sales, the APC model provides other inclusive pathways for SSP income generation, including livestock rearing and fruit tree and mushroom cultivation. As implementing partners noted, these additional targeted interventions were a specific focus in areas where irrigation or infrastructure constraints limited horticultural winner crop cultivation. According to project monitoring data, 35 percent of PG members participated in backyard poultry or goat rearing,[6] while 14 percent cultivated fruit trees and 3 percent grew mushrooms. This inclusive design ensures that women SSPs engaged in the project can find appropriate entry points regardless of their resource constraints. For example, landless or land-poor farmers who cannot dedicate substantial area to horticultural winner crops might be able to engage meaningfully in backyard poultry activities requiring minimal land.

Despite the multiple pathways for project engagement, some PG members remain inactive or are yet to become PC shareholders. APC project leadership acknowledged at interim that some PG members were still not actively engaged in any of the key project activities, although the exact share was not clear from project monitoring data. This continued to be the case at endline, despite additional efforts by implementing partners to encourage engagement. The ongoing gap suggests that this is likely to be a

[6] The project encouraged PG members to adopt intensive livestock farming with proper herd size, shelter, immunization, and feed management. According to project monitoring data, a smaller share of PG members (28 percent) adopted these more intensive livestock practices.

long-run feature of the model. Discussions with project stakeholders suggest multiple possible reasons for PG member inactivity. First, SSPs might lack of interest in the winner crops identified, or be averse to risk in taking up new crops due to concerns around not having access to enough land, capital, or irrigation to turn a profit, or ability to produce and harvest enough produce within the synchronized timeframe. Second, some SSPs rely on and remain in debt to *kuchias* and other local traders for production and sales of staple crops, limiting their ability to transact through the PG. Third, some SSPs were already members of other, non-APC FPOs in the area and may not see additional benefits of engaging more deeply with the APC PGs/PCs. At endline, project implementing partners described additional measures that had been undertaken to increase active participation, including exposure visits for inactive members to villages where greater winner crop cultivation was happening, and more training and on-field support for taking up new winner crops. Overall, changing SSPs' behaviors is challenging (as described below), and more time might be needed for some SSPs to observe how their neighbors are affected by the project and be convinced to increase their engagement. However, the project might consider focusing more on outreach to less engaged members to help them decide if they want to engage and, if so, support them in doing so. Actively engaging a larger fraction of PG members in the project would broaden its impacts on SSPs' livelihoods and further support its stated mission of market inclusivity.

Similarly, some PG members were not sufficiently motivated to become PC shareholders. By March 2025, 82,095 farmers had become PC shareholders, or about two-thirds of all PG members. This represents a doubling of the number of shareholders in two years, yet still leaves one-third of PG members as non-shareholders. As described in more detail in our interim evaluation report (Borkum et al. 2024), the unique additional benefits provided to PC shareholders relative to other PG members—which can include priority access or preferential prices for "doorstep" provision of inputs and produce aggregation, modern farm equipment rentals, access to storage facilities, and digital payments for PC-facilitated output sales— vary across PCs, and in some PCs might not provide sufficient motivation to become a shareholder.[7] Further, none of the PCs have yet paid out dividends to shareholders, instead reinvesting any profits in the PC. Other key barriers include unaffordable share costs (which has been partially addressed by allowing installment payments),[8] challenging bank documentation requirements, and geographic distance from PC services. PC staff also explained that in some cases, PG members are reluctant to join the PC because someone else in their family is already a PC shareholder and they see no benefit of paying more than one shareholding fee within the family. PC staff and board members described being actively engaged in going village-to-village to recruit PG members to become shareholders, but explained that they were limited in their capacity to do this given limited time and staff. Future plans to further incentivize shareholding include better access to credit through the PCs, specialized training for SSPs, and value addition services. Clearer differentiation of PC shareholder benefits by PCs could drive higher shareholding in the future, but must be balanced against the PCs' desire to continue serving a broader group of female SSPs.

[7] With regards to digital payments, qualitative data from SSP FGDs and PC staff interviews suggest that a lack of access to a cash-out point (ATM or bank)—or inconvenience of these cash-out points—mean that many SSPs still prefer cash payments.

[8] PC shareholders pay one-time shareholder fees ranging between 500 and 1000 rupees (depending on the minimum number of shares required to become a shareholder).

C. PG/PC operations and performance

In this section, we examine the extent to which the project's PGs and PCs are operating as intended, including key aspects of the organizational model and measures of their business performance to date.

PG performance

Most project PGs have achieved stability after about two years of critical government start-up funds and experience in crop planning and production coordination; however, access to ongoing working capital remains more limited. As described in more detail in our interim report (Borkum et al. 2024), it takes at least a couple of years for PGs to become fully operational. Public financing is critical to PG start-up, and convergence with government schemes takes months or years to achieve and is often dependent on scheme availability and seasonality. According to PRADAN's project close-out report, 95 percent of the 932 PGs have now received government Institution Building and Capacity Building (IBCB) funds, totaling 181.8 million rupees ($2.1 million). However, only 57 percent of PGs have accessed government financing for working capital, totaling 60.3 million rupees ($0.7 million). The working capital financing is typically only for the first three years of PG operation. These two sources of funds serve distinct but complementary purposes in strengthening PG institutional capacity and operational effectiveness: PGs utilize IBCB funds to set up offices, acquire assets, and pay staff; while working capital funds serve as revolving credit for internal loans to members for crop cultivation, livestock rearing, and other income-generating ventures, with interest earnings providing additional income.

Implementing staff also described at interim that it takes a couple of years for PG members to successfully complete a few cycles of crop planning, synchronized production, and collective marketing. After having gained this experience, the PGs become more independent in these processes and rely less on the support of PRADAN and its implementing partner NGOs.

The project's FPOs perform best when agro-climatic conditions drive farmer interest, the government has committed support, and NGO implementing partners have well-established capacity. PRADAN staff explained that these three elements are critical to success. First, differences in irrigation potential, soil conditions, and topography create variation in productivity; this affects SSPs' interest in cultivating winner crops. The district administration's commitment to the APC project also has a strong influence on the project's success—particularly for linkages with government schemes for irrigation infrastructure and subsidies (described in more detail below).

> "Performance depends on farmer interest based on the surrounding conditions, partner NGO interest in implementing the scheme, and the district administration's interest. When all three come together, you see clusters perform very well."
>
> PRADAN staff

Finally, the capacity and performance of partner NGOs significantly influences project outcomes. As described in more detail in the interim report, PGs established in the earlier stages of the APC project are more stable than those established later**,** for which some NGO partners entered new geographies for the first time, and where PGs experienced delays with training and start-up funding from the government.

PC performance

Since interim, the PCs have transitioned from lean new market entrants to fully-staffed businesses, effectively managing their daily operations, finances, and governance. Although PCs were initiated with some delay relative to initial plans, all 30 PCs serving the original 40 project blocks are fully operational. Initially, these PCs relied heavily on PRADAN and implementation partner NGO support for operations. Over the past year and a half since the interim study, however, they have hired and retained dedicated staff including CEOs, accountants, marketing managers, and other roles. The PCs now also have established mechanisms for selecting board members from PG members every two or three years, ensuring smoother leadership transitions and strengthening governance and organizational stability. In the process, they have ensured that the new board members will come from within the community. They also prioritize selection of PG members who are more invested in the PC's success—specifically, those who have frequently transacted with the PC. This approach reinforces the sense of ownership among community members, as they see the PC as their own company, built for them and managed by them, which further strengthens trust and engagement.

The PC staff and board members have also improved their capacity and processes since our interim study, according to PCs and implementing partners. Accounting has been standardized and compliance has improved, as all PCs have now established systems for record entry and book-keeping. Staff and board members have gained experience in shareholder recruitment and engagement, procurement, information dissemination, and buyer selection. The PCs have also gained experience transacting with multiple buyers and are now better able to identify which buyers to trade with—those who purchase large volumes, pay on time, offer competitive prices, and are flexible. They have generated a database of buyers they have transacted with over the last 3 years to facilitate repeat sales. Implementing partners explained that the capacity of PC staff and board members to negotiate independently with buyers has strengthened, as PCs have developed a greater focus on margins and profitability.

However, ongoing challenges remain with staff retention; some ongoing project financial and capacity-building support is still needed. Despite the improvements described above, staff retention remained an issue at endline for some PCs. In one of our case studies, the PC had lost several staff due to an inability to pay competitive salaries; they were unsure what to do to address the problem. By contrast, staff retention had improved in our other case study since interim, since earlier concerns about the PC being unable to generate profits/expand business had been alleviated.

> "Staff retention issues continue as before. Our CEO has already left, and recently two managers resigned from the PC. Our company does not have sufficient funds to pay higher salaries. We don't know what we can do to resolve this."
>
> *PC staff*

Both PC staff and project implementing partners said that PC staff and board members still require a degree of ongoing support—both in terms of financing and capacity building—in certain technical areas, despite improvements in the past year. These include accounting, buyer identification and negotiation, and coordination for government convergence.

The PCs have achieved a solid financial foundation through initial working capital and start-up grants and strong shareholder bases, positioning them for future bank linkages. At the time of our interim evaluation, when the PCs were newly established, only a few had received government start-up funding from Mission Shakti. With limited financial resources, they were not able to provide many services to their members. However, by endline, all of the 30 PCs had received their working capital grants. Further, 28 PCs had received the first tranche of an additional grant to cover operational costs, and 18 had received a second tranche. As described above, the PCs have also significantly expanded their shareholder bases, recruiting 82,095 shareholders across the 30 PCs by the end of the project (2,736 shareholders per PC on average).

"Earlier, a limiting factor when the PCs were new was limited money: government grants hadn't been received, share capital was limited. Now the PCs have reached a more mature stage where they are more confident and can provide more services based on members' demands."

Implementing partner

With this access to grant funding, a strengthened shareholder base (and related paid-up capital), and growing business experience, implementing partners explained that the PCs are now able to provide comprehensive services to their shareholders, and have solid financial foundations for sustained operations. As their revenue continues to grow, the PCs will be better positioned to strengthen financial linkages with banks and non-banking financial companies (NBFCs) to expand and diversify their businesses into lines with higher profit potential such as value addition and processing, as described in the section on sustainability and scalability below.

The APC PCs' overall financial performance has been strong compared to most registered FPOs in Odisha, generating increasing paid-up capital and revenues from sales through a commission-based model (Table II.2). Most registered FPOs in India are young and not yet stable, with very few reaching the stage of steady growth. By contrast, the 30 APC PCs in the original 40 project blocks, while still relatively young, have generated substantial and increasing revenue from both input and output trade since they were launched. The 30 PCs generated 35.3 million rupees ($411,000) in annual revenue in FY 2024-25 (1.2 million rupees or $14,000 on average). The PCs' average paid-up share capital of 0.9 million rupees ($10,500)—the amount received from shareholders in exchange for shares and a key indicator of PC viability—was well above the median in India of 0.1 million rupees and the typical range of 0.1-0.3 million rupees in Odisha (Joshi 2022, Neti and Govil 2022). However, no APC PCs have distributed cash dividends to date, as they continue to reinvest profits into business expansion, as we describe below.

"In Odisha, there are approximately 1,500 functional FPOs, but only 100-150 operate at a high level of effectiveness. Among them, the APC PCs have emerged as the top performers."

Government official

Table II.2. APC PC financial performance in FY 2024-25 compared to benchmarks

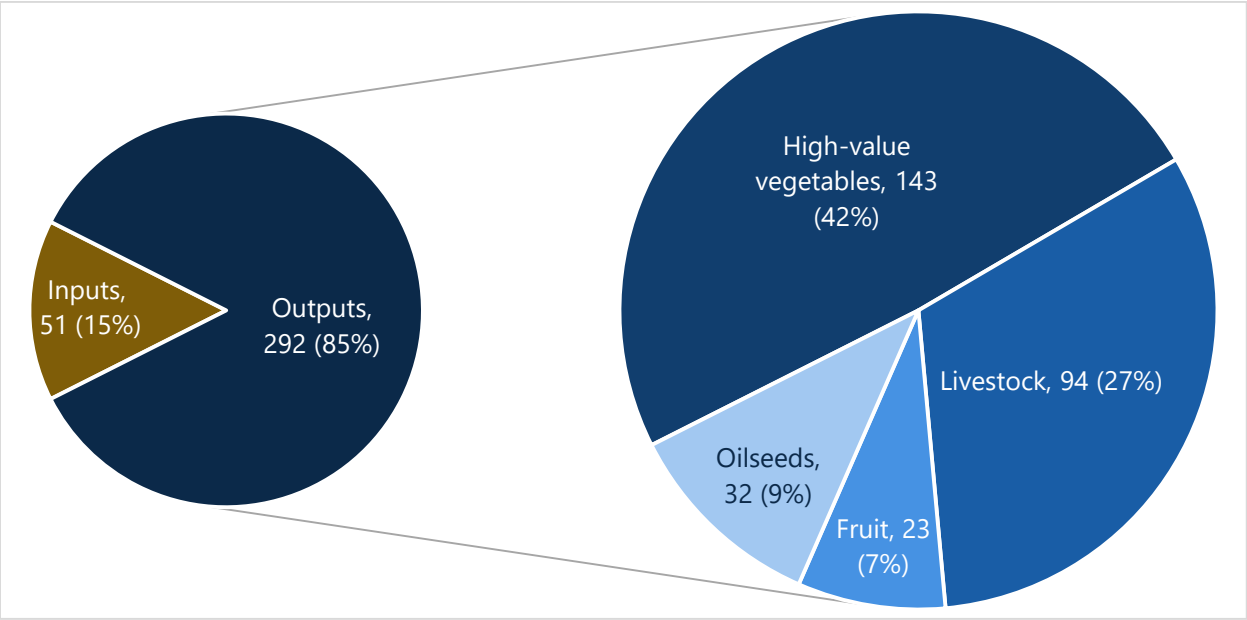
	APC PCs (average across 30 PCs)	Benchmark
Revenue	1.2 million rupees ($14,000)	--
Profit	24 of the 30 PCs had positive profits; median profits were 0.1-0.5 million rupees ($1,200-$5,800)	--
Paid-up capital	0.9 million rupees ($10,500)	Median of 0.1 million rupees ($1,200) for PCs in India[1,2]
# of shareholders	2,736	80% of Odisha FPOs have <100 members[1]

Table sources: 1= Joshi (2022), 2= Neti and Govil (2022)

Project PCs primarily generate revenue from output sales, with additional revenue from input sales (**Figure II.2**). In FY 2024-25, the 30 PCs generated 292.4 million rupees ($3.4 million) in revenue from output sales, and 51.1 million rupees ($0.6 million) in input sales, contributing 85 percent and 15 percent of their total sales revenue respectively. In terms of output sales, PCs sometimes conduct direct marketing, but more often play a facilitator role, whereby they arrange for buyers and inform the SSPs (through PGs) about the buyer's expected arrival at the village collection point. PG members then aggregate their produce at the collection point, the buyer collects the produce, and payment is made to the PC and distributed to SSPs, minus a commission. Output sales in FY 2024-25 were predominantly driven by high-value vegetables (42 percent) and livestock (27 percent), with some revenue generated from oilseeds and fruit sales. Project implementing partners also explained in interviews that some PCs were beginning to generate meaningful revenue through mechanized farm equipment rentals via custom hire service centers, although these amounts were not documented in the project monitoring data.

According to PRADAN monitoring data, the primary marketing channels for project PCs are traders (both direct and facilitated sales, accounting for 63 percent of annual revenues in FY 2024-25) and retailers (direct sales, 29 percent). PCs also sold a small amount of produce to processors and institutional buyers (3 percent), Agricultural Produce Market Committee *mandis* and the government's e-NAM (National Agriculture Market) portal (3 percent), and retail outlets (2 percent), all of which were facilitated sales. To date, the PCs have engaged with 796 buyers across eleven states in India.

Figure II.2. APC PC revenue sources (millions of rupees and percent of total), FY 2024-25



Source: Adapted from PRADAN's project completion report

Note: Revenues are defined as the values of sales for inputs sold by the PC and output sales conducted directly or facilitated by the PC

PC profits to date have not been substantial enough to distribute dividends to shareholders; the PCs currently use their profits for rotating working capital. Unaudited data for FY 2024-2025 show that 24 of the 30 PCs had positive profits. Among those PCs, median profits were 0.1-0.5 million rupees ($1,200-$5,800); 3 PCs had profits of more than 1.5 million rupees ($17,500). In both case studies, PC staff reported positive profits but noted that these were not yet substantial enough to distribute dividends. Instead, they used these profits mostly as rotating working capital. One PC also planned use the profits for additional insurance and credit for SSPs; another planned to use them to purchase assets in the future (either land or a processing unit for cashew production).

D. Winner crop selection and uptake

In this section, we describe how winner crops are selected, explore the main facilitators and barriers to winner crop uptake by SSPs, and discuss the sustainability of the crop selection model.

The winner crop selection process is inclusive; the project is supporting active female SSP participation and promoting self-determination by ensuring that SSPs have the final say. As described in more detail in our baseline and interim reports, potential viable winner crops are identified collaboratively at the block-level by PRADAN or its NGO partners in consultation with PC staff and board members, as well as with PG executive committees. Each PG has its own planning and monitoring sub-committee which then selects its winner crops from the list identified, and plans coordinated production and input procurement. PRADAN and its NGO partners then support the PG in building out a package of practices around those crops to ensure high-quality production. Finally, individual PG members decide which, if any, of these PG-selected winner crops they will produce and how much area they will dedicate

to them. According to PRADAN staff, actively engaging SSPs in the selection of the winner crops has been critical in convincing communities to adopt synchronized production of these crop over large areas.

"For the farmers in this area, brinjal is the main vegetable crop. Now we are trying to diversify it little bit, because crop rotation is required; we are trying to promote tomato and chili. But brinjal is easy for them as they know the technique about flowering, fruiting, and so on, so they naturally tend to cultivate brinjal more."

Government official

Winner crop uptake among smallholder farmers has increased substantially, driven by success of early adopters and improved market linkages over time. According to project monitoring data, winner crop cultivation by PG members has expanded dramatically over the course of the APC project, almost tripling from 9,016 hectares in 2019-20 to 35,480 hectares by 2024-25, with 76 percent of PG members cultivating winner crops in 2024-25. As we describe in more detail in our interim report (Borkum et al. 2024), initially, farmers were hesitant to adopt winner crops due to limited commercial agriculture experience and limited adoption of modern farming practices. However, witnessing early adopter success led to increased interest and production expansion. Exposure visits by SSPs to existing clusters and enhanced training sessions significantly boosted SSP confidence and facilitated greater adoption.

"To motivate inactive members, we organized exposure visits to villages where more winner crop cultivation is happening. We also provided more training and on-field support to farmers… After getting exposure, their interest increased."

Implementing partner

"Any crop change takes around two to three years. Adoption of new technologies takes time."

Implementing partner

Project implementing partners also explained that winner crop uptake has increased as the PGs and PCs have formalized market relationships with input and agri-tech suppliers. For example, in the case of crops like ginger, potato, or spine gourd, for which seeds are not readily available in local markets, implementing partners had to support PGs to identify private input suppliers who were able to extend their commercial operations into project areas—which often took a few years.

The APC project has also developed specific intervention strategies for each of the most common winner crops. According to PRADAN's close-out report, for each of the project's major winner crops, APC has developed a strategy for which interventions to prioritize, ranging from investments in upstream support to post-harvest management and specific types of market linkages. These are in addition to project interventions around inputs, packages of practices, and basic post-harvest processing that are common to all winner crops. For example, the APC project plans to invest in additional processing for chili and in market linkages to processors for tomatoes in the future.

Despite the APC project's emphasis on crop diversification and rotation, many SSPs prefer repeat cultivation of the same limited number of winner crops. PG members typically have more than one winner crop to choose from in each season—and are encouraged to cultivate at least two. The selection of more than one winner crop per season, together with variation in the selected winner crops across seasons and years based on the criteria discussed earlier, is expected to encourage SSPs both to diversify

their production within a season and rotate the crops they produce across seasons and years. As mentioned earlier, the APC project also promotes the production of non-horticultural high-value crops such as pulses and oilseeds to further diversify production.

However, our findings from both qualitative and survey data suggest that SSPs may prefer to focus on one specific crop that they are familiar with and/or have experienced initial success with under the project. This can increase the risks of soil degradation, pest attacks, and pesticide resistance, in addition to market price risks from production gluts. However, at both interim and endline, market gluts did not arise as a critical issue in any of our market assessment case studies (and many PGs and PCs were pursuing mitigation measures such as staggered planting).

PC upstream support for high-value crops preferred by SSPs benefits both SSPs and the PC, even if those crops are not selected as winner crops for PC aggregation and sales. As described above, the APC model for winner crop selection is driven by three criteria: market attractiveness, smallholder suitability, and agro-ecological compatibility. While all three criteria are important, they can be in tension, requiring a careful balance in the selection of winner crops. For example, if a crop lacks sufficient market attractiveness at a larger scale, then it does not make sense for the PC to engage in aggregate sales even if that crop has strong smallholder suitability and agro-ecological compatibility. By contrast, PG members may prioritize smallholder suitability for a crop with some local market potential, even if overall market potential is not as promising as for other crops. This is because crops requiring high initial investment or unfamiliar cultivation practices can be challenging for SSPs to adopt, despite strong market potential. Project staff explained that farmer familiarity and existing knowledge significantly influence adoption success, with crops like turmeric and indigenous paddy varieties gaining traction because farmers could build on traditional cultivation practices while accessing modern markets.

An example of how SSPs' crop preferences and market profitability can be in tension come from one of our market assessment case studies in Chapter III, where SSPs continued to cultivate and sell cauliflower after their PC stopped promoting it as a winner crop (due to low profitability). SSPs sold cauliflower directly to the PC's former buyers and continued to benefit from cauliflower-specific inputs and services provided by the PC. This example illustrates the importance of PCs continuing to offer at least upstream support for crops that are not selected for PC aggregation and sales but are preferred by SSPs. Offering this support—which can include improved seeds, training, quality assessment support, and irrigation—enables the PC to continue to engage with a broad range of PG members and increase its revenues (for example, through input sales or equipment rentals), without taking on the risk of potentially non-profitable aggregate sales. Positive SSP experiences with the PC for crops they are comfortable with might eventually encourage additional PG members to experiment with cultivating novel winner crops.

E. Public and private sector engagement

In this section, we assess the successes and challenges associated with coordinating APC project implementation with about a dozen government entities which are involved in convergence with government schemes. We also assess the influence of the APC project on private sector market participation.

Convergence with government schemes

Strong convergence with government schemes has been key to the APC project's success, with more than eighty-two million dollars leveraged to date from multiple government departments. The APC project has established strong linkages with multiple government departments and agencies, including Horticulture, Agriculture, Odisha Lift Irrigation Corporation (OLIC), Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), Mission Shakti, Odisha Agro Industries Corporation Limited (OAIC), Integrated Tribal Development Agency (ITDA), and the Odisha Livelihoods Mission (OLM), to develop agri-infrastructure at the cluster-level for irrigation, farm machinery, post-harvest management, and other purposes. The monetary value of convergence with government schemes reported by PRADAN was 6,849 million rupees ($79.8 million) by project close-out, significantly exceeding the end-of-project target. **Table II.3** summarizes detailed successes and challenges around convergence with specific types of government schemes, as shared by stakeholders during interviews and focus groups.

Table II.3. Successes and challenges with government convergence

Scheme type	Successes	Challenges
Irrigation	• Support for irrigation has been provided through a variety of government schemes and programs, including OLIC, OAIC, MGNREGA, Watershed, ITDA, and the DMF. • Irrigation infrastructure development has been particularly impactful, enabling *rabi* season cultivation. This includes the establishment of 428 new large-scale irrigation infrastructure Community River Lift Projects (and revival of 161 existing structures), and also medium-scale irrigation structures including 1,353 Micro River Lift Projects, 675 bore wells, and 3,175 farm ponds. • Access to subsidized micro-irrigation such as drip and sprinkler irrigation has also increased through convergence with the PMKSY scheme, with 2,363 hectares of land covered to date.	• Convergence of large-scale irrigation infrastructure like mega-lifts has been slow with limited access in some locations despite successes elsewhere. • Some geographies have no perennial water source, so the only feasible infrastructure would draw on borewells or ponds; those schemes are also not suitable for all geographies and are slow to occur. These irrigation facilities also require pumps, which some PGs have purchased for SSPs' use, but might have been delayed due to delays in receipt of PG funding. • SSPs remain relatively unaware of the PMKSY scheme, despite attempts to build awareness. Multiple requirements for micro-irrigation to be feasible—such as a large water source or borewell, pumps, and a large area of agricultural land—may also make this scheme irrelevant to many APC-affiliated SSPs.
Storage and post-harvest processing	• Post-harvest infrastructure has expanded significantly in APC project areas, with 560 storage structures now provided under MIDH government schemes. This includes provision of crates for sorting, grading, and packing, as well as storage infrastructure (including solar-powered cold storage). • In a few blocks, solar dryers have been established to add value, reduce perishability, and expand markets for crops like chili and ginger.	• Access to storage remains limited, and specific scheme access varies by location. • The minimum size for storage facilities was initially too large for PGs, though has now been reduced. • Returns to storage are primarily limited to semi-perishables such as ginger, onions, and turmeric. Cold storage for perishable vegetable crops has been more limited, as its primary purpose is to prevent distress sales. • Solar dryers are still not widespread.
Modern farm equipment (including	• Farm mechanization significantly expanded through the APC project through government convergence with the DA&FW and ITDA, with 77,176 farmers accessing	• Availability of modern farm equipment through government schemes varies by geography. • The amount of money SSPs must spend up front or as a copayment to purchase modern farm

Scheme type	Successes	Challenges
mechanized equipment)	equipment to date. This included equipment and machinery like power tillers, tractors, sprayers, ridgers, weeders, pump sets, and rotavators. • Farm mechanization *melas* (fairs) allow SSPs to purchase subsidized equipment on-site.	equipment may be preventing some SSPs from using them. • Some of the available modern farm equipment is not well-suited for use by females or smaller-built individuals, limiting the potential impact.
Seeds	• The APC project provides access to ITDA subsidized seeds with both partial and full subsidy options. Seed distribution is integrated into demonstration programs ensures timely availability, with priority given to APC clusters under the MIDH scheme for hybrid vegetables.	• Fully subsidized seeds may lack variety and timeliness of delivery may not align well with growing schedules, hampering production. • Partially subsidized seeds can be of a wider variety and accessible in time for planting, but many SSPs in locations where fully subsidized seeds are offered choose to wait for fully subsidized seeds to become available to save money.
Livestock support	• Shed construction facilitated under ITDA and MGNREGA, as well as connections to private organizations for additional funding support, has resulted in construction of 19,369 backyard poultry sheds and 18,179 goat sheds. • OLM provided support with vaccination and deworming services.	• Shed construction under MGNREGA has been constrained by labor and raw material issues. • In addition, SSPs who opt for shed facilities need to pay up front and are only reimbursed later. This has constrained the take up of shed construction-related activities, although some SSPs have built their own simple sheds after having been trained through PGs and PCs.
Credit	• According to project monitoring data, 57 percent of PG members accessed credit through PGs by project close-out, primarily through SHG federation linkages. PGs use working capital as revolving funds for internal loans to members, with interest earnings providing additional income.	• Only a fraction of government credit to SHGs is allocated toward APC activities, leaving members credit constrained. Banks remain reluctant to lend to PCs despite business plans, citing extensive documentation requirements and concerns about non-performing assets.
Agricultural technology adoption	• Technology adoption accelerated through government convergence, including advanced techniques such as mulching, grafting, soilless nurseries, and hybrid cultivation. Government departments formally adopted successful pilot technologies, with soilless nursery techniques introduced across all 40 original APC blocks by the MIDH.	• Changes in subsidy disbursement methods affected adoption rates. For example, mulching adoption decreased when payment requirements shifted from partial upfront payments to full upfront payments with later reimbursement, making initial fund arrangement difficult for SSPs.

Source: PRADAN project monitoring data and reports; interviews and focus group discussions

APC=Agriculture Production Cluster; DA&FW= Department of Agriculture and Farmer's Welfare; DMF = District Mineral Foundation; ITDA = Integrated Tribal Development Agency; MIDH= Mission for Integrated Development of Horticulture; MNGREGA = Mahatma Gandhi National Rural Employment Guarantee Act; OAIC= Odisha Agro Industries Corporation Limited; OLIC = Odisha Lift Irrigation Corporation; PC = Producer Company; PG =Producer Group; PMKSY = Pradhan Mantri Krishi Sinchayee Yojana Scheme; SHG=self-help group; SSP = small-scale producer.

Challenges with government scheme convergence remain, including a recent shift requiring upfront payment for subsidies, delays in funds disbursal, and staff shortages within the

government and partner NGOs. Government officials explained that most subsidy programs have recently been shifted to disbursal through the Direct Benefit Transfer program, which requires farmers to arrange full upfront payments with later reimbursement, creating financial barriers. This shift has adversely impacted scheme utilization by SSPs compared to previous arrangements.

Delays in fund disbursements and staff shortages on the ground create additional implementation bottlenecks. Although funding from multiple agencies benefits the project, it creates administrative challenges requiring coordination across different funding sources. Staff from one PC explained that, despite good coordination across the state, district, and block-levels, various government departments request the same documents repeatedly; they suggested that the funding and document requests should be synchronized by one nodal agency to streamline processes. Further, convergence relies heavily on human resources from implementing NGO staff in both scheme implementation (for example, connecting SSPs to schemes) and reporting. NGO staff's high workload—and frequent staff attrition due to this high workload, combined with low pay—can slow implementation and disrupt the continuity of convergence.

> "APC is a very big project, and it requires large extension services in the field. While the government can provide technical support, most outreach activities to farmers must be done by project field staff."
>
> Government official

Private sector market participation

While private sector linkages were initially limited when marketing was fragmented through PGs, the growth of PCs and agri-clusters has led to more private sector entrants. Implementing partners explained that at the outset of the APC project, private sector participants showed little interest in transacting with PGs (or SSPs directly) on a fragmented basis. However, once higher volumes began flowing through PCs, private players such as input and transportation companies are now proactively reaching out to PCs, recognizing their potential to reach a larger market. For example, PC staff in Laikera reported that private sector transportation companies and a pesticide company had entered the market since the PC expanded operations.

According to PRADAN's project close-out report, in addition to the 796 buyers that PGs and PCs have sold to date, the APC project has engaged with 31 other private sector actors, including agri-input and livestock input companies, agri-tech firms, and NBFCs. Ten of the private sector partners were new to the Odisha agricultural market entirely (primarily agri-tech firms), and as a result some innovative products have been introduced to the market for SSPs (for example, S4S solar dehydration and *sabzi* coolers). APC has also facilitated some public-private partnerships between agri-tech firms and government schemes to increase their reach. Dedicated funds for scaling up private sector technologies like solar dehydration have also been introduced by the state government for value addition in some of the clusters.

F. Sustainability

Although the APC project PGs and PCs have stabilized, as described above, our findings identified several needs to ensure their long-term sustainability.

An important ongoing challenge with the APC model is determining how to sustain field-level support to farmers—specifically, via the *Udyog Mitra* (UM) and agri-entrepreneur (AE) roles. As described in more detail in our interim report (Borkum et al. 2024), PRADAN has experimented with two different organizational staff roles and financing models to provide essential "handholding support" to SSPs for crop planning, production, record-keeping, aggregation, and collective marketing: UMs at the PG-level, and AEs at the PG- or PC-level. Several stakeholders described sustainable financing for these roles as the biggest challenge of the APC project.

At the project's outset, a cadre of one UM per PG was established to provide field-level support to farmers, with salary funding through Mission Shakti for a three-year period. Multiple stakeholders described this role as successful and critical to the project model, as UMs provide support for PG record-keeping, crop planning, SSP training, sorting, grading, packaging, and transportation. However, a sustainable financing mechanism for the UM role has not been established. Interviews with project implementing partners and PC staff suggest that while the formal UM role has been phased out, UMs (who are typically PG members) remain active in some areas in a more informal role supporting their fellow PG members. One PC staff member said that after the initial three-year public financing ended, the PC started to provide an honorarium to former UMs as well as commission bonuses on output and input sales to encourage their continued support of other PG members. Another PC said that while they tried this commission-based model for a time, they were not able to continue financing it.

Recognizing the limited sustainability of the UM public financing model, PRADAN developed a plan to phase out UMs in favor of AEs. In partnership with the government's Agriculture Promotion and Investment Corporation of Odisha Limited (APICOL), PRADAN planned to provide training and incubation financing for 1,000 AEs to establish micro-enterprises that provide horticulture or livestock support at the PC level, with 20-25 AEs per PC. These agri-entrepreneurs were to be identified and groomed from within the local community, including existing *Udyog Mitras*. The for-profit social enterprise nature of this project was envisaged to ensure that support can be provided more sustainably to SSPs.

However, the AE program was significantly delayed by more than two years relative to initial plans, due to multiple hurdles with APICOL-provided training and incubation support (described in more detail in our interim report). According to project monitoring data, by Q1 2025 1,024 AEs had participated in training, 753 had started enterprises spanning nine different trades,[9] with 618 operating independently. Financing remains a major constraint, with just 135 AEs having accessed initial APICOL financing—a stipend of 5,000 rupees ($58) per month for 12 months. No financial assistance is provided for enterprise start-up under the program, requiring AEs to arrange their own funds or take out bank loans. Program staff explained that most AEs lack collateral, large enough landholdings, or land ownership documentation to access government schemes designed for larger enterprise start-up. Further, both PRADAN and government stakeholders explained that AEs require additional technical support develop business plans required to secure bank linkages, and then to obtain regulatory approvals for their enterprises, such as obtaining

[9] These agri-entrepreneurs span nine different trades: nursery management (129), agri-input and output marketing (203), farm mechanization (26), non-pesticide management (27), mushroom spawn production (34), goat farming (183), poultry farming (212), fish fingerling production (16), and backyard poultry clusters (194).

licenses and dealership rights for input distribution. Potential modifications to the AE program for the scale up phase of the APC project are currently under discussion with APICOL.

Additional financing is needed both to sustain FPO operations and also to scale up into more profitable business lines. Some government officials recognize the need for extended financial operating support to both PGs and PCs beyond the initial 5-year project period. Officials acknowledge that both PGs and PCs developed from scratch in areas with low literacy and significant socio-economic challenges require continued financial assistance to achieve long-term sustainability. As noted earlier, all 30 PCs had already received working capital grants and 28 had received the first tranche of an additional grant for operational costs, but only 18 had received the second tranche. Similarly, 95 percent of PGs had received government IBCB funds but only 57 percent had received working capital financing for working capital for the first three years of operation. Government officials noted that ongoing financing would be necessary for at least two and up to five additional years to enable both PGs and PCs to remain operational.

> "PG formation takes at least one year, then mobilizing PG members and forming a PC takes another year. Then to strengthen and establish them, it take sanother 2-3 years. And at that stage if you leave them, they will fail. They need support for at least another 2-3 years. "
>
> *Government official*

Additional formal financing is also key to scaling up PC operations into more profitable business lines such as value-addition or processing; this requires stringent documentation of performance. Despite the working capital grants the project PCs had secured by endline, and stable revenues generated from output sales, many stakeholders felt that the PCs still need greater formal financing for business expansion and diversification. According to project staff, several PCs have expanded or were planning to expand into processing or value-addition for winner crops to increase profits. At endline, both market case studies had begun making such investments: one PC dried and processed mustard, while the other had plans to process cashews. Other PCs were exploring processing units for crops like ginger, cashew, and chili. Some PCs have secured additional financing through government schemes such as *Mukhyamantri Krishi Udyog Yojana*, which provides a 50 percent subsidy for women collectives looking to scale up their businesses and set up processing units.

> "Banks are not interested in providing credit to the PCs. There is an intense documentation requirement dependent on PC performance. So this funding issue will remain."
>
> *Government official*

Access to formal financing through banks and non-bank financial companies (NBFCs) remains more challenging. The state government has provided a credit guarantee scheme for FPOs to provide financial support through NABKISAN. Based on this scheme, NABKISAN can provide loans to PCs, subject to them meeting the eligibility criteria. However, only PCs which are performing well will be able to secure this funding. Formal bank financing also remains limited, since banks are hesitant to lend to FPOs and as such, require extensive documentation of performance and compliance.

Similarly, ongoing support will be key to strengthening PC governance and technical capacity, for example through ongoing trainings and advisory boards for strategic guidance. Both government officials and project implementing partners emphasized that beyond ongoing financial support, project PCs need to work on management and governance strengthening over the next few years, with particular attention to staff retention and capacity-building in technical positions like CEO, marketing, and accounting roles. For example, some stakeholders felt that extensive documentation and accounting for PC compliance is a particularly challenging aspect of PC management, which requires training and adequate compensation. To build PC capacity and retain key staff, stakeholders emphasized the need for competitive salaries and capacity-building trainings. One official suggested that expert guidance through advisory boards could be provided, as is being done as part of the Promotion and Stabilization of Farmer Producer Organizations program recently introduced by the government in the state to support high-performing FPOs.[10]

"At the PC level, the major issue is regulatory compliance in a timely manner. Accounting-related work is difficult for PC staff and board members—they need more training and more staff. Three staff is not enough to cover the work for six thousand farmers—it's extremely challenging."

Implementing partner

"PC staff are not so educated that they can do these activities on their own; it's only possible because of the current support system. There needs to be a human resource provision for the board and CEO for the next 3-4 years to support and train them in things like audit filing, record keeping, compliance, and inventory management."

Government official

Environmental sustainability will require a continued focus on climate-resilient crops, crop diversification and rotation, and water efficiency and non-pesticide management practices. Multiple stakeholders described poor irrigation access and increasingly irregular weather patterns due to climate change as key risks for sustainability of the APC project, and for horticultural production overall in Odisha. The APC project has emphasized environmental sustainability since its outset, with agro-ecological compatibility one of the three criteria for winner crop selection. PGs and PCs assess each crop's local soil compatibility and resilience to pests, and consider crop water requirements as well as local rainfall patterns. Local NGO partners have played a key role in identifying local, resistant, and indigenous crop varieties. The project has provided trainings on climate mitigation strategies such as water conservation and non-pesticide management practices

"Climate change is also affecting the area; the rainfall pattern is very stressful. We are looking for ways to mitigate those risks. Grafted brinjal and turmeric are being promoted because they are more resilient."

Implementing partner

"When we get excessive rainfall, we cannot farm. When there is less rain, we face difficulties. The land needs to be leveled so that excess rainwater drains properly. "

SSP, Khaprakhol

[10] This program was launched in 2020 as a collaborative effort with the Government of Odisha DA&FW and the non-profit organizations Palladium and Tanager, with the goal of improving the profitability and sustainability of FPOs by enhancing their market access, business operations, and overall capacity.

(including on producing and applying various bio-inputs such as bio potash and organic compost). PGs and PCs also sell inputs that are not otherwise available on the market (for example, organic fertilizers and light/sticky/pheromone traps for pest management).

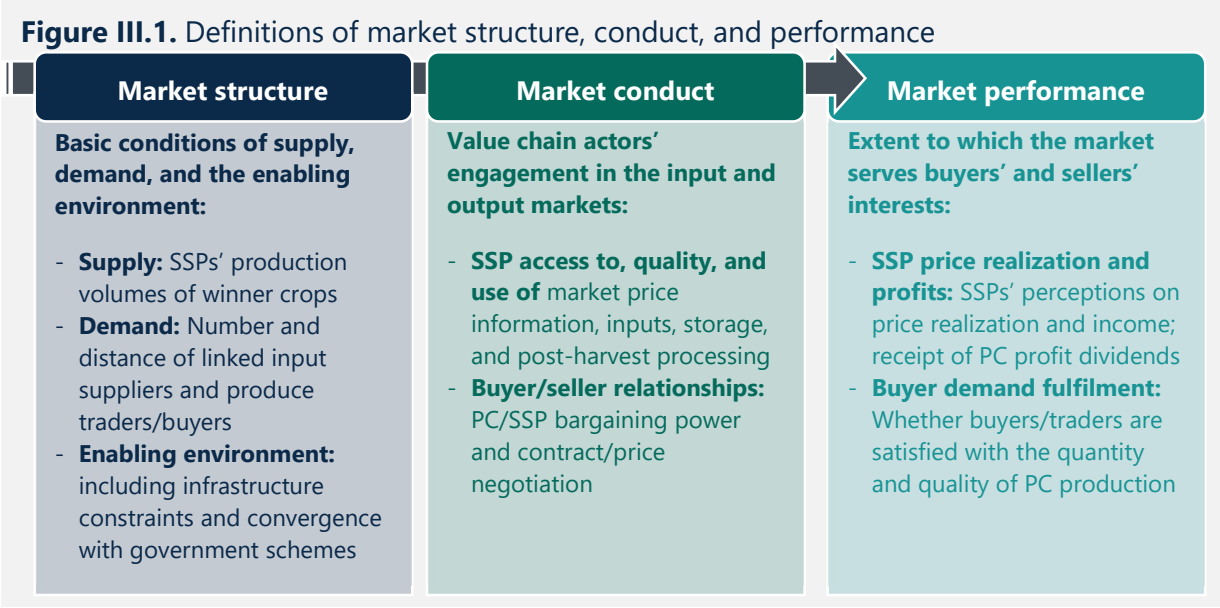
As described earlier, the APC project is also already promoting crop diversification, including crop rotation across seasons and years, to mitigate both climate and market risks. However, many SSPs prefer to focus on one specific crop that they are familiar with and/or have experienced initial success with under the project. The project will need to maintain a strong focus on crop diversification in the future. Other crops that are more resilient to climate risks, such as grafted brinjal and tomato, as well as turmeric, are also being introduced. Implementing partners also emphasized the need to promote more non-perishable crops which can withstand higher temperatures once harvested.

III. Market Assessment: Endline Findings

In this chapter, we assess the influence of the APC project on market structure, conduct, and performance in Odisha (these terms are defined in **Figure III.1** and are described in detail in our evaluation design report in Borkum et al. (2021)). First, we present findings from two endline case study winner crop value chains—brinjal and cauliflower—describing how each market has changed in the years since the APC project began. Next, we synthesize findings across case studies (including a third case study focused on tomato, conducted at interim only);[11] these findings are summarized in **Table ES.2.**

Overall, we find that the APC project fundamentally changed the market for SSPs in all three case study areas by increasing winner crop production volumes, the number of market actors to whom SSPs are connected for inputs and outputs, the quality of the relationships between SSPs and those market actors, and the benefits of market engagement with SSPs for those actors. We also find that these benefits are more pronounced in cases where the PC continuously promotes a winner crop over multiple seasons/years (although some benefits can be sustained even if the PC stops promoting a winner crop).

Figure III.1. Definitions of market structure, conduct, and performance



[11] As described earlier, at interim we also conducted a market assessment in a third geography/value chain: tomato in Bolangir district, where the APC project is implemented by the NGO Vikalpa. A summary of these findings is available in **Annex B**. However, the findings were very similar to those in the brinjal value chain in Rayagada. We therefore narrowed the focus at endline to the two geographies/value chains that are the focus of this endline report: brinjal in Rayagada district and cauliflower in Jharsuguda district.

A. Market assessment endline case studies

We present two market assessment endline case studies that illuminate distinct pathways in how the APC project affects horticultural markets. The two case studies vary by value chain, how long the crop was continuously promoted by the PC as a winner crop, and which entity implemented the project on the ground (**Table III.1**):

1) **Brinjal:** The Mahila Pragati PC in Kolnara block, Rayagada district has continually promoted brinjal as one of its winner crops for four years, across all three growing seasons each year. In this district, the APC project was implemented directly by PRADAN.

2) **Cauliflower:** The Janghalinga Mahila PC in Laikera block, Jharsuguda district discontinued promotion of cauliflower as a winner crop after three years (during which it was a winner crop in one to two of the three growing seasons per year). In this district, the APC project was implemented by Social Education for Women's Awareness (SEWA), an NGO that was already operational in Jharsuguda prior to the APC project.

In both cases, the PGs became active starting in 2018–19, and the block-level PCs were established in 2019 but did not complete licensing and registration (and begin formal operations) until 2021. The two PCs are similar in size, with just over 3,000 members across 23 or 24 PGs. Laikera is relatively more remote than Kolnara and the latter receives more government support for agriculture because Rayagada is classified as an "Aspirational District."[12] Although both PCs have promoted a variety of winner crops each season, the Mahila Pragati PC in Kolnara has focused on a smaller number overall compared to the Janghalinga Mahila PC in Laikera (five versus eight).

Table III.1 Comparison of the two endline market assessment case studies

	Kolnara block, Rayagada district	Laikera block, Jharsuguda district
Winner crop selected for market assessment	 **Brinjal**	 **Cauliflower**
APC local project implementing partner	PRADAN	SEWA (NGO pre-existing in Jharsuguda)
Name of PC and number of shareholders	Mahila Pragati PC (1,739 shareholders)	Janghalinga Mahila PC (1,309 shareholders)
Number of PGs and PG members	23 PGs (3,027 members)	24 PGs (3,105 members)
Average distance of villages from nearest statutory town	26 kilometers	38 kilometers
Government "Aspirational District"	Yes	No

[12] "Aspirational Districts" are underdeveloped districts identified by the Government of India based on a human development index. In those districts, the central and state governments are playing a more substantive role in construction/rehabilitation of infrastructure and linkages to agricultural schemes, in addition to other human development areas like health and education.

	Kolnara block, Rayagada district	Laikera block, Jharsuguda district
Number of years that the PC promoted the winner crop since it was established	4 years (2021-2024; ongoing)	3 years (2021-2023; no longer promoting)
Seasons during which the selected winner crop is aggregated and sold	Year-round (*kharif*, *rabi* and *zaid* seasons)	*Kharif* and *rabi* seasons[13]
Other crops promoted by the PC (in various seasons)	Chili, marigold, sunflower, pigeon pea, cashew	Chili, high-value paddy, gourd, tomato, cabbage, watermelon, sesame

Below, we summarize the key changes in each case study market as a result of the APC project through both visual "market maps" (**Figures III.1 and III.2**) and tables (**Tables III.2 and III.3**) highlighting specific aspects of each value chain. On the upstream side, market actors providing SSPs with inputs such as seeds, fertilizer, information, and training are illustrated on the left-hand side of the map, whereas the downstream or output market for the crop is on the right-hand side. Market actors which provide both input and output services are in the center of the map. including female SSP access to inputs, market price information, post-harvest practices (quality assessment and storage), and transportation and sales. As described in **Annex A**, these market maps are based on focus group discussions and participatory mapping exercises conducted with SSPs participating in the APC project, as well as with PC staff and board members and local project implementing partners.

- **Boxes** illustrate key market actors, with female SSPs in the center:
  - **Green boxes** represent actors who existed in the market prior to the APC project, and green boxes with concentric rings illustrate existing actors whose prominence in the market has declined since the start of the APC project.
  - **Blue boxes** represent new actors which SSPs have begun engaging with since the start of the APC project.
  - Distance of each market actor from the SSP is illustrated based on box position, overlaid against **concentric rings in the background**.
- **Lines between each box** illustrate the exchange or relationship between market actors, with **thicker, solid lines** representing a relatively stronger exchange based on quantity and/or quality (where SSPs or the PC interact more with that actor because they perceive the relationship to have greater benefits) and **thinner, dotted lines** representing a relatively weaker exchange.
- **Icons** represent the goods and services exchanged between the actors (fertilizer, seeds, market price information, knowledge or training, crops, storage, quality assessment, and transportation).

[13] When Janghalinga PC first began promoting cauliflower in 2021, it only aggregated and sold during the *rabi* season; by 2023 the PC was selling cauliflower in both the *rabi* and *kharif* seasons.

Case 1: Brinjal market assessment in Kolnara, Rayagada

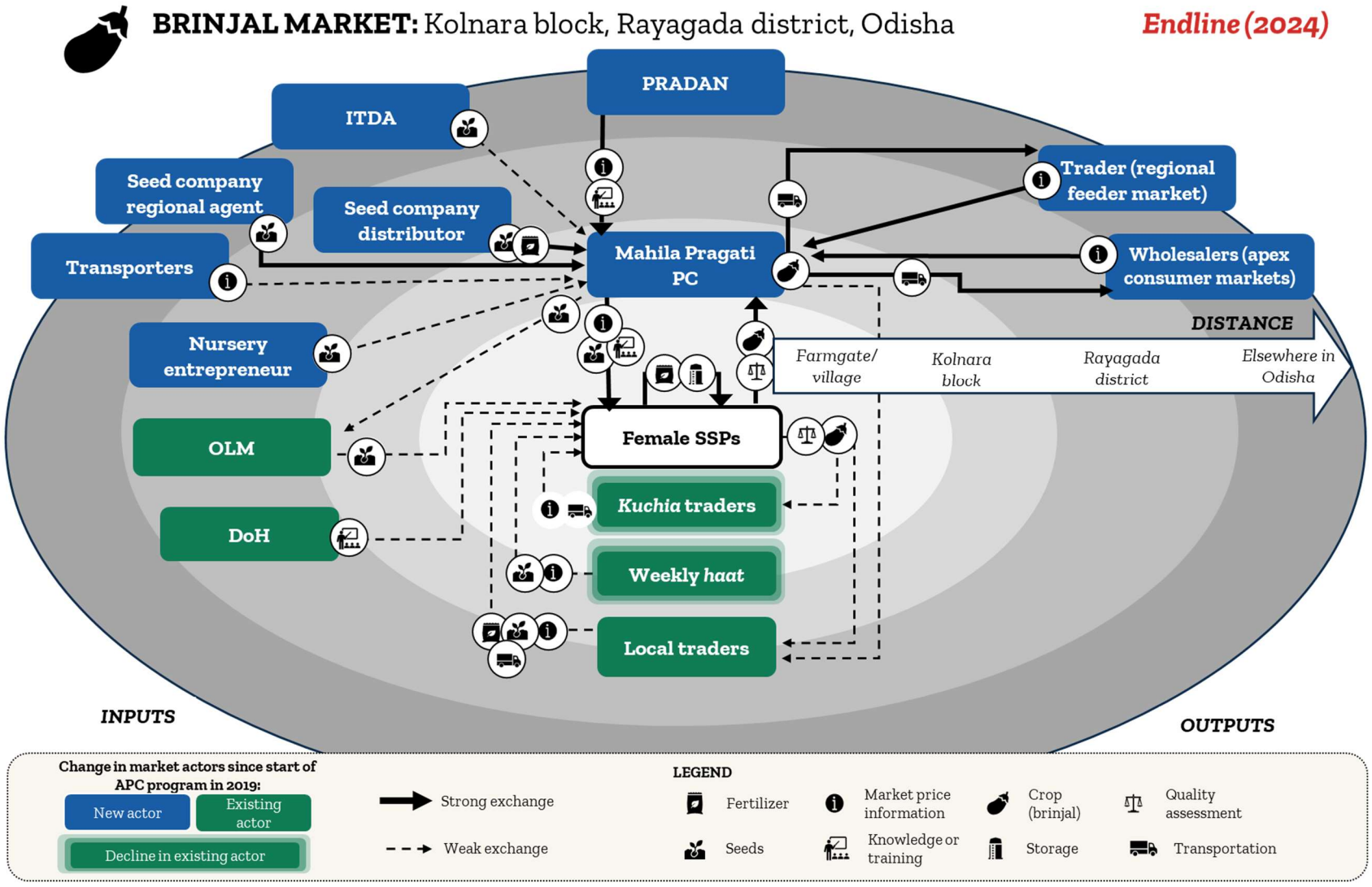
PRADAN launched the APC project in Rayagada district in 2019, and the Mahila Pragati PC was established in 2021. The PC has promoted brinjal as a winner crop since its establishment, along with various other crops like chili, marigold, and sunflower;, this case study therefore illustrates the longer-term market impacts of consistent winner crop promotion. There has been a fundamental shift in the brinjal market in Rayagada because of the APC project (summarized below and illustrated in detail via a market map in ***Figure III.2*** *and* ***Table III.2****). SSPs have increased production volumes of local, high demand brinjal varieties due to linkages to previously inaccessible input and output markets throughout Rayagada and neighboring districts. SSPs now depend less on* kuchia *traders*[14] *and weekly* haats *(markets) for both inputs and sales than before the project.*

Upstream: *SSPs cultivate larger volumes of brinjal than before the project, facilitated by commercial input linkages through the PC. The PC provides high-quality inputs via large seed companies and distributors, as well as discounted or subsidized seeds via government departments like ITDA and the Soil Conservation Department. SSPs also have improved access to mechanized farm equipment through the PC. The PC also facilitates SSP access to government irrigation schemes through the MIDH, ITDA, and the Soil Conservation Department. However, despite Rayagada receiving more government support for irrigation infrastructure as an "Aspirational District", further scaling of brinjal production beyond the main* kharif *rainy season remains limited by lack of access to perennial water sources and irrigation infrastructure. Compared to other traders and markets that SSPs used to engage with, the PC offers more upstream support services, including training on brinjal cultivation and quality assessment, and reliable market price information.*

Downstream: *SSPs now rely less on* kuchia *traders and local* haats *for brinjal sales than before the project, although they continue to engage to some extent with local traders. In contrast, SSPs' now have a strong relationship with the PC for output sales. SSPs now sell most of their brinjal to the PC, which reduces their transportation costs by having buyers pick up aggregated produce from the village. PC guidance on good brinjal sorting and packaging practices has improved the quality of SSPs' brinjal stocks, which has reduced quality-based stock rejection and price deductions. As a result of these shifts, SSPs perceive that their income has increased, and the Rayagada brinjal variety has gained prominence and seen increased demand in the regional market. The Mahila Pragati PC generates most of its revenue from brinjal sales.*

[14] *Kuchia* traders are local commission agents or intermediaries who trade directly with farmers at the village-level or farmgate. They differ from "local traders" as we define them, who are commission agents or intermediaries who deal with larger volumes of stock than *kuchias* and operate throughout the district.

Figure III.2 Brinjal market map (Kolnara block, Rayagada district): APC project endline market assessment (2024)



*The arrow and icons pointing from female SSPs to themselves represent self-sufficient services (seed-saving, at-home storage).

Acronyms: ASHA = Augmentation in Small Holders' Prosperity through Agricultural production clusters; DoH = Department of Horticulture; Dpt = Department; ITDA = Integrated Tribal Development Agency; OLM = Odisha Livelihoods Mission; PC = Producer Company; PRADAN = Professional Assistance for Development Action; SSP = small-scale producer

Table III.2 APC project effects on the brinjal market in Kolnara, Rayagada

	Pre-project (before 2019)	Medium to long-term effects (2023-2025)
Cultivation	SSPs in Kolnara typically only cultivated brinjal in the rainy *kharif* season and only for home consumption.	SSPs have increased their production volume by allocating more land for brinjal to sell to the Mahila Pragati PC due to greater access to input and output markets, as well as field-level support and training. Although some SSPs purchased water pumps to produce brinjal outside of the *kharif* season, many still lack access to perennial water and irrigation, which restricts their cultivation to this season
Access to inputs 	SSPs relied on local traders and *haats* for lower-quality seeds and fertilizer, which were not always in stock. SSPs also over-used fertilizer, leading to poorer soil quality.	SSPs now access higher-quality, more affordable seeds of multiple varieties through the PC's relationship with a regional seed company and through a government scheme. They have also increased organic manure application and decreased chemical fertilizer/pesticide application to improve soil health.
Access to market price information 	SSPs accessed unreliable price information from local traders, *kuchias*, and *haats*.	SSPs now have better access to accurate market price information through their PC, which collects this information from multiple sources. The PC uses this information to determine who to sell to and how much.
Quality assessment and storage 	SSPs did not assess the quality of their brinjal, despite occasional training from the government. They did not store brinjal, rather harvesting and selling within a day due to its perishability.	SSPs now sort, weigh, and package their brinjal with direct field support and training from the PC, which enables SSPs to sell multiple quality grades. SSPs still do not store brinjal; the PC does not have cold storage and it is not a priority because it would not significantly extend shelf-life.
Transportation and sales 	Brinjal SSPs sold small volumes to *kuchias* and a block trader, both of which provided unreliable but sometimes higher prices.	SSPs now aggregate and sell larger volumes through the PC which, among other sales channels, transports brinjal in larger vehicles to larger traders/wholesalers in regional/consumer markets up to 200-300 kilometers away. Buyers emphasized the high-quality of and demand for the local brinjal variety sold by the PC.
Income and price realization	SSPs earned limited income from small-volume local brinjal sales.	SSPs perceive that their income has increased via greater volume of high-quality brinjal production and sales through the PC, as well as reliable pricing by the PC. However, the PC has not yet distributed profits to shareholders.

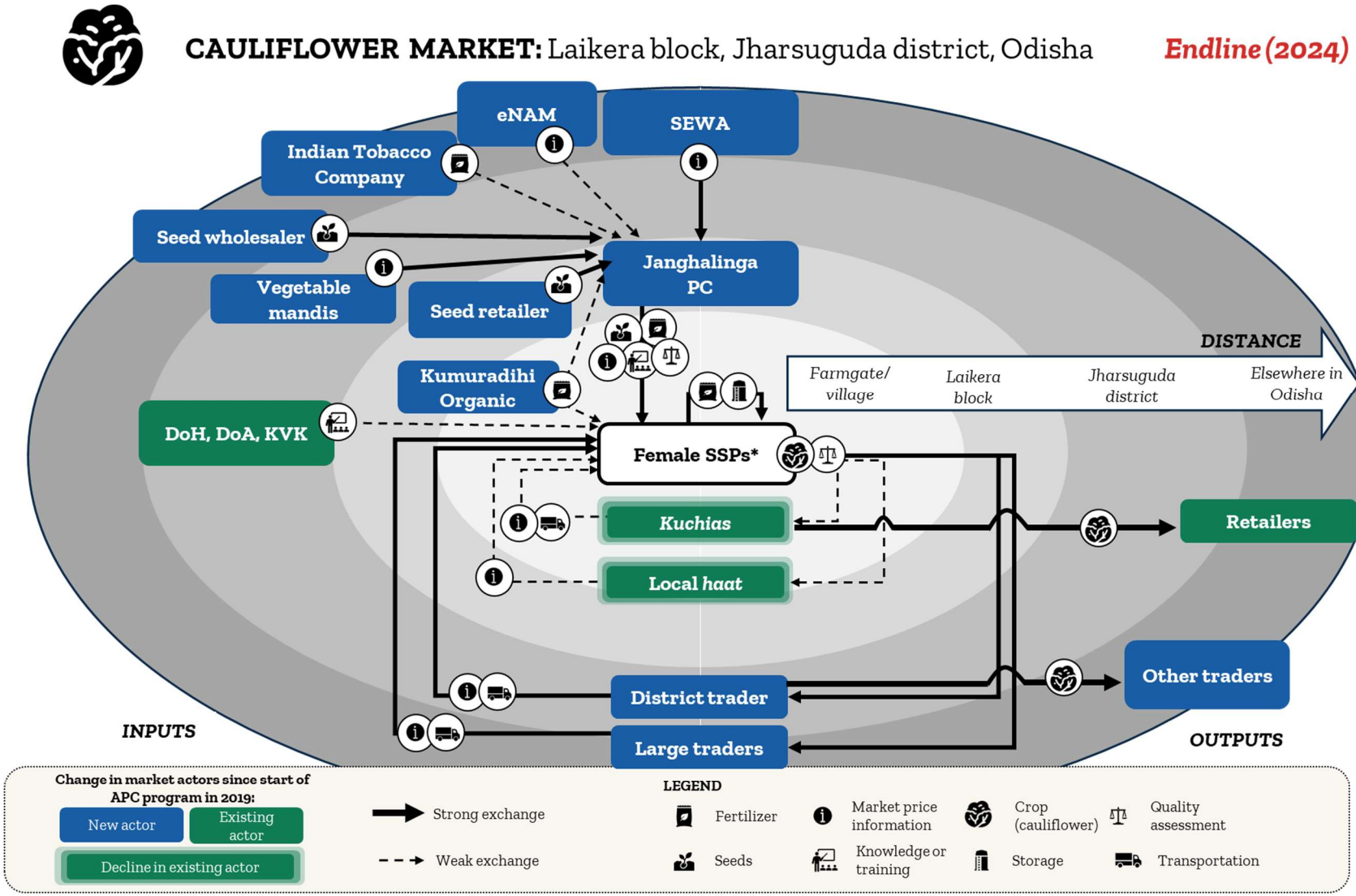
Case 2: Cauliflower market assessment in Laikera, Jharsuguda

SEWA, a partner NGO of PRADAN, has implemented the APC project in Laikera block since 2018; the Janghalinga PC was established in 2021 and began promoting cauliflower that same year, among other winner crops like chili, cabbage, watermelon, cucumber, and tomato. In 2024, the PC discontinued aggregate sales of cauliflower after facing losses due to perishability and frequent market price fluctuations, which hindered its profitability. This case study therefore serves as an example of market shifts in response to a shorter period of PC winner crop promotion. These effects are summarized below and illustrated in a market map in ***Figure III.3*** *(the interim market map is also provided in Annex C* ***Figure C.1****), and described in more detail in* ***Table III.3****. We find that, despite the PC discontinuing its sales of cauliflower, SSPs continued to cultivate larger volumes and began selling directly to the buyers who previously procured cauliflower through the PC, albeit at a smaller scale.*

Upstream: *Despite no longer promoting cauliflower as a winner crop, the PC continued to sell inputs for cauliflower, leveraging its connections to larger input suppliers such as seed wholesalers and retailers, Kumuradihi Organic Unit, and ITC Ltd. SSPs' procurement of inputs from local dealers like* kuchia *traders and local* haats *has accordingly decreased. The PC also continues to provide services for cauliflower production and sales including training, market price information, and guidance on quality assessment practices.*

Downstream: *Janghalinga PC was not generating sufficient revenue or profit from cauliflower to continue aggregating and selling it. Now, SSPs no longer sell cauliflower to the PC since it is no longer promoted as a winner crop. SSPs' cauliflower sales to local buyers, specifically* kuchia *traders and buyers in local* haats*, have decreased over the course of the project. Now, SSPs sell most of their cauliflower directly to the PC's former buyers (district traders and large out-of-district traders); however both SSPs and traders expressed a preference for aggregate sales through the PC. SSPs perceive overall sustained increases in income due to larger sales volumes and (initially) more reliable prices from the PC for cauliflower and other winner crops. Further scaling of sales is hampered by the PC's discontinuation of aggregate cauliflower sales.*

Figure III.4 Cauliflower market map (Laikera block, Jharsuguda district): APC project **endline** market assessment (2024)



*The arrow and icons pointing from female SSPs to themselves represent self-sufficient services (production of organic manure, seed-saving).

Acronyms: ASHA = Augmentation in Small Holders' Prosperity through Agricultural production clusters; eNAM = (electronic) National Agriculture Market; DoA = Department of Agriculture; DoH = Department of Horticulture; KVK = Krishi Vigyan Kendra; PC = Producer Company; SEWA = Social Awareness for Women's Education; SSP = small-scale producer

Table III.3 APC project endline effects on the cauliflower market in Laikera, Jharsuguda

	Pre-project (before 2018)	Interim effects (mid-2023) (cauliflower is a winner crop)	Endline effects (early 2025) (cauliflower is no longer a winner crop)
Cultivation	SSPs commonly grew cauliflower, primarily harvesting once during the rainy *kharif* season.	SSPs increased cauliflower production to sell to the Janghalinga PC, by increasing the land allocated to cauliflower and/or increasing frequency of production: some harvested 2-3 times throughout the year, including in the *rabi* off-season, for those with access to irrigation.	Although the PC stopped purchasing cauliflower in 2024, SSPs are still cultivating larger volumes of cauliflower than before in both the *kharif* and *rabi* seasons, although cultivation in the *rabi* season remains limited to SSPs with irrigation access.
Access to inputs	SSPs accessed seeds and fertilizer through local traders who offered credit, but whose stock was unreliable and whose prices were high. Some SSPs also saved their own seeds.	SSPs accessed higher-quality, more affordable seeds through the PC's relationship with a wholesaler. SSPs' use of chemical fertilizers decreased through the production of organic manure sold through an APC-affiliated business (the Kumuradihi organic manufacture unit).	The PC continues to sell high-quality, affordable inputs to SSPs, including cauliflower seeds.
Access to market price information	SSPs accessed price information from local *kuchias* or *haats* that they sold to.	SSPs have better access to accurate market price information through their PC, which collects this information from multiple sources (e-NAM, buyers, and other FPOs) and transmits it to SSPs via WhatsApp.	Although the PC no longer procures cauliflower, they still share market price information on cauliflower with SSPs. SSPs also now collect price information directly from institutional buyers.
Quality assessment and storage	SSPs did not grade or sort their cauliflower. Some SSPs said they did not store it at all, rather harvesting on the same day that *kuchias* came to pick it up. Other SSPs said they only stored it at their home during the day while they waited for the *kuchia*.	SSPs sort, and weigh their cauliflower with assistance and training provided by their PG's and PC's staff. SSPs still do not store cauliflower but harvest on the day the PC sells; the PC does not have cold storage.	The PC's decision to discontinue promoting cauliflower was partially driven by its higher perishability compared to some other winner crops (e.g. chili, watermelon) and limited opportunities for long-term storage. Nonetheless, the PC still provides trainings and advice relevant to cauliflower quality assessment.
Transportation and sales	SSPs sold small amounts of cauliflower to local *kuchias* or *haats*. Although *kuchias* pick up the produce directly from SSPs' fields, they offer unreliable, lower prices and often delay payments. Selling at *haats* is time-consuming and laborious for SSPs, although prices are higher.	SSPs mostly sell to the PC, transporting the cauliflower to PG offices on bike or rickshaw, where PC-affiliated buyers (or PC staff) collect the aggregated produce and make digital payments. The PC does not have access to a larger vehicle, which limits its sales to buyers within and nearer to Jharsuguda district and buyers who are willing to handle transportation. SSPs still sell to *kuchias* or *haats* in smaller volumes or when PC procurement is delayed.	SSPs no longer aggregate and sell cauliflower to the PC since it is no longer promoted as a winner crop. However, the PC has facilitated a direct connection between SSPs and former PC buyers, who now procure and transport cauliflower directly from individual SSPs in villages (paying in cash). SSPs mention some challenges when their stock exceeds traders' volume capacity; and the buyer expressed a preference for the previous relationship of aggregate procurement through the PC, which was more convenient.

Income and price realization	SSPs earned limited income from small-volume local cauliflower sales.	SSPs perceive that they have increased their income primarily—but through increased area under cauliflower production and lower production costs, rather than higher prices, better quality, or PC profit sharing (which has not yet happened).	Since SSPs continue to cultivate and sell large volumes of cauliflower, they perceive higher income due to higher sales volumes. They have also continued to benefit from lower costs of inputs. In the past year, higher income was also driven by higher market prices for cauliflower.

B. Market structure: key findings

In this section, we synthesize findings about the influence of the APC project on market structure from the two endline case studies above, as well as a third case study conducted at interim (tomato in Bolangir district; see **Annex B**. Market structure refers to the number of actors operating in the market and at what scale. On the supply side, we assess the number of SSPs engaged in commercial production and their volume of winner crop production over time, as well as the number and accessibility of input suppliers. On the demand side, we assess the number and accessibility of crop buyers to which SSPs are linked. We also examine the actors present in the enabling environment: including government schemes.

In all three case studies, the APC project has fundamentally shifted the market structure for the winner crop by facilitating coordinated and increased production and sales. SSPs now synchronize their production and cultivate larger volumes of winner crops, having previously cultivated small volumes for home consumption and limited sales. SSPs now rely less on local traders and markets who offer less favorable terms, for both input purchases and output sales. PCs coordinate collective sales of winner crops to larger and more distant output market actors. These market structure shifts are most significant in cases where the PC continues to promote the winner crop over multiple seasons/years. (In one case the PC discontinued promoting cauliflower as a winner crop, but continued to provide support SSPs in cauliflower cultivation, and SSPs began to sell directly to some institutional buyers to whom the PC used to sell aggregated cauliflower). In all three case studies, access to irrigation facilities has posed a barrier for many SSPs to cultivating winner crops outside of the rainy rabi *season, despite some support in some project areas through government irrigation schemes.*

When PCs promote a winner crop for multiple consecutive seasons, larger numbers of SSPs cultivate larger volumes by increasing the area under production and/or frequency of cultivation (through crop rotation or off-season cultivation). In all three case studies, SSPs who participated in focus groups said that the PCs' promotion of a winner crop over multiple years led to their sustained increasing production of that crop. Before joining the APC project, these SSPs primarily grew small amounts of horticultural crops

> "Earlier, we were not aware of where to sell brinjal or how to cultivate it properly. Personally, I was growing it in my backyard, but now I cultivate it on 0.5 acres of agricultural land. Currently, we sell our produce to the PC, which sends a vehicle to collect it. As a result, many farmers are now cultivating [winner crops] on larger areas."
>
> *SSP, Kolnara*

for home consumption and sale in local markets. The PCs' input, farming, and marketing services encouraged SSPs to increase their production volume of winner crops. This was largely accomplished by increasing the area of winner crops cultivated through cultivating previously unused farmland, allocating land away from other crops to winner crops, and/or increasing off-season cultivation, for those SSPs with access to irrigation. In contrast, relatively few SSPs said that they have experienced higher yields of winner crops due to improved farming practices and high quality inputs. These findings are validated by our impact evaluation in Chapter IV, which shows that project SSPs produced larger volumes of winner crops than comparison SSPs through greater areas cultivated rather than higher yields. SSPs in all three case studies emphasized that the main aspects of the APC project that facilitated and motivated them to increase their production were "doorstep services" that provided greater access to larger and more reliable input and output markets, as well as handholding support from PC staff on good farming and post-harvest practices.

The APC project has increased SSPs' access to more and further-flung input suppliers. Before joining the APC project, SSPs in our case study geographies mostly procured seeds, fertilizers, and pesticides from limited, local sources: weekly *haats* outside their village, *kuchias*, or other local traders. The PCs now facilitate SSPs' access to more bulk suppliers located further away, including wholesaler and seed companies, and by improving connections to government subsidy schemes for inputs. SSPs we spoke with in all case studies described the PC as their preferred source for seeds and pesticides because the PCs provide high-quality inputs at lower prices than local input sellers, with timely doorstep delivery. The PCs have strengthened their input supplier network over the course of the project by also introducing new sources for seedlings and organic manure.

Through the APC project, the PCs have facilitated SSPs' access to a more expansive, distant, and stable buyer network. Before joining the APC project, SSPs in our three case studies either did not sell winner crops (rather growing them for home consumption), or sold small quantities to a limited number of *haats*, *kuchias*, or local traders within their village or block. They were unable to sell to larger buyers due to distance and limited transportation, and because larger buyers typically did not procure small volumes produced by individual SSPs without synchronized production. As a result of the APC project, SSPs in our case studies now synchronize production and sell winner crops collectively through PGs and PCs, enabling them to access larger institutional buyers who offer better prices and reduce transportation burdens. PRADAN explained that the PCs initially targeted buyers within a radius of 150-200 kilometers—typically within the district. Over time, growth in SSP cultivation volumes has enabled PCs to expand their network from local traders to regional buyers who are located further but have a higher procurement capacity. Mahila Pragati PC, for instance, sells most of its stock to regional traders located outside of Rayagada district, who offer higher prices than other traders and wholesalers, and can accept large volumes of produce at once. Most buyers that we spoke to have transacted with the PCs for several years and plan to continue purchasing stock from the PC, which indicates the stability of the PCs' buyer network.

The case of Jharsuguda shows that even if a PC discontinues its promotion of a winner crop, some positive upstream effects on production and input access can be sustained in the short-term; however downstream marketing benefits are more difficult to maintain. The Janghalinga PC stopped promoting cauliflower as a winner crop after three years, SSPs continued to cultivate and sell larger volumes of cauliflower than they had prior to the APC project. This was likely driven by two key factors: the PC's continued handholding support and input services to SSPs, including for cauliflower production; and the SSP's ability to shift to direct sales to the PC's institutional cauliflower buyers. SSPs in Jharsuguda explained that they continued to cultivate cauliflower in a synchronized manner at the same volume one year after the PC had stopped promoting it as a winner crop, because the PC continued to sell high-quality cauliflower seeds at affordable prices, provide market price information for cauliflower, and support cauliflower quality assessment. Further, after discontinuing their promotion of cauliflower as a winner crop, Janghalinga PC connected SSPs directly to some institutional buyers to whom they previously sold cauliflower, such that SSPs were able to continue their sales. However, since the PC no longer facilitates aggregation of cauliflower at PG offices, the buyers now must collect the produce individually from SSPs in each village. Similarly, since the PC no longer purchases and makes direct payments to the SSPs for the cauliflower, SSPs now transact directly with the buyers. In cases where these buyers cannot procure all the SSPs' cauliflower, SSPs sell to *kuchias* and the local *haat*, as before the project. In this way, parts of the PC and SSP buyer network have remained stable despite changes in PC strategy, at least in the short-term. However, the long-term sustainability of increased cauliflower cultivation and sales without PC marketing support is uncertain. Some SSPs we spoke to expressed disappointment that Janghalinga PC is no longer purchasing cauliflower and, as described below in the market performance section, buyers expressed a preference (and willingness to pay) for direct aggregation and procurement of cauliflower from the PC.

"Primarily, we want the PC to procure cauliflower since we cultivate it on a large scale. We grow other vegetables, but only in small quantities."

"The PC should start procuring cauliflower from us. We are not asking them to buy when production is low, but they should procure when we have surplus."

SSPs, Laikera

"Cauliflower is a perishable item, and there is a risk associated with it. Frequent price fluctuations make it difficult to procure... We used to procure cauliflower in the past (for one year), but due to consistent losses, we stopped. Another issue is the lack of storage facilities."

PC staff, Laikera

Some SSPs have been able to cultivate more in the off-season due to increased access to irrigation facilities. However, irrigation is an ongoing barrier to cultivating all crops in the *rabi* and *zaid* off-seasons for many other SSPs, despite increased linkages to government subsidies and infrastructure investments in some areas. In 2023 and 2025, we heard from SSPs in Bolangir that the APC project successfully facilitated greater access to subsidized drip irrigation and borewell facilities through government subsidies. In Rayadada and Jharsuguda, some SSPs have purchased water pumps and installed bore wells individually, while others have benefitted from a lift irrigation system installed in one area of the district. The small group of SSPs that gained access to borewells, water pumps, or drip irrigation facilities said that this has enabled them to cultivate higher volumes of different winner crops

throughout the year and sell at higher prices during the *rabi* season. However, respondents reported that this only accounts for a small portion of SSPs in the districts, and many still rely entirely on rainfall or perennial water sources.

The APC project aims to facilitate SSP linkages to government subsidies for drip and sprinkler irrigation and farm pond construction through the *Pradhan Mantri Krishi Sinchayee Yojana* (PMKSY) scheme. Beyond the government's classification of certain districts as "Aspirational Districts" which receive dedicated support for irrigation infrastructure, the government also now prioritizes APC project areas for large-scale irrigation projects, such as mega- or river-lift projects through the Odisha Lift Irrigation Corporation which facilitates flow of water from rivers, canals, or reservoirs. However, our conversations with SSPs in Jharsuguda and Rayagada in 2025 suggest limited broader impact on irrigation due to a lack of a water source in these areas. SSPs and multiple other stakeholders indicated that access to water and irrigation continues to be a major challenge to production of high-value crops in Odisha. For many SSPs, this limits production of winner crops in the *rabi* or *zaid* seasons. This was the case for all three case studies before the project and remains to be a challenge in 2025 for the two case studies we examined at endline, in Rayagada and Jharsuguda. SSPs in both districts also mentioned applying for bore well installation through ITDA but have not yet received support.

C. Market conduct: key findings

In this section, we synthesize cross-case findings about the influence of the APC project on market conduct, by assessing how different value chain actors are engaging with each other, and the quality of those interactions. On the upstream side, we assess SSP's and PC's relationships with input providers, and their access to quality, and use of market price information, inputs, storage, and post-harvest processing. Downstream, we analyze the relationships between SSPs/PCs and buyers, including bargaining power and price negotiation.

In all three case studies, the APC project has improved market conduct related to winner crops. SSPs now have access to more accurate and reliable market price information through the PCs, which enables both PCs and SSPs to negotiate prices and sales volumes. SSPs also now have better access to higher-quality seeds and organic fertilizer and have improved their quality assessment practices. Taken together, this has resulted in higher quality produce. SSPs in our case studies primarily store their produce at home for just a day or two prior to sale (if at all), as they had before the APC project started; some stakeholders felt that cold storage had limited potential to improve price realization and market access for vegetables. In the case of cauliflower, high perishability and limited opportunities for long-term storage hindered its profitability, which drove the PC to discontinue its promotion.

SSPs in both case studies now have access to more accurate market price information through their PCs. Before the APC project, SSPs in our case studies accessed market price information for both inputs and outputs by visiting local *haats* (which was time consuming), through communications with family and friends living near those markets (whose information was not always up to date), or through *kuchias* (who tended to quote different prices to different SSPs). The APC project PCs provide SSPs with more current, accurate market price information by gathering information from different sources, including (1) district and local traders that the PCs sell to; (2) larger regulated market committee markets or *mandis* throughout the district, whose prices are posted on eNAM (the government's online trading platform for agricultural commodities); (3) transport drivers; and (4) other FPOs in nearby districts. The PCs then share this information directly with SSPs via WhatsApp, and through in-person meetings with APC-trained village entrepreneurs or PC staff. In both Jharsuguda and Rayagada districts, SSPs told us that they primarily accessed price information from their PC because it was more reliable, accurate, and trustworthy.

PCs and SSPs use this market price information to negotiate sales prices and volumes; the project has strengthened the market position of SSPs, who can make more informed and varied sales choices. PCs use the market price information they access to negotiate prices and sales volumes with buyers and traders. As evidenced by our case study of brinjal in Rayagada district, PCs that offer high-quality and/or high-demand varieties of produce are better-positioned to negotiate prices with buyers. From the perspective of SSPs, before the APC project they were primarily price takers and had little choice in the buyers they sold to. With improved access to accurate price information and to new buyers through the PC, SSPs now have more choice about whom to sell to and in what quantities, as well as better information to make that choice. PCs' trade with new buyers and traders has also created competition in APC locations, resulting in the decreased ability of local *kuchias* and traders to offer low or unreliable prices to SSPs.

> "PC and PRADAN staff inform us of the brinjal market price, transportation cost, labor cost and tell us how much quantity we can sell for a certain price."
>
> *SSP, Kolnara*

> "It is mandatory for us to collect price quotations from company agents as well as from wholesalers. We even collect prices from different zones of the same company and after comparing all prices we finalize one. Every day we observe how the retail market is behaving."
>
> *PC staff / board member*

As described above, in the year after the PC in Jharsuguda stopped promoting cauliflower, SSPs still reported receiving price information on cauliflower from PC staff and were connected directly with the PC's former institutional cauliflower buyers. This enabled the SSPs to strengthen their bargaining power directly with these institutional buyers, even in absence of the PC's direct role in facilitating sales. However, it was not clear if the PC will continue to collect and disseminate cauliflower price information if it continues not to promote it as a winner crop.

The APC project has facilitated SSP access to higher quality inputs at lower cost and has promoted a shift away from overuse of chemical fertilizers. Before the APC project, SSPs in our case studies purchased inputs (including seeds, fertilizer, pesticides, and herbicides) from local sources such as local traders, *kuchias,* and local *haats.* SSPs found the quality of inputs from these sources to often be unreliable. For example, in terms of seeds, SSPs sometimes received seeds that had poor germination

rates. Some SSPs saved their own seeds but also struggled similarly with low or slow germination rates. In comparison, the SSPs find that seeds sold by the PC sprout faster and at more predictable rates, which supports PGs in their coordinated harvest and aggregation practices and give higher yields. The project has facilitated better SSP access to higher-quality seeds at lower cost by building relationships with bulk distributors and wholesalers in district markets and transporting the seeds directly to farmers' doorsteps.

The APC project has also raised SSP awareness about lower-cost or subsidized seeds through government sources including block DOH offices and the ITDA. However, access to these government seeds varied across our case studies, as has the particular scheme or source. SSPs in our focus groups noted that varieties of government seeds were more limited and that delivery was sometimes delayed.

Implementing staff also said that some SSPs over-used chemical fertilizer prior to the APC project, leading to reductions in soil quality. Now, many SSPs in our three case studies either prepare their own manure or purchase organic manure or liquid fertilizer through the PC for application on winner crop fields. In Jharsuguda district, the local APC project implementing partner (SEWA) established a business that procures liquid organic manure fertilizer from some SSPs and sells to other SSPs. PRADAN staff said that in other cases, PCs have become licensed distributors of organic fertilizer. SSPs who have transitioned to applying organic fertilizers and pesticides under project guidance have noticed improved vegetable quality and taste. Stakeholders in our case studies also emphasized that the switch from chemical to organic fertilizer and manure promoted by the project will contribute to improved soil health.

Neither SSPs nor PCs store produce for longer than one or two days before selling due to perishability, but cold storage facilities would not significantly extend the shelf life of vegetables. SSPs' horticultural crop storage practices remain largely unchanged by the APC project. Prior to the project, most SSPs stored their vegetable crops at home for just a day or two before sales due to perishability. The APC project initially aimed to enhance SSPs' ability to store crops and capitalize on higher sales prices by linking PGs/PCs to government subsidies and/or providing working capital to build "pack houses" (indoor storage and aggregation facilities), hybrid indoor-outdoor storage structures (primarily for onions and other semi-perishables), and cold storage for longer-term storage (including both larger facilities and smaller *sabji* coolers). However, according to numerous stakeholders, progress remains limited. Uptake of government subsidy schemes for storage construction have been limited due to prohibitive upfront PG/PC capital investment requirements, and the structures that have been built are primarily used as temporary transit storage overnight or up to a couple of days.

Some PC staff and implementing partners were of the view that returns to cold storage are insufficient to justify its costs in the case of vegetables, although they were more promising for semi-perishables. However, in other cases, stakeholders felt that extending the potential sales window of vegetable crops even by a few days through cold storage could improve PCs' bargaining power and ability to mitigate challenges such as temporary price drops or buyer delays in picking up the produce. In the case

> ``But the kind of commodities we are dealing with, there is no assurance that by storing the vegetable for 10-15 days, the incremental gains in the price will be significant. However, storage structures may work well for semi-perishables such as ginger, turmeric, groundnut."
>
> *-PRADAN leadership*

of cauliflower production in Jharsuguda, frequent market price fluctuations was one of the drivers of the PC's decision to discontinue cauliflower promotion.

The APC project has improved SSP practices in quality assessment in our case studies, which enable PCs sell winner crops at more consistent prices by minimizing stock rejection or price deductions. Prior to the APC project, SSPs across all three case studies practiced minimal quality assessment (if any) of vegetable crops prior to sales. In some cases, local *kuchias* or traders would assess the quality of the produce and sort it prior to purchase. After receiving training from their PC on proper harvesting and sorting practices (mainly sorting out pest-infected or rotten produce), SSPs in all three cases now ensure the stock they sell to the PC only contains good quality produce. In the case of brinjal in Rayagada district and tomato in Bolangir district, SSPs additionally weighed and packaged their produce for sale through the PC. These quality assessment practices mitigate quality-based rejections or price deductions from buyers, which enables PCs to retrieve more consistent prices. The APC project has also facilitated SSP access to government trainings around quality assessment and, in some cases, access to subsidized plastic trays for sorting and grading. As described in the section below on market performance, although the APC project does not promote value addition for most winner crops, value addition is increasingly being promoted for certain semi-perishables.

> "In post-harvest, we have seen a shift in sorting, grading, and packaging practices. Earlier, farmers sold older stock or pest-attacked crops. But now people understand that even a small amount of that kind of stock reduces the sales price.
>
> *Implementing partner staff*

D. Market performance: key findings

In this section, we synthesize cross-case findings about the influence of the APC project on market performance, by assessing the extent to which the market serves both buyers' and sellers' (SSPs and PCs) interests. We examine SSPs' perceptions of price realization and income in our case study areas, and the extent to which the PCs have generated other benefits for SSP members, especially profit dividends. We also synthesize findings from interviews with buyers and traders to assess their level of satisfaction with the quantity and quality of PC winner crop production.

In all three case studies, the APC project has had some positive effects on market performance, although challenges remain related to scaling up SSP production and profits. SSPs perceive that their income has increased because of greater volumes of winner crop production, although no PC profit sharing has taken place to date. SSPs also appreciate that the PC provides more reliable pricing for winner crops, even if the PCs' prices are not notably higher than market prices, on average. Perceived increases in income motivate SSPs to continue engaging in the market. Some PCs were exploring investments in non-perishables, post-harvest processing, and value addition to further increase SSP profits. While synchronized production can in theory lead to production gluts and market price drops, this did not appear to be occurring frequently, and most PCs were pursuing some mitigation measures like staggered planting and production to meet predicted buyer demand. Buyer demand is being met by the PCs in terms of quantity and

quality; buyers we spoke to in all case studies perceive that SSPs engaged in the APC project provide higher-quality produce than other producers. Buyers find the PCs' aggregation model to be convenient for pickup, transportation, and payments; one large buyer expressed a preference for Janghalinga PC to continue selling cauliflower for the convenience provided by aggregation.

SSPs across all three of our case studies perceive that their income has increased because of the APC project, primarily due to increased area of winner crop production, higher sales volumes, and more reliable prices. SSP income from winner crop production prior to the APC project was limited since most SSPs were cultivating only for at-home consumption or small volume sales to local buyers who dictated prices. SSPs in all three case studies perceived that their income from winner crops had increased primarily because of increased area under production and greater collective sales volumes in the *kharif* season and, for those with access to irrigation, in the *rabi* and *zaid* seasons. SSP and PC staff perceptions of price differentials between the PC and local actors varied by commodity and geography. Overall, it appears that *kuchia* and *haat* pricing was unreliable, sometimes higher or lower than the PC's prices. As a result, SSP perceptions of whether the PC offers better pricing may depend on the extent to which SSPs sell to these different types of local actors and when, but on average prices appeared to be similar to the PC. Rather, it is the reliability of the PC's prices that distinguishes it from other buyers. Another perceived mechanism for increased SSP income is lower cultivation costs for SSPs due to the PCs facilitating access to more affordable inputs and offering trainings on their efficient application. SSP perceptions of increased income from the APC project were also not driven by PC profit sharing, as none of the PCs in our case studies had distributed dividends to shareholders.

While high-level stakeholders expressed concerns about the risk of price drops resulting from over-production of winner crops, this concern was not reflected strongly in our three case studies. In the first-round evaluation report (Narayan et al. 2022), implementing partners, PC staff, and SSPs expressed concern that increases in collective winner crop production could lower prices due to a production glut. To address this, the project has encouraged mitigation measures such as harvesting only based on predicted market demand, staggering planting, and (in more limited cases) storage. Across all three of our case studies, only the local implementing staff in Rayagada district mentioned the possibility of a market glut related to SSP overproduction of brinjal. To address this, both PC staff and PRADAN emphasized that they plan brinjal production volumes based on predicted market demand and stagger production across PGs. While stakeholders in Bolangir district did not mention the risk of tomato over-production, tomato SSPs and PC staff said that

"In the APC project there is a challenge around production. There is a limitation related to how much area can be extended under a winner crop. Otherwise, the market will clog, and the possibility of distress selling will arise. We have to think logically. It is linked to phase-wise farming timing. Some PGs plant early and some start a little late."

PRADAN staff

"During planting, as per our plan each individual takes their tomato seedlings and plants in their field independently. Some may start planting a little early, some may start a little late. If all of us plant at the same time, then the fruit may come at the same time, so it is better to plant at different times."

SSP, Khaprakhol

they employed both staggered planting and harvesting based on predicted market demand. The PC has also invested in cold storage which has extended the sales window of tomatoes by a few days; however, the high perishability of the local tomato variety would not likely withstand a more serious production glut even with cold storage. In Jharsuguda district, cauliflower SSPs did not purposefully stagger planting; however, this happened naturally due to differences in microclimate and terrain and access to irrigation.

Given limitations around SSP income generation through large-scale production of perishable winner crops, some PCs were exploring investments in non-perishables, post-harvest processing, and value addition. While the initial focus of the APC project was on vegetables, PRADAN staff said that they later realized that in some areas large scale vegetable production was not feasible due to lack of access to water and irrigation and other agro-climactic factors. They also realized that there should be some commodities that can mitigate climate risks. The project therefore also introduced non-perishable crops such as pulses and oilseeds. Support from the DA&FW also helped incorporate non-perishables like groundnut into the project. According to PRADAN, the introduction of these crops has helped diversify risk and provided additional income to farmers. PRADAN has also explored some investments in post-harvest processing in a few blocks, including solar drying for red chili and ginger so that it can be sold out-of-state. Value addition for non-perishables could also help further improve incomes, though it is not part of current plans.

In our case study areas, buyers were satisfied with the quality, quantity, and consistency of produce sold by PCs. Across all three case studies, the APC-affiliated buyers we interviewed said that they were satisfied with the volume of winner crops they purchased from the PC, especially during the *kharif* season. However, some buyers note that the PCs produce smaller volumes of winner crops during the *rabi* and *zaid* seasons, which drives buyers to procure from other suppliers. In addition to quantity, buyers also find that the PCs generally meet their quality demands. The buyers we spoke to explained that poor sorting of pest-infected produce is a common challenge with many farmers and traders. However, under PC guidance on quality assessment, buyers in all three case studies have noticed fewer cases of pest-infected stock, which in turn has reduced price deductions and stock rejections. In Rayagada and Bolangir, buyers also note that the PCs cultivate round brinjal and desi tomatoes, respectively, which are the varieties in highest demand in the markets. Consistency in PC quality over several seasons has established trust between the PC and their buyers. Some buyers say this high quality is the reason they primarily purchase winner crops from the PC.

> "Previously, individual farmers did not sort and grade their produce, often including damaged tomatoes, which created challenges while selling to traders. Through the PC, we receive good-quality, sorted, and graded produce, which helps us save on labor costs. That is why we prefer to buy from the PC."
>
> *APC-affiliated buyer, Bolangir*

Buyers find the PCs' aggregation to be convenient and some are willing to pay more for aggregated produce rather than procuring directly from individual SSPs/villages. Buyers in our case studies explained that a benefit of purchasing from APC PCs was the convenience of procuring from multiple SSPs at one central location and/or having the PC transport the produce directly to the buyer. Prior to the APC project, buyers who engaged with SSPs would have to visit SSPs individually to collect stock (and that effort would have only secured small volumes due to a lack of synchronized production). The PCs' aggregation practices save time and transportation costs for buyers. In Jharsuguda, one buyer we spoke to now purchases cauliflower from SSPs individually, since the PC no longer promotes and aggregates cauliflower but APC SSPs continue to produce large volumes of high-quality cauliflower. However, this buyer emphasized the ease of transportation and sending payments that PC aggregation provided and expressed willingness to pay slightly more for aggregated cauliflower over disaggregated stock.

> "When I purchase directly from farmers, I may pay one or two rupees less because I have to cover multiple farmers and make cash payments. But if the company handles the transaction, I am willing to pay two rupees extra per kilogram because they aggregate the stock at one place and ensure quality."
>
> *APC-affiliated buyer, Jharsuguda*

IV. Impact Evaluation: Endline Findings

This chapter focuses on quantitative findings on the APC project's impacts on female SSPs at endline. We use a matched comparison group design to measure these impacts. Specifically, to estimate the project's average impact on participating SSPs, we compare outcomes for the full sample of SSPs who are members of functioning PGs to those of a comparison group of similar SSPs in villages that the project did not serve (see **Annex A** for details). To gain deeper insight into the project's influence on key outcomes, we also compare the outcomes of a smaller sample of SSPs who were highly engaged with PGs to those from a matched comparison group of similar SSPs (**Box IV.1**). The data for the endline impact evaluation were collected through SSP surveys across three agricultural seasons—the 2023-2024 *rabi* season, 2024 *zaid* season, and the 2024 *kharif* season—about three to four years after the PGs were established in treatment villages.

Box IV.1. Highly engaged sample

The highly engaged sample comprises treatment SSPs who actively participated in the APC project at endline. We identified these SSPs as those who accessed inputs and/or equipment through the PC, and/or reported selling crops with the support of the PC. We had data on these criteria for each season and hence analyzed seasonal outcomes (for example, cultivation patterns and crop sales) using the highly engaged SSPs from each corresponding season. We also created a broader highly engaged sample by identifying SSPs who met at least one of these criteria in any of the three seasons, which we used to analyze agricultural year outcomes (for example, revenues and income). The percentage of the treatment SSP sample classified as highly engaged was **26 percent in *rabi*, 4 percent in *zaid*, and 32 percent in *kharif*.** For the agricultural year overall, **40 percent were highly engaged in at least one season**, of which the vast majority purchased inputs through the PC (sometimes in conjunction with other types of PC engagement).

We present the endline impact evaluation findings across several dimensions for both samples: cultivation patterns, crop production, crop sales, livestock holdings and health, agricultural revenues and income, women's economic empowerment, and dietary diversity. Our analysis focuses mainly on the *kharif* and *rabi* seasons, as these are the two main cultivation periods in Odisha. The *kharif* season, which takes place during the rainy months from June to December, is important for rain-fed crops such as paddy and maize. The *rabi* season, which follows the monsoon and is much drier, depends more on irrigation and typically involves non-staple crops. We also examine the *zaid* season, the shorter dry summer season between *rabi* and *kharif*. While *zaid* cultivation is not as common, it still contributes to agricultural income for SSP households. Hence, we include a brief summary of the project's impacts during this season. Finally, we aggregated revenues and income data across all seasons to measure the overall effect of the project on SSPs' agricultural earnings at endline.

Overall, we find evidence of positive project impacts along many dimensions at endline, including agricultural revenues and income, especially for the highly engaged treatment sample and in the dry *rabi* season, critically facilitated by increased irrigation (through government convergence). In the full treatment sample, these impacts are somewhat diluted by the large fraction of SSPs who have been less engaged thus far; increased engagement by these SSPs in the future might result in larger average impacts in the full sample. **Table ES.3** in the Executive Summary summarizes the key findings at endline.

A. Treatment sample characteristics

In this section, we review the baseline characteristics of treatment villages, households, and SSPs in both the full and highly engaged samples to provide context for the endline impact evaluation results. In **Annexes D and E,** we compare baseline characteristics and baseline season outcomes between the treatment and comparison group to assess the validity of the comparison group to serve as a counterfactual.[15] The findings suggest that the treatment and comparison groups were similar at baseline for both samples, with few substantive or significant differences, lending credibility to the evaluation design. Our endline analysis accounts for the mostly small baseline differences that were observed by including statistical controls for them, as described in **Annex A**.

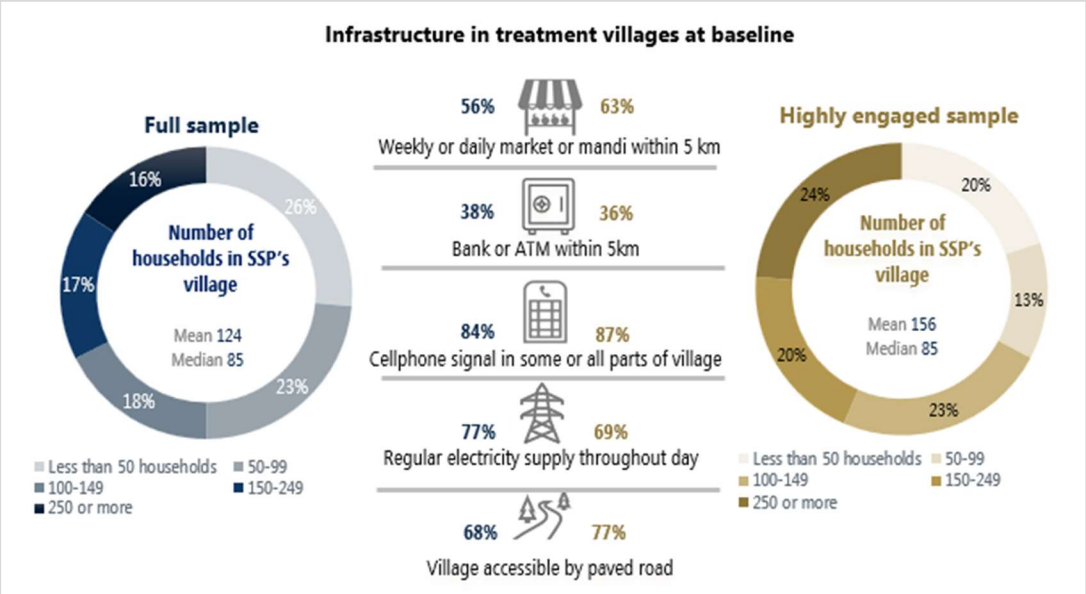
As we discuss in **Annex A**, the impact evaluation treatment sample is not representative of PG members across all project geographies, but rather of members of late-forming PGs that were established in late 2020 and early 2021 in areas where implementation was more challenging due to remoteness and implementation by less well-established NGO partners. It is important to bear this in mind when interpreting the findings given the potential for differences in impacts across geographies.

At baseline, treatment SSPs in the full and highly engaged samples lived in villages with similar infrastructure. In the full and the highly engaged samples, the median treatment SSP lived in villages that had 85 households at baseline (**Figure IV.1**). Most treatment SSPs lived in villages that had a cellphone signal in some or all parts of their village (84 percent in full sample and 87 percent in the highly engaged sample), had regular electricity supply (77 percent and 69 percent), and were accessible by a paved road (68 percent and 77 percent). More than one-half of SSPs in both treatment samples had a *mandi* or market within five kilometers of their village, and about one-third lived in a village with a bank or automatic teller machine within five kilometers.

Treatment households and SSPs across both study samples had similar socioeconomic and demographic characteristics and had high levels of disadvantage. At baseline, more than one-third of the treatment SSPs in both samples belonged to households below the poverty line based on the progress out of poverty index developed by the Grameen Foundation (http://www.progresssoutofpoverty.org/) (**Table IV.1**). Almost all treatment households reported their religion as Hindu, and about three-quarters were from scheduled castes and scheduled tribes. Treatment SSPs in both samples had a similar median age of about 40 years at baseline, most of them were married, and only about one-sixth were the head of their households. Treatment SSPs' educational attainment levels were also similar in both groups at baseline, with more than one-half reporting that they were illiterate (**Table IV.1**).

[15] The endline analysis samples differed slightly across seasons because of different response rates. In Annexes C and D, we focus on assessing baseline balance for the *rabi* analysis sample, because this season drives the impacts reported in this chapter. Baseline balance was very similar for the *zaid/kharif* analysis sample and for the full agricultural year analysis sample (not shown).

Figure IV.1. Baseline village characteristics of the endline treatment samples



Source: APC baseline village listing survey

Sample size: 707 treatment SSPs in the full sample for the 2023-2024 *rabi* season, 186 treatment SSPS in the highly engaged sample for the 2023-2024 *rabi* season.

Table IV.1. Baseline household and SSP characteristics of the endline treatment samples

	Full treatment sample mean	Highly engaged treatment sample mean
Household characteristics		
Household size	4.8	4.8
Household in poverty (%)[a]	41.3	36.5
Religion is Hindu (%)	93.8	91.4
Caste belongs to scheduled caste or tribe (%)	78.2	75.8
Household head is female (%)	17.3	22.0
SSP characteristics		
Age (%)		
18-29 years	18.0	14.0
30-39 years	30.7	33.9
40-49 years	25.2	19.9
50 years or older	26.2	32.3
Median (years)	40	40
Education of SSP (%)		
Illiterate (did not attend school)	61.7	55.4
Completed primary or less	16.8	18.3
Completed middle	7.8	10.2
Completed secondary or above	13.7	16.1
Married (%)	87.1	83.9
SSP is household head (%)	13.2	17.2

Source: APC baseline survey.

[a]Based on the progress out of poverty index developed by the Grameen Foundation (http://www.progresssoutofpoverty.org/)

Sample size: 707 treatment SSPs in the full sample, 186 treatment SSPs in the highly engaged sample

B. Cultivation patterns

The APC project aimed to increase the production of winner crops, improve access to agricultural inputs, and support complementary infrastructure for post-harvest storage and processing through government convergence. Below, we assess endline impacts on a range of agricultural production outcomes—cultivation patterns, crop harvests and yields, use of techniques and inputs, and use of post-harvest management—for the 2023-2024 *rabi* and 2024 *kharif* seasons.

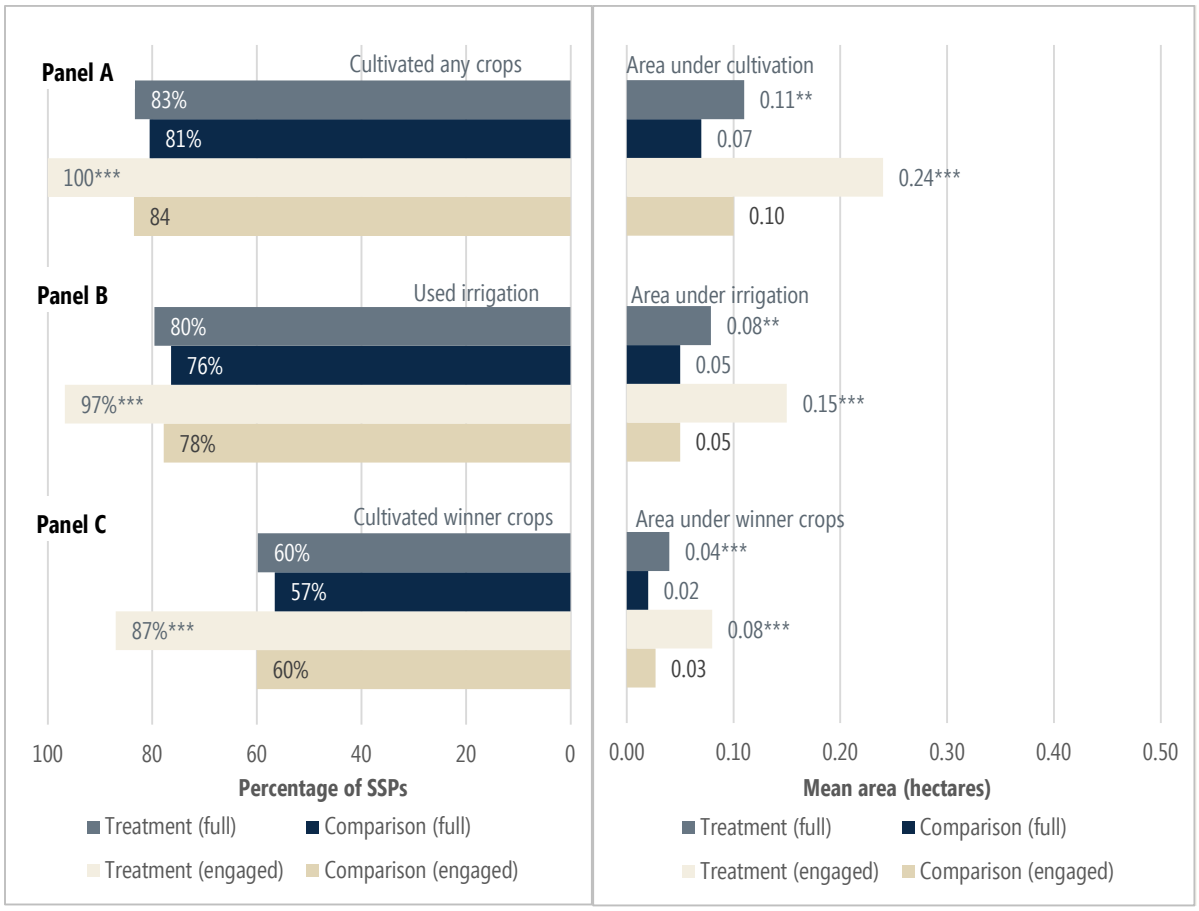
Rabi season

In the 2023-2024 *rabi* season, treatment SSPs cultivated a larger mean area of land than comparison SSPs. In the full sample, about 8 in 10 SSPs in both the treatment and comparison groups cultivated land in this season, but the former cultivated a larger mean rea (0.11 vs. 0.07 hectares) **(Figure IV.2, panel A)**. In the highly engaged sample, treatment SSPs were more likely to cultivate than comparison SSPs (100 vs. 84 percent) and cultivated more than twice the mean area (0.24 vs. 0.10 hectares). Almost all SSPs who cultivated in this season irrigated; the average area irrigated was a large fraction of the average area cultivated, emphasizing the importance of irrigation to *rabi* season cultivation **(Figure IV.2, panel B)**. The proportion of SSPs cultivating in the *rabi* season has increased since the 2022-2023 season, when only about 5 in 10 treatment SSPs and 4 in 10 comparison SSPs cultivated (Borkum et al. 2024). This could reflect differences in agro-climatic conditions across seasons and/or increased convergence with government irrigation schemes in both treatment and comparison areas over time. Although some of these improvements in *rabi* cultivation have occurred more broadly, our findings imply that the APC project led to relatively greater improvements in the treatment group.

Highly engaged treatment SSPs were substantially more likely to cultivate winner crops and cultivated larger areas of these crops than the comparison group. In the 2023-2024 *rabi* season, SSPs primarily cultivated horticulture crops, many of which are winner crops. In the full treatment sample, the most common crop varieties were brinjal, tomato, chilies, potato, and green beans, and the percentage of SSPs cultivating these crops was similar in the comparison group (**Figure IV.3**). The overall percentage of SSPs cultivating winner crops was also similar in the treatment and comparison groups (60 vs. 57 percent),[16] but treatment SSPs cultivated about twice the mean area of winner crops (0.04 vs. 0.02 hectares) **(Figure IV.2, panel C)**. For the highly engaged sample, the most common crops were largely similar to the full treatment sample, but there were larger impacts on the percentage of SSPs growing crops such as tomato (66 percent in treatment, 45 percent in comparison), brinjal (66 percent, 44 percent), chilies (54 percent, 41 percent), and okra (33 percent, 23 percent) (**Figure IV.3**). Overall, highly engaged treatment SSPs were much more likely to cultivate winner crops than the comparison group (87 vs. 60 percent) and cultivated almost three times the mean area of winner crops (0.08 vs. 0.03 hectares) **(Figure IV.2, panel C).**

[16] Winner crops are defined at the block level, and we used those block-level designations in our analysis. However, individual PGs can choose to promote a subset of winner crops identified for their block. Further, the PGs/PCs can support high-value crops that are commonly cultivated but are not winner crops (for example, by coordinating input provision). Therefore, our findings related to winner crops do not align perfectly reflect the high-value crops that the project is supporting for a given PG.

Figure IV.2. Cultivation in the 2023-24 *rabi* season

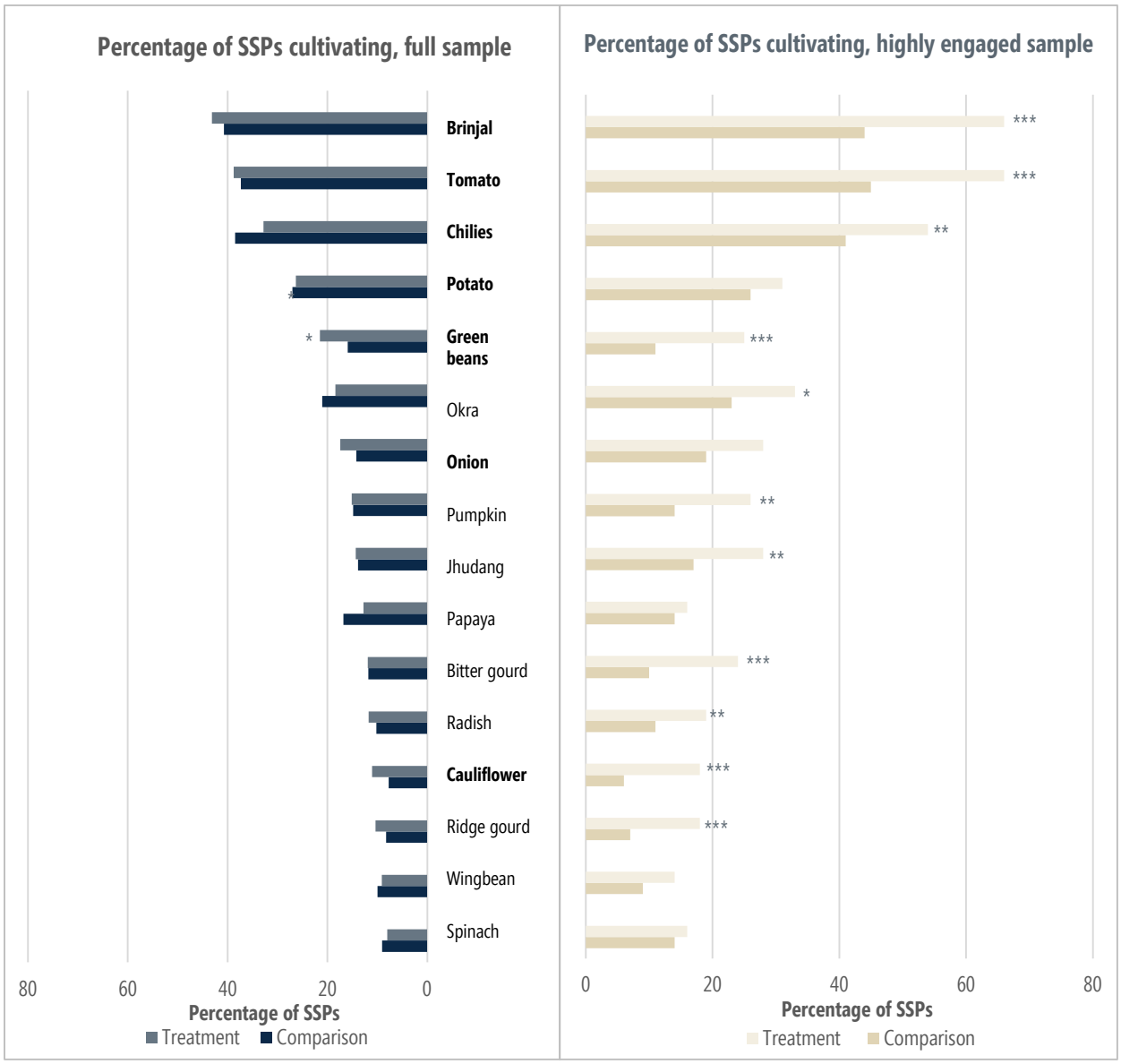


Source: APC *rabi* endline survey.

Sample size: 707 treatment SSPs and 982 comparison SSPs in the full sample, 186 treatment SSPs and 674 comparison SSPs in the highly engaged sample

*/**/*** Significantly different from zero at the 0.1/0.05/0.01 level.

Figure IV.3. Cultivation in the 2023–2024 *rabi* season, by crop



Source: APC *rabi* endline survey.

Notes: Only the 15 most commonly cultivated crops among treatment SSPs in the full or highly engaged samples are included. Winner crops in the 2023-2024 *rabi* season are italicized but vary across blocks.

Sample size: 707 treatment SSPs and 982 comparison SSPs in the full sample, 186 treatment SSPs and 674 comparison SSPs in the highly engaged sample

*/**/*** Significantly different from zero at the 0.1/0.05/0.01 level.\

Kharif season

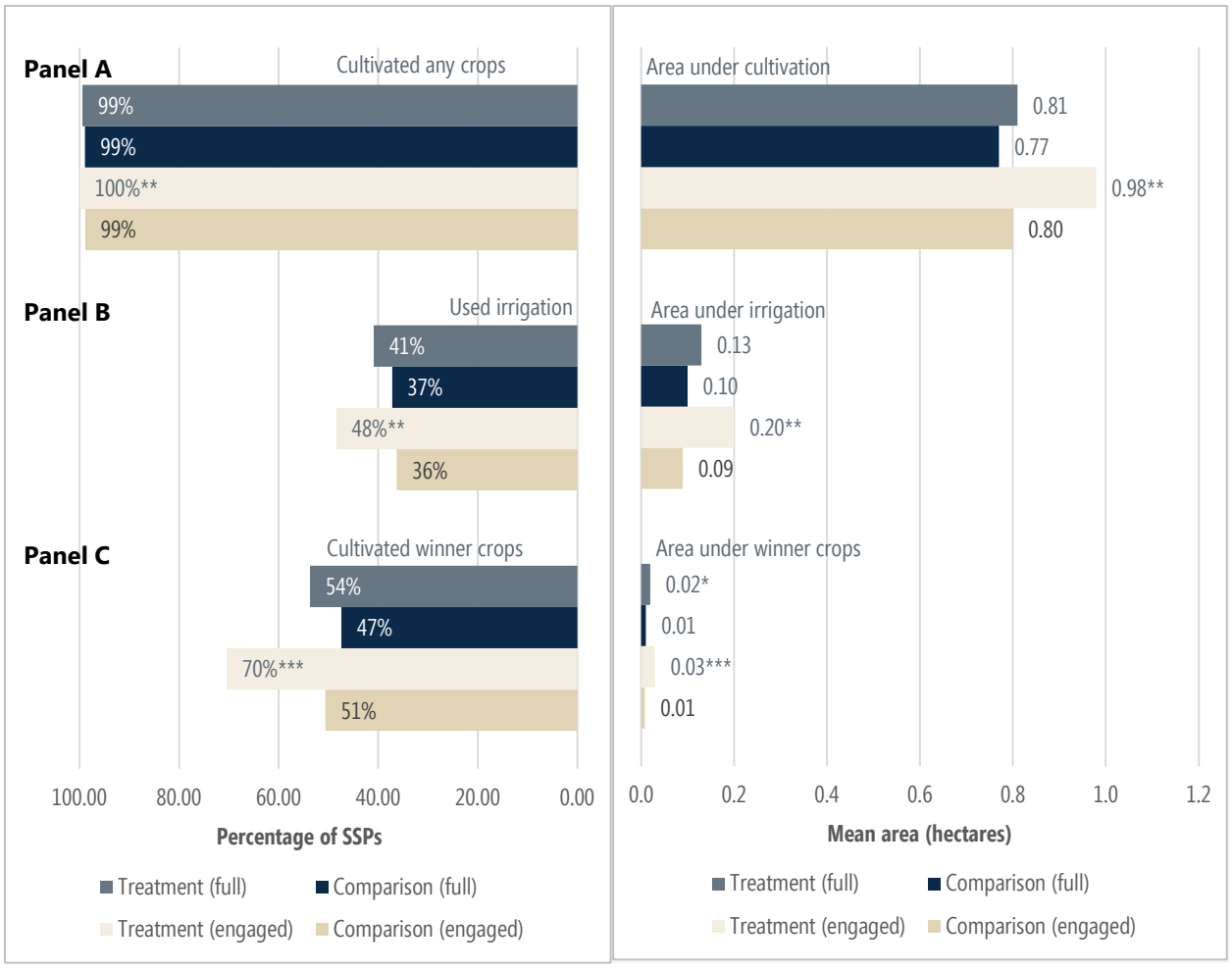
In the 2024 *kharif* season, highly engaged treatment SSPs cultivated a larger area of land and irrigated more than SSPs in the comparison group. Nearly all SSPs in both the treatment and comparison groups cultivated land during the 2024 *kharif* season, with the average area cultivated substantially larger than in the 2023–2024 *rabi* season. On average, treatment SSPs cultivated a similar

area as comparison SSPs in the full sample (0.81 vs. 0.77 hectares), but significantly more in the highly engaged sample (0.98 vs. 0.80 hectares) **(Figure IV.4, panel A)**. Use of irrigation for cultivation in the *kharif* season was much less common than in the *rabi* season **(Figure IV.4, panel B)**. Nevertheless, highly engaged treatment SSPs were significantly more likely to irrigate than comparison SSPs (48 vs. 36 percent) and irrigated more than double the area on average (0.20 vs. 0.09 hectares). Consistent with paddy's dominance of *kharif* season cultivation, it also accounted for the greatest irrigated area in this season (not shown), although rain-fed paddy cultivation remained by far the most dominant mode of cultivation. Overall, these findings demonstrate that the APC project resulted in modest improvements in *kharif* cultivation for both staple[17] and high-value crops among highly engaged SSPs—plausibly associated with increased access to irrigation and modern equipment through convergence—although the impacts on high-value crops were more substantial in the *rabi* season.

Highly engaged treatment SSPs were significantly more likely than comparison SSPs to cultivate winner crops in the 2024 *kharif* season, although the areas cultivated were small. In the 2024 *kharif* season, nearly 90 percent of SSPs in both treatment and comparison groups across both samples cultivated paddy, the main staple crop in Odisha **(Figure IV.5)**. In the full sample, SSPs also commonly cultivated a variety of horticultural crops, including several winner crops such as brinjal, chilies, tomato, and green beans, with cultivation rates for these crops largely similar across the treatment and comparison groups **(Figure IV.5)**. SSPs in the highly engaged sample cultivated similar crop varieties to the full sample, but the treatment group was significantly more likely than the comparison group to cultivate winner crops such as brinjal (38 vs. 30 percent) and chilies (48 vs. 38 percent). For winner crop cultivation overall, treatment-comparison differences were also only pronounced for the highly engaged sample: 70 percent of treatment SSPs cultivated winner crops compared to 51 percent in the comparison group, and they allocated three times as much land to these crops (0.03 vs. 0.01 hectares) **(Figure IV.4, panel C).** These findings suggest that the APC project's impacts during the *kharif* season were largely concentrated among highly engaged SSPs. However, across both samples, the area devoted to winner crops was very small relative to the total area under cultivation, even more so than in the *rabi* season.

[17] High-value paddy, referring in this context to aromatic or indigenous varieties that are highly valued in the market, was a winner crop in some project areas and upscaling high-value paddy clusters and linking with processors is one of the APC project's strategic priorities moving forward. Our survey did not distinguish between this crop and regular (staple) paddy. However, high value paddy was a winner crop in only 3 of the 15 evaluation blocks in the 2024 kharif season. Some PCs have also supported SSPs' procurement of even staple paddy seeds in a timely and affordable manner as part of their services to SSPs.

Figure IV.4. Cultivation in the 2024 *kharif* season

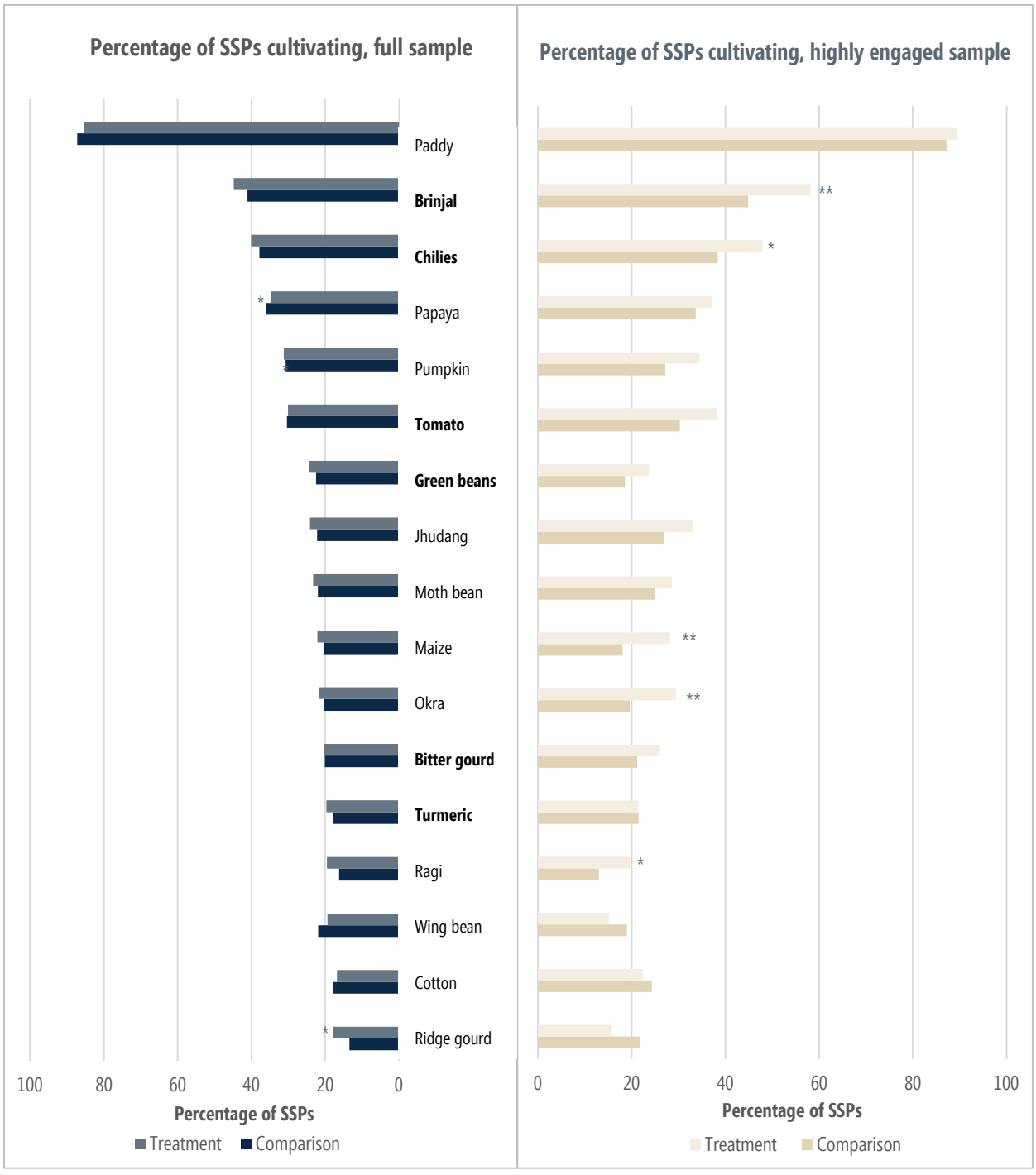


Source: APC *zaid/kharif* endline survey.

Sample size: 693-701 treatment SSPs and 960-974 comparison SSPs in the full sample, 223 treatment SSPs and 700-703 comparison SSPs in the highly engaged sample

*/**/*** Significantly different from zero at the 0.1/0.05/0.01 level.

Figure IV.5. Cultivation in the 2024 *kharif* season, by crop



Source: APC *zaid/kharif* endline survey.

Notes: Only the 15 most commonly cultivated crops among treatment SSPs in the full or highly engaged samples are included. Winner crops in the 2023-2024 *rabi* season are italicized but vary across blocks.

Sample size: 701 treatment SSPs and 974 comparison SSPs in the full sample, 223 treatment SSPs and 703 comparison SSPs in the highly engaged sample.

*/**/*** Significantly different from zero at the 0.1/0.05/0.01 level.

C. Crop production and processing

Rabi season

Harvest amounts were greater for treatment SSPs relative to comparison SSPs; this was largely driven by increased cultivated area rather than increased yields. In the full sample, treatment SSPs saw substantially greater mean harvest amounts than the comparison group for most commonly cultivated crops (**Table IV.2)**. However, there was no systematic difference in mean yields of these crops between the treatment and comparison groups. These findings were similar for the highly engaged sample, although treatment-comparison differences in harvest amounts were even greater. These findings suggest that impacts on harvest amounts in the 2023-2024 *rabi* season were largely driven by cultivation on larger areas of land rather than higher yields.

Table IV.2. Crop harvest and yield for common crops in the 2023-2024 rabi season

	Full sample			Highly engaged sample		
	Treatment mean	Comp. mean	Difference	Treatment mean	Comp. mean	Difference
Harvest, full sample						
Crop harvest for the most common crop varieties, among those cultivating each crop (kg)						
Brinjal	86	72	14	108	74	34**
Tomato	129	92	37**	173	97	76***
Chilies	54	19	34**	74	19	55**
Potato	190	107	83**	253	119	134***
Green beans	106	58	49**	132	28	104**
Okra	90	45	45*	147	24	122**
Onion	46	40	5	62	51	11
Pumpkin	131	83	48	201	114	87
Jhudang	56	32	24*	71	44	27
Papaya	32	45	-13	40	54	-13
Bitter gourd	46	53	-7	51	137	-85
Yield, full sample						
Yield for the most common crop varieties, among those cultivating each crop (kg per hectare)						
Brinjal	13,772	15,082	-1,310	14,349	16,386	-2,037
Tomato	14,517	15,692	-1,175	14,787	17,048	-2,262
Chilies	6,343	6,378	-35	7,114	7,177	-63
Potato	12,766	12,,355	411	11,456	9,796	1,661
Green beans	11067	13,901	-2,833*	10,120	12,848	-2,728
Okra	11,753	10,655	1,098	10,976	10,393	583
Onion	7,200	8,016	-816	6,889	5,872	1,017
Pumpkin	142,026	230,898	-88,872**	123,656	199,757	-76,101
Jhudang	12,220	16,710	-4,490*	11,361	16,982	-5,620*
Papaya	121,898	354,368	-232,471***	108,150	356,393	-248,243**
Bitter gourd	22,485	21,044	1,442	20,268	15,128	5,140

Source: APC *rabi* endline survey.

Notes: Only the top 15 most commonly cultivated crops among treatment SSPs in the full or highly engaged samples are included, sorted by the prevalence of cultivation in the full treatment sample. Winner crops in the 2023-2024 *rabi* season are italicized but vary across blocks. Our approach to outliers for these indicators was crop specific, depending on the distribution. In some cases, we top-coded at the 99th percentile and replaced all values above the top-coding threshold with the top-coding threshold. In others, there were one or two outliers, which we set to missing.

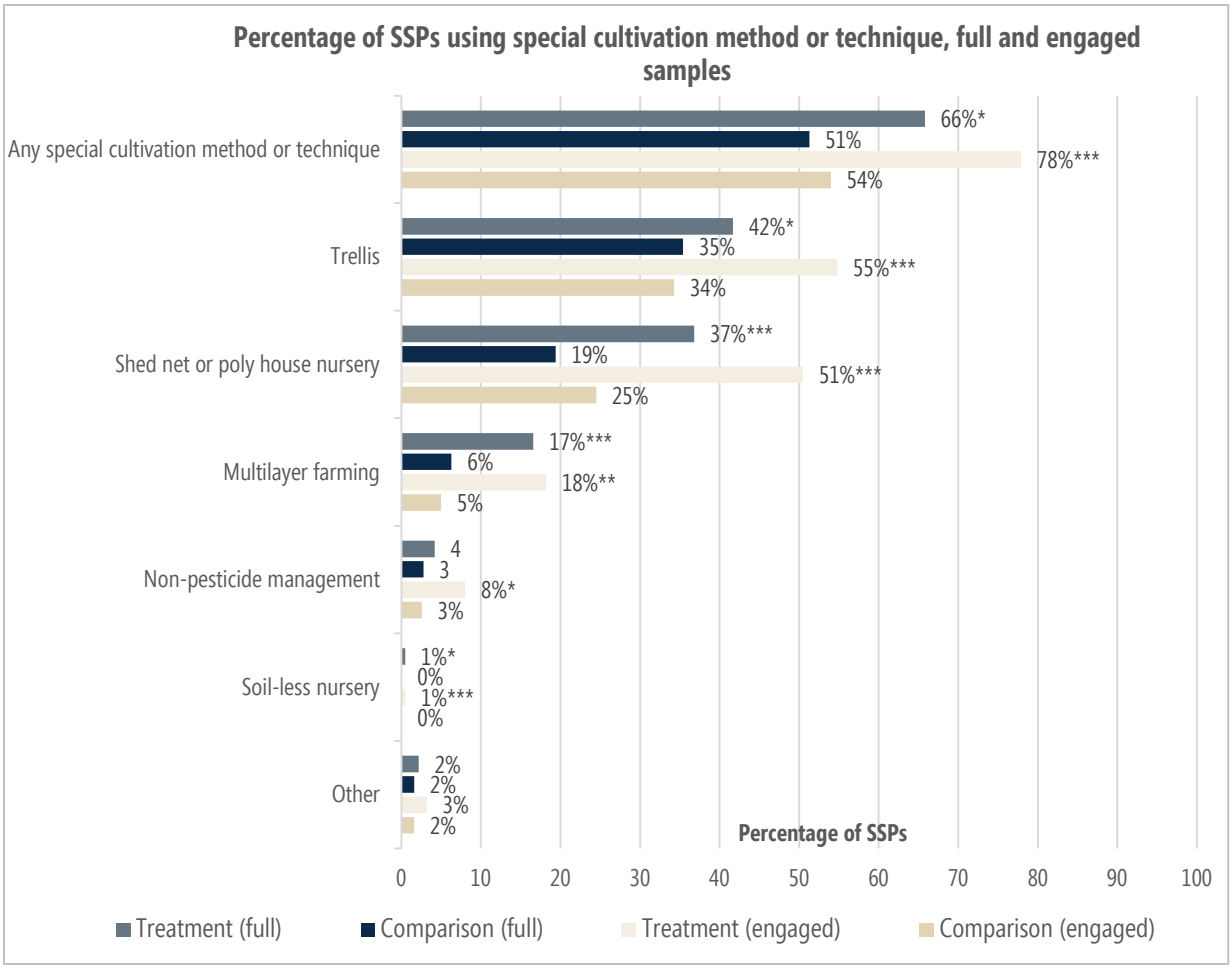
Sample size: For harvests, 305 to 84 treatment SSPs and 383 to 111 comparison SSPs in the full sample, 123 to 29 treatment SSPs and 244 to 70 comparison SSPs in the highly engaged sample. Yield sample sizes could be smaller than harvest sample sizes if SSPs reported a negligible area of cultivation for a crop.

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

Treatment SSPs were substantially more likely to use special cultivation methods or techniques promoted by the project, modern equipment, and pesticides and herbicides. These treatment-comparison differences were especially large for the highly engaged sample: 24 percentage points for any special methods or techniques, 23 percentage points for modern equipment, 34 percentage points for pesticides (23 percentage points for organic pesticides, which were encouraged by the project), and 12 percentage points for herbicides **(Figures IV.6, IV.7, and IV.8)**. The findings above suggest that these differences did not translate into systematically higher yields for the treatment group. However, they might have enabled SSPs to cultivate on larger areas of land, either physically (for example, through increased use of tractors and irrigation equipment) or by increasing their perceived protection against crop losses (for example, through pesticides).

Highly engaged treatment SSPs were more likely than comparison SSPs to store their *rabi* crops, as well as to process them before selling. In the full sample, treatment SSPs were no more likely than comparison SSPs to use storage (72 vs. 68 percent, not shown) or post-harvest processing techniques (72 vs. 67 percent, **Figure IV.9**), although they were more likely to use some specific processing techniques like grading, de-leafing and packing. In contrast, treatment SSPs in the highly engaged sample were much more likely than comparison SSPs to use storage (92 vs. 67 percent, not shown) and post-harvest processing techniques (95 vs. 76 percent, **Figure IV.9**), especially de-leafing, packing, bunching, and grading. These impacts might plausibly reflect the training provided by the project on post-harvest processing with a view to meeting buyers' quality needs.

Figure IV.6. Use of special cultivation methods or techniques in the 2023-2024 *rabi* season, among SSPs who cultivated

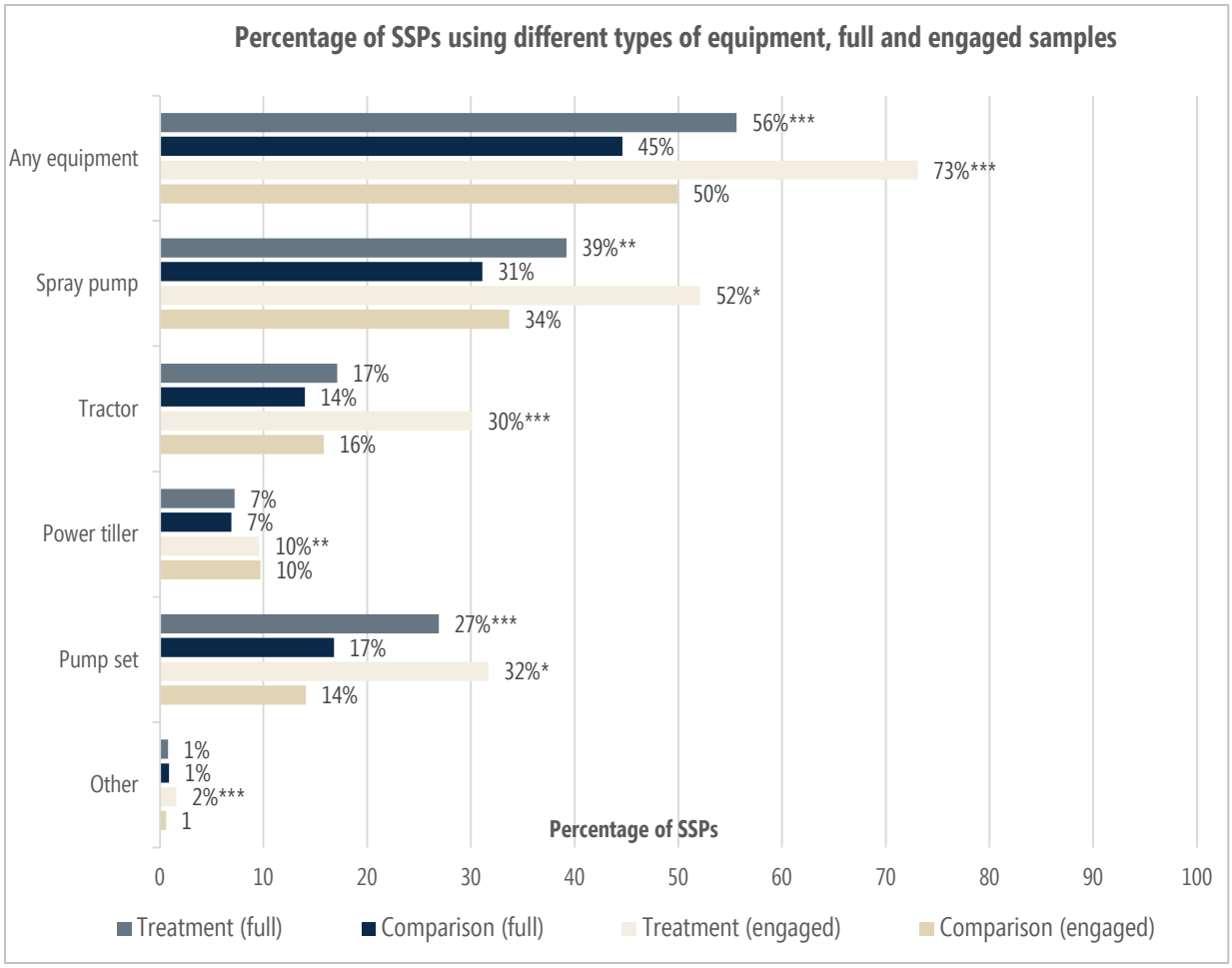


Source: APC *rabi* endline survey.

Sample size: 589 treatment SSPs and 763 comparison SSPs in the full sample, 186 treatment SSPs and 516 comparison SSPs in the highly engaged sample

*/**/*** Significantly different from zero at the 0.1/0.05/0.01 level.

Figure IV.7. Use of modern farm equipment in the 2023-2024 *rabi* season, among SSPs who cultivated

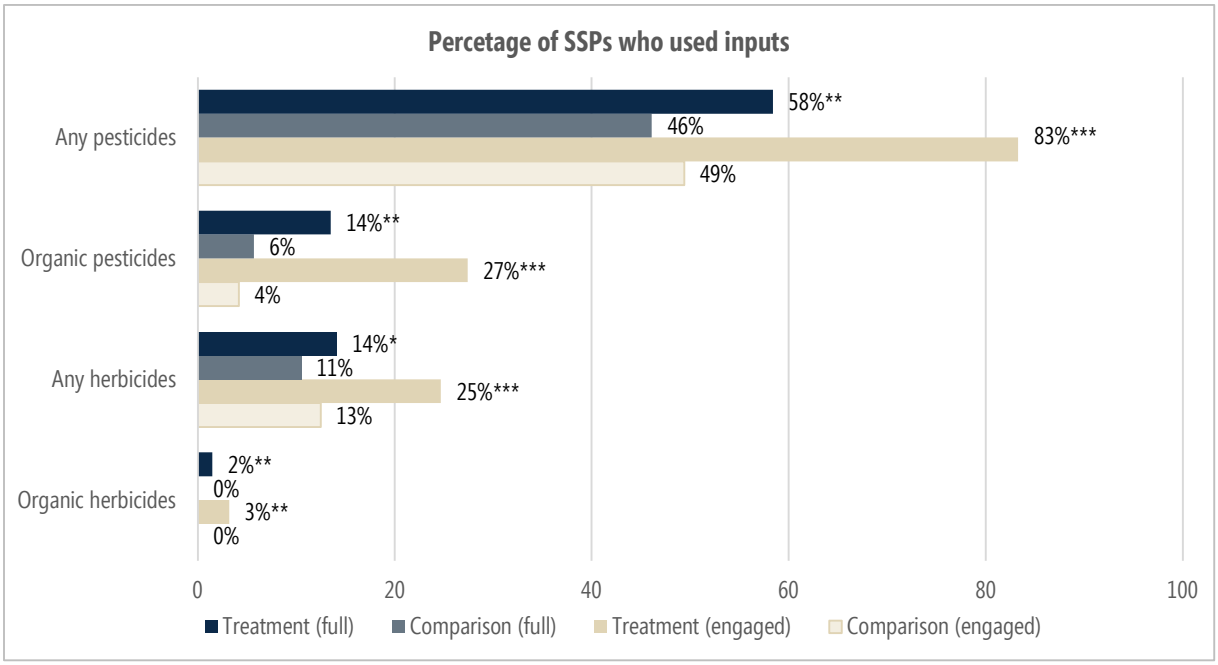


Source: APC *rabi* endline survey.

Sample size: 589 treatment SSPs and 763 comparison SSPs in the full sample, 186 treatment SSPs and 516 comparison SSPs in the highly engaged sample

*/**/*** Significantly different from zero at the 0.1/0.05/0.01 level.

Figure IV.8 Use of pesticides and herbicides in the 2023–2024 *rabi* season, among SSPs who cultivated

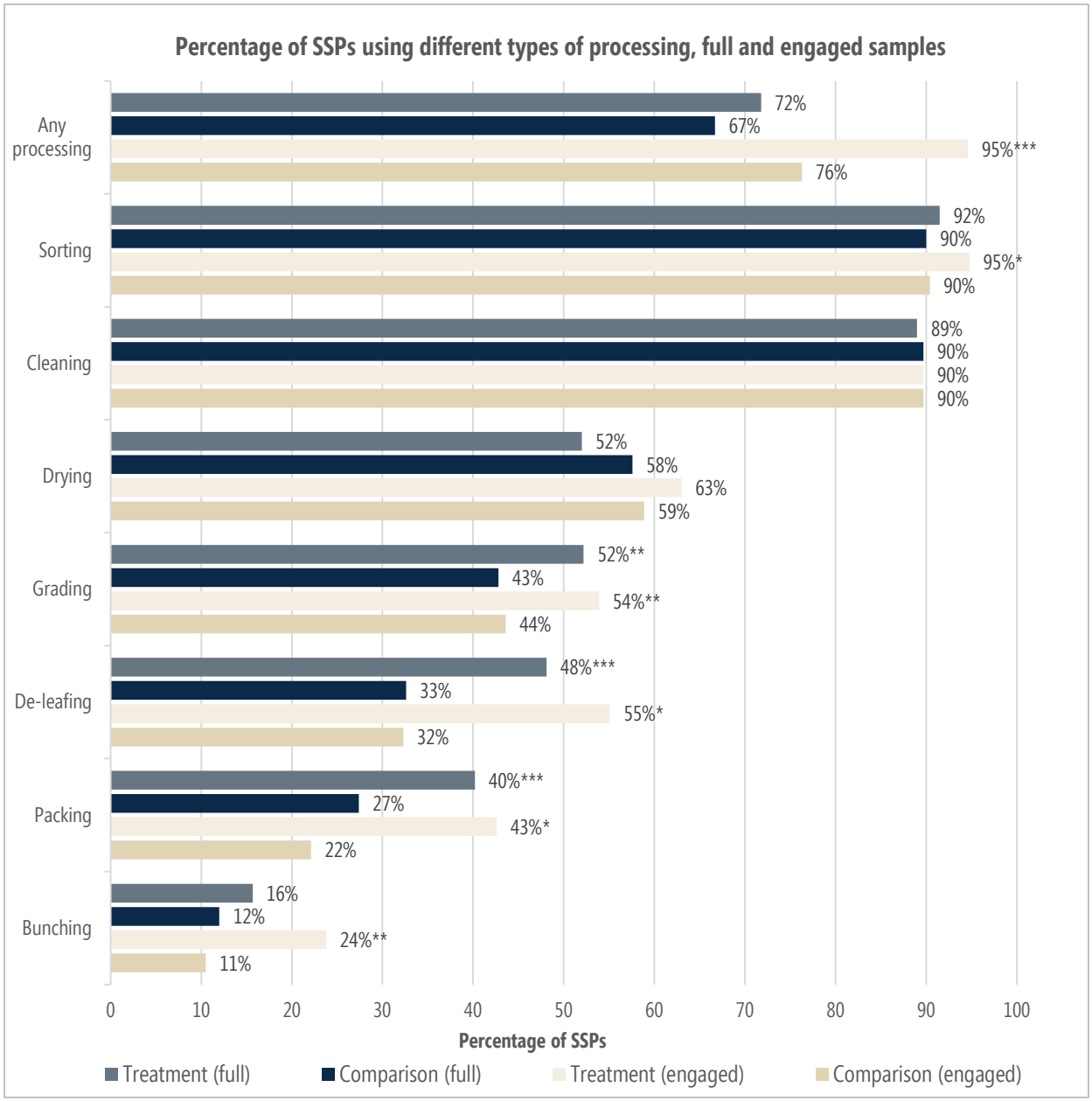


Source: APC *rabi* endline survey.

Sample size: 589 treatment SSPs and 763 comparison SSPs in the full sample, 186 treatment SSPs and 516 comparison SSPs in the highly engaged sample

*/**/*** Significantly different from zero at the 0.1/0.05/0.01 level.

Figure IV.9. Use of processing in the 2023-2024 *rabi* season, among SSPs who cultivated, and types of processing, among SSPs who processed



Source: APC *rabi* endline survey.

Sample size: 532 to 707 treatment SSPs and 663 to 982 comparison SSPs in the full sample, 186 to 176 treatment SSPs and 451 to 674 comparison SSPs in the highly engaged sample

*/**/*** Significantly different from zero at the 0.1/0.05/0.01 level.

Kharif season

Highly engaged treatment SSPs harvested greater quantities of crops than comparison SSPs, while crop yields remained unaffected across both samples. In both the full and highly engaged samples, treatment SSPs had higher mean harvests than the comparison group for a handful of commonly

cultivated crops (**Table IV.3**). These differences were generally more common and larger in magnitude for the highly engaged sample, for crops such as paddy, brinjal, chilies, and green beans. In contrast, there were no systematic differences in mean crop yields between treatment and comparison groups in either sample. These findings indicate that the APC project increased total harvest amounts for highly engaged SSPs during the 2024 *kharif* season through expanded cultivation area rather than yield improvements—a pattern consistent with findings from the 2023–2024 *rabi* season.

Table IV.3. Crop harvest and yield for common crops in the 2024 kharif season

	Full sample			Highly engaged sample		
	Treatment mean	Comp. mean	Difference	Treatment mean	Comp. mean	Difference
Harvest, full sample						
Crop harvest for the most common crop varieties, among those cultivating each crop (kg)						
Paddy	1489	1374	115	1,857	1,561	295*
Brinjal	84	66	18	135	52	83***
Chilies	13	9	4	19	7	12***
Papaya	44	43	1	47	59	-12
Pumpkin	69	58	12	88	77	11
Tomato	63	67	-3	88	49	38
Green beans	57	36	20	59	15	44**
Jhudang	36	23	13**	54	26	28***
Moth bean	14	11	3	14	10	4
Maize	88	46	42***	91	44	47*
Okra	63	30	33**	70	42	29
Bitter gourd	27	17	9*	37	19	18*
Turmeric	41	52	-11	46	35	10
Ragi	135	91	44**	127	88	39
Wing bean	19	14	5	27	15	12
Cotton	507	451	56	518	329	189
Ridge gourd	23	14	9*	24	13	10**
Yield, full sample						
Yield for the most common crop varieties, among those cultivating each crop (kg per hectare)						
Paddy	2,852	2,703	150	2,858	2,634	224
Brinjal	19,401	18,975	426	19,643	19,360	283
Chilies	9,811	11,208	1,397	9,863	11,421	-1,558
Papaya	409,160	434,902	-25,742	413,442	583,737	-170,294
Pumpkin	169,749	151,779	17,970	156,423	140,826	15,597
Tomato	20,807	21,666	-859	25,443	21,672	3,771
Green beans	19,921	19,403	518	22,330	19,529	2,801
Jhudang	16,282	12,981	3,301	18,070	11,843	6,227
Moth bean	3,195	1,002	2,194	1,850	1,562	287
Maize	9,037	11,410	2,373	9,123	9,428	-305

	Full sample			Highly engaged sample		
	Treatment mean	Comp. mean	Difference	Treatment mean	Comp. mean	Difference
Okra	17,436	17,450	14	19,926	17,338	2,589
Bitter gourd	29,815	25,073	4,742	25,046	23,394	1,652
Turmeric	6,096	9,230	3,134	3,931	8,547	-4,616**
Ragi	2,429	3,506	1,077	1,460	1,228	232
Wing bean	54,619	38,360	16,259	52,342	56,196	-3,854
Cotton	1,031	1,075	43	1,047	813	235
Ridge gourd	37,644	41,557	3,913	25,227	40,819	15,592

Source: APC zaid/*kharif* endline survey.

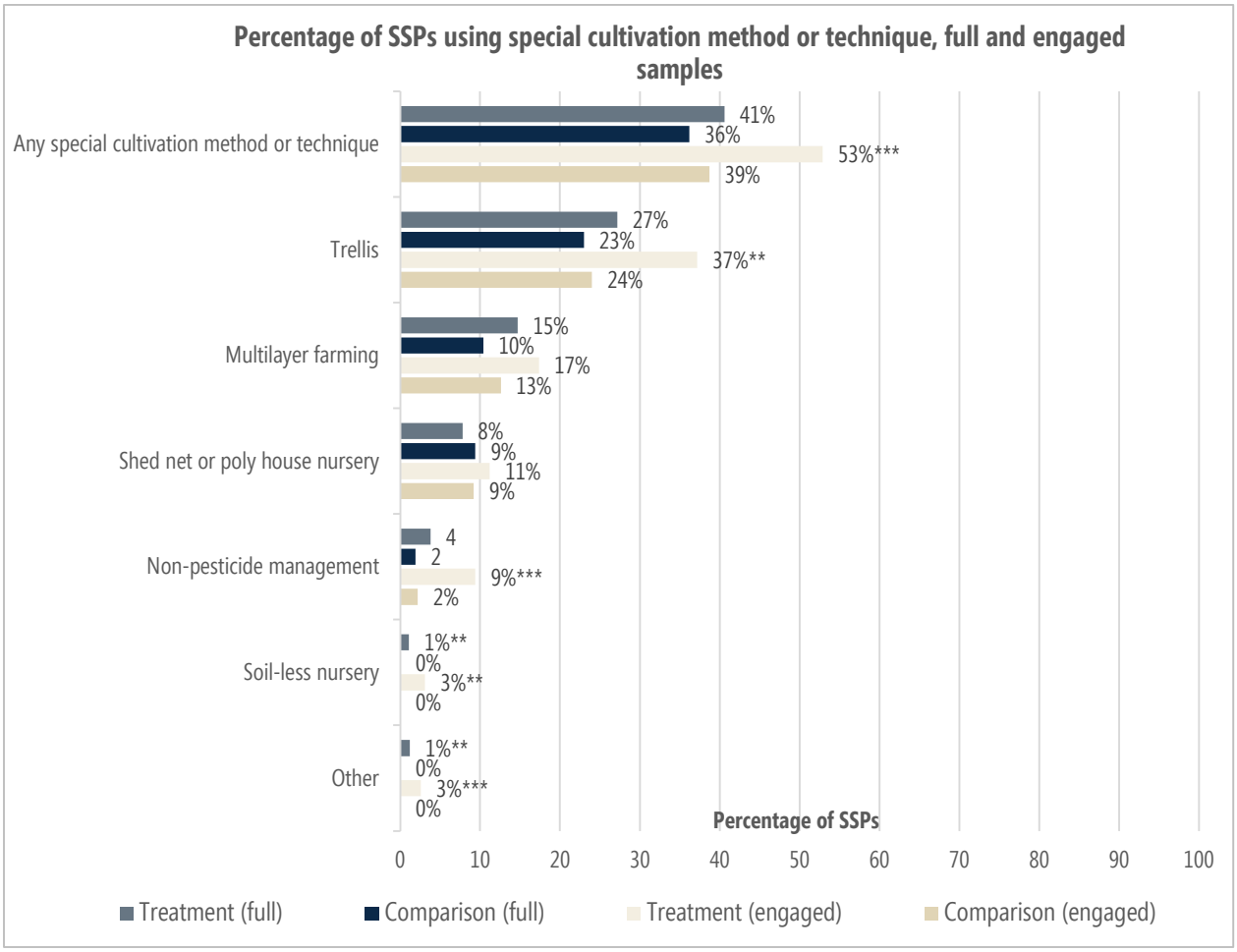
Notes: Only the top 15 most commonly cultivated crops among treatment SSPs in the full or highly engaged samples are included, sorted by the prevalence of cultivation in the full treatment sample. Winner crops in the 2024 *kharif* season are italicized but vary across blocks. Our approach to outliers for these indicators was crop specific, depending on the distribution. In some cases, we top-coded at the 97th percentile and replaced all values above the top-coding threshold with the top-coding threshold. In others, there were a few outliers, which we set to missing.

Sample size: For harvests, 603 to 122 treatment SSPs and 846 to 171 comparison SSPs in the full sample, 200 to 34 treatment SSPs and 625 to 162 comparison SSPs in the highly engaged sample. Yield sample sizes could be smaller than harvest sample sizes if SSPs reported a negligible area of cultivation for a crop.

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

Highly engaged treatment SSPs were significantly more likely to use special cultivation methods or techniques promoted by the project modern equipment, and pesticides and herbicides. In the full sample, there were no notable differences in the use of special cultivation methods and techniques between the treatment and comparison groups (**Figure IV.10**). However, in the highly engaged sample treatment SSPs were more likely to have used at least one special method than the comparison group (53 vs. 39 percent), although the overall adoption rates of many practices were low. Similarly, treatment SSPs in the highly engaged sample were more likely to use modern equipment (90 vs. 74 percent), especially irrigation equipment, but there were no impacts for the full sample (**Figure IV.11**). There were no impacts on herbicide use for either sample, although pesticide use was modestly higher for the highly engaged sample, driven in part by impacts on the use of organic pesticides (**Figure IV.12**). Overall, these findings suggest that deeper SSP engagement in the APC project led to greater uptake of improved cultivation practices and modern equipment. However, the project's influence was limited among PG members more broadly, and these increased adoption rates among highly engaged SSPs did not translate into meaningful improvements in crop yields.

Figure IV.10. Use of special cultivation methods or techniques in the 2024 *kharif* season, among SSPs who cultivated

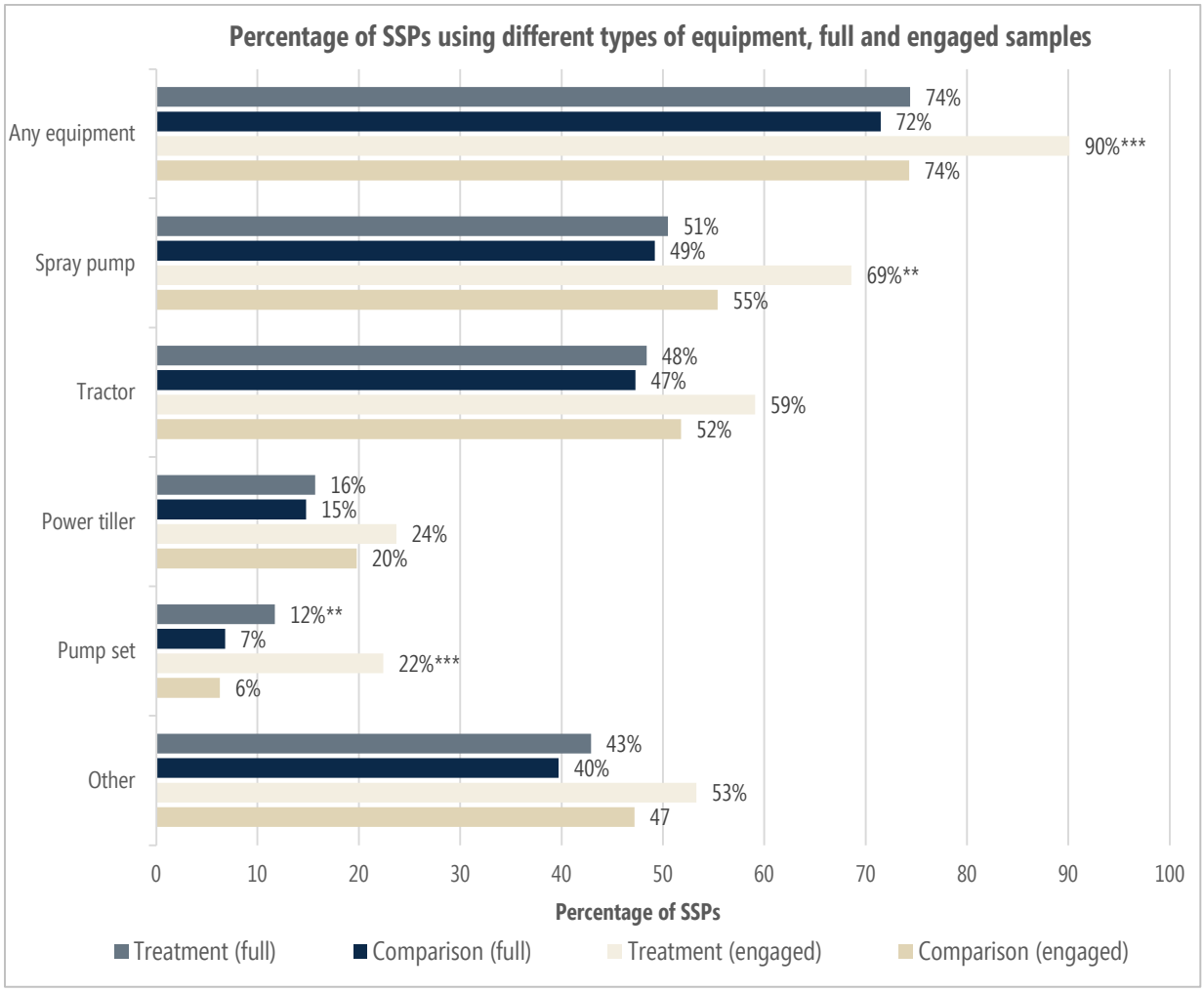


Source: APC zaid/*kharif* endline survey.

Sample size: 697 treatment SSPs and 958 comparison SSPs in the full sample, 223 treatment SSPs and 690 comparison SSPs in the highly engaged sample

*/**/*** Significantly different from zero at the 0.1/0.05/0.01 level.

Figure IV.11. Use of modern farm equipment in the 2024 *kharif* season, among SSPs who cultivated

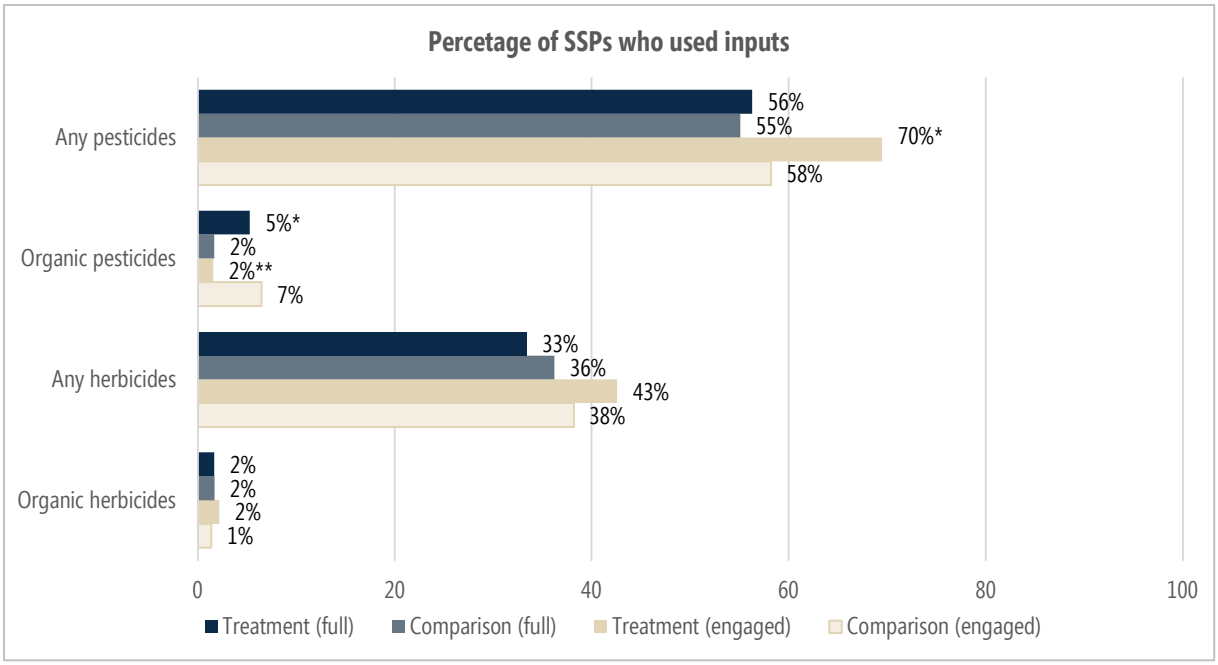


Source: APC *zaid/kharif* endline survey.

Sample size: 697 treatment SSPs and 958 comparison SSPs in the full sample, 223 treatment SSPs and 690 comparison SSPs in the highly engaged sample

*/**/*** Significantly different from zero at the 0.1/0.05/0.01 level.

Figure IV.12. Use of pesticides and herbicides in the 2024 kharif season, among SSPs who cultivated



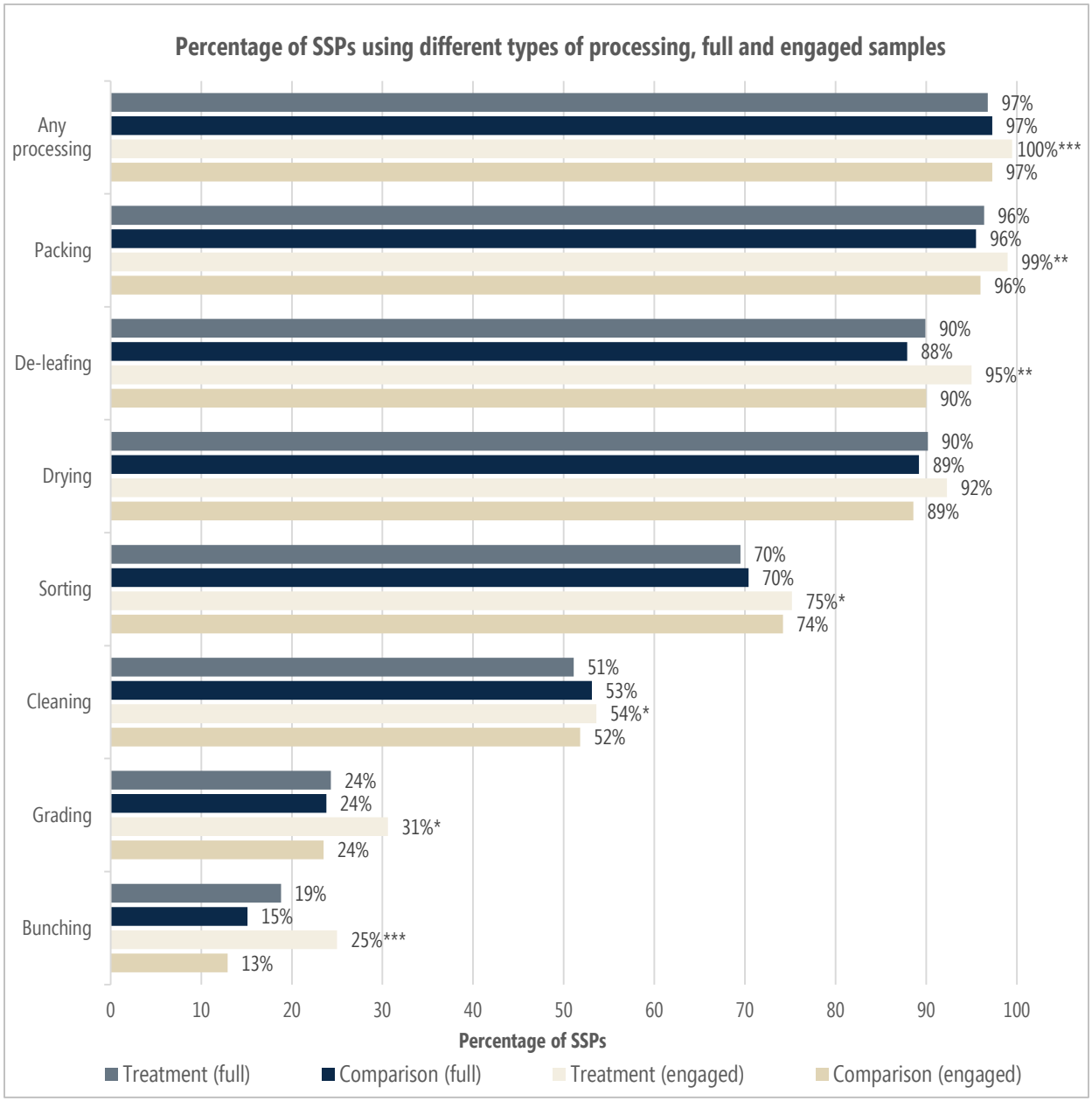
Source: APC zaid/*kharif* endline survey.

Sample size: 697 treatment SSPs and 958 comparison SSPs in the full sample, 223 treatment SSPs and 690 comparison SSPs in the highly engaged sample

*/**/*** Significantly different from zero at the 0.1/0.05/0.01 level.

Highly engaged treatment SSPs were more likely than comparison SSPs to engage in post-harvest processing techniques before selling in the *kharif* season. Across the full and highly engaged samples, nearly all SSPs stored their crops—primarily at home—with no significant differences between treatment and comparison groups (not shown). Almost all SSPs in both the full and highly engaged samples reported conducting some type of post-harvest processing (**Figure IV.13**). For the highly engaged sample only, there were modest statistically significant treatment-comparison differences in the use of specific methods such as de-leafing (95 vs. 90 percent), grading (31 vs. 24 percent) and bunching (25 percent vs. 13 percent). Consistent with earlier findings, these results suggest that stronger engagement in the APC project was associated with greater uptake of post-harvest processing ahead of sales.

Figure IV.13. Use of post-harvest processing in the 2024 kharif season, among SSPs who cultivated



Source: APC zaid/*kharif* endline survey.

Sample size: 679 to 701 treatment SSPs and 933 to 974 comparison SSPs in the full sample, 222 to 203 treatment SSPs and 672 to 703 comparison SSPs in the highly engaged sample

*/**/*** Significantly different from zero at the 0.1/0.05/0.01 level.

D. Crop sales

Rabi season

The APC project had a substantial positive impact on the percentage of SSPs selling crops in the 2023-2024 *rabi* season, including winner crops. In the full sample, treatment SSPs were substantially more likely than comparison SSPs to have sold any crops (52 vs. 38 percent) and any winner crops (37 vs. 24 percent) (**Figure V.14**).[18] These impacts are larger in the highly engaged sample, with treatment SSPs about twice as likely as the comparison group to have sold any crops (82 vs, 43 percent) and more than twice as likely to have sold any winner crops (65 vs, 26 percent). These strong impacts on crop sales are consistent with positive impacts on harvest amounts, as well as post-harvest processing, which we described earlier. We do not have clear quantitative data about the proportion of sales that were facilitated by PCs.[19] However, given that some commonly-reported sales channels (for example, direct to consumers or to village shopkeeper) are unlikely to have been facilitated by PCs and that many of the crops sold were not winner crops, we infer that a meaningful fraction of sales were independent of the PC. Nevertheless, the findings suggest that the APC project led SSPs to have an increased commercial orientation in the rabi season.

Kharif season

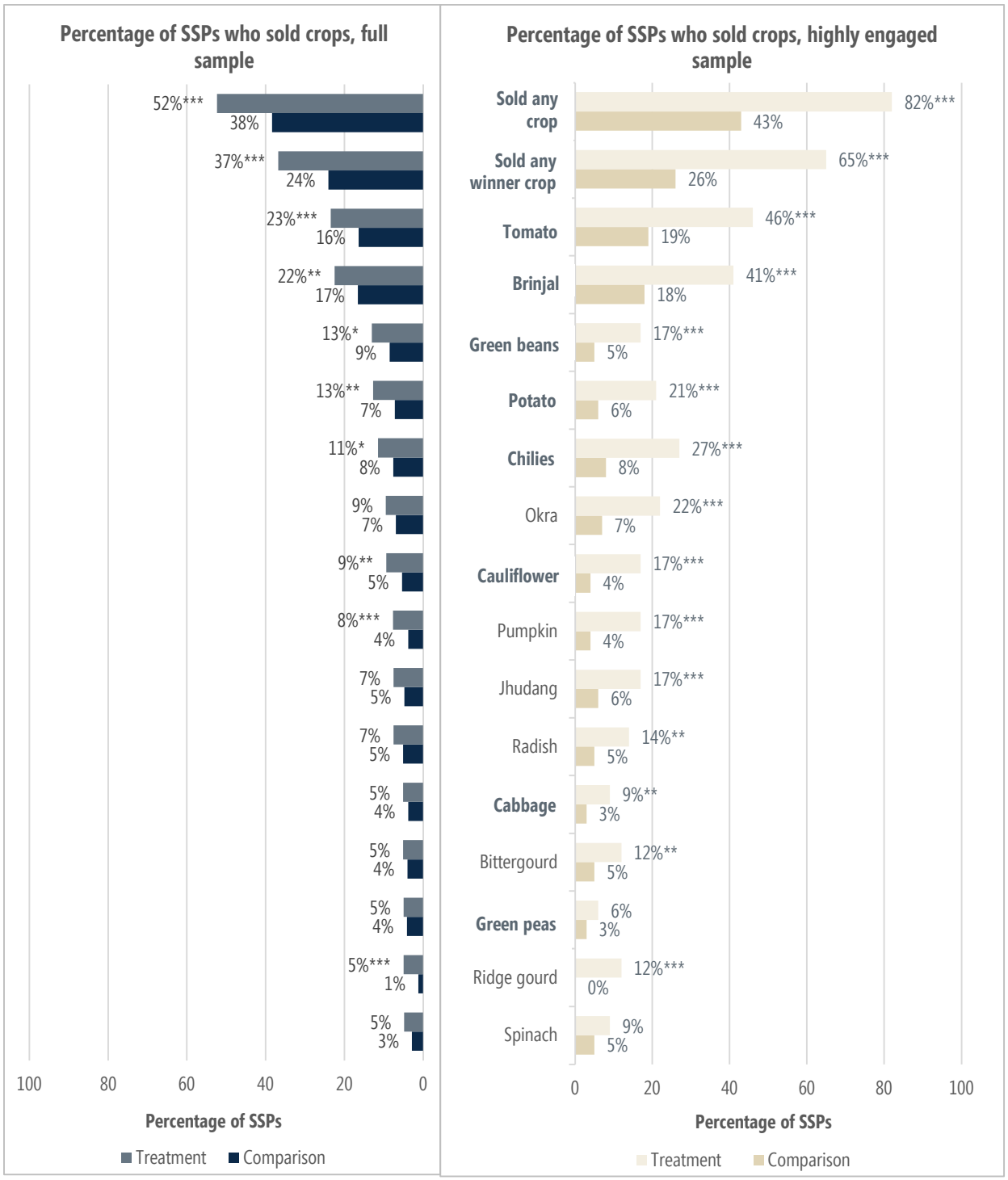
Treatment SSPs were also significantly more likely to sell crops—including winner crops—than comparison SSPs during the 2024 *kharif* season. In the full sample, treatment SSPs were more likely than comparison SSPs to have sold any crops in this season (65 vs. 56 percent) (**Figure IV.15**).[20] In the highly engaged sample, there were more striking differences: 80 percent of treatment SSPs reported selling crops, compared to just 60 percent of comparison SSPs. Moreover, 34 percent of highly engaged treatment SSPs sold at least one winner crop compared to only 13 percent in the comparison group. Across both samples, the most commonly sold crops were paddy, a staple, and horticultural crops such as brinjal, tomato, jhudang (cowpea), and pumpkin, with statistically significant differences between treatment and comparison groups for many of these crops. These findings generally align with the positive impacts on cultivated area and harvests reported earlier, suggesting that the APC project resulted in larger marketable surplus and hence increased commercial activity for SSPs.

[18] Comparing these percentages to the percentage of SSPs who cultivated in the *rabi* season suggests that a substantial minority cultivated crops but did not sell them. These crops were most commonly chilies, brinjal, tomato, onions, papaya, okra, and other horticulture crops, cultivated on very small areas of land. Those crops are also cultivated for sale to differing degrees, but typically on much larger areas of land.

[19] It proved challenging to reliably capture this information in an SSP survey because of differences in perceptions and awareness among SSPs of who the ultimate buyer was and the role played by the PC in supporting sales (which could involve direct sales and facilitated sales). We use survey reports of sales involving the PC as one of the components to define highly engaged SSPs, recognizing that this is likely imprecise. However, in practice the highly engaged sample is driven mostly by input purchases from the PC, which encompasses many of the SSPs reporting other types of engagement.

[20] These estimates are based on completed sales and do not include crops from the 2024 *kharif* season that were being stored for future sale or yet to be harvested at the time of the endline survey in January-February 2025. Projected sales data are incorporated into the revenue and income indicators presented later in this chapter to provide a more complete picture of SSP earnings from crop cultivation and sales.

Figure IV.14. Crop sales in the 2023-2024 *rabi* season, among all SSPs



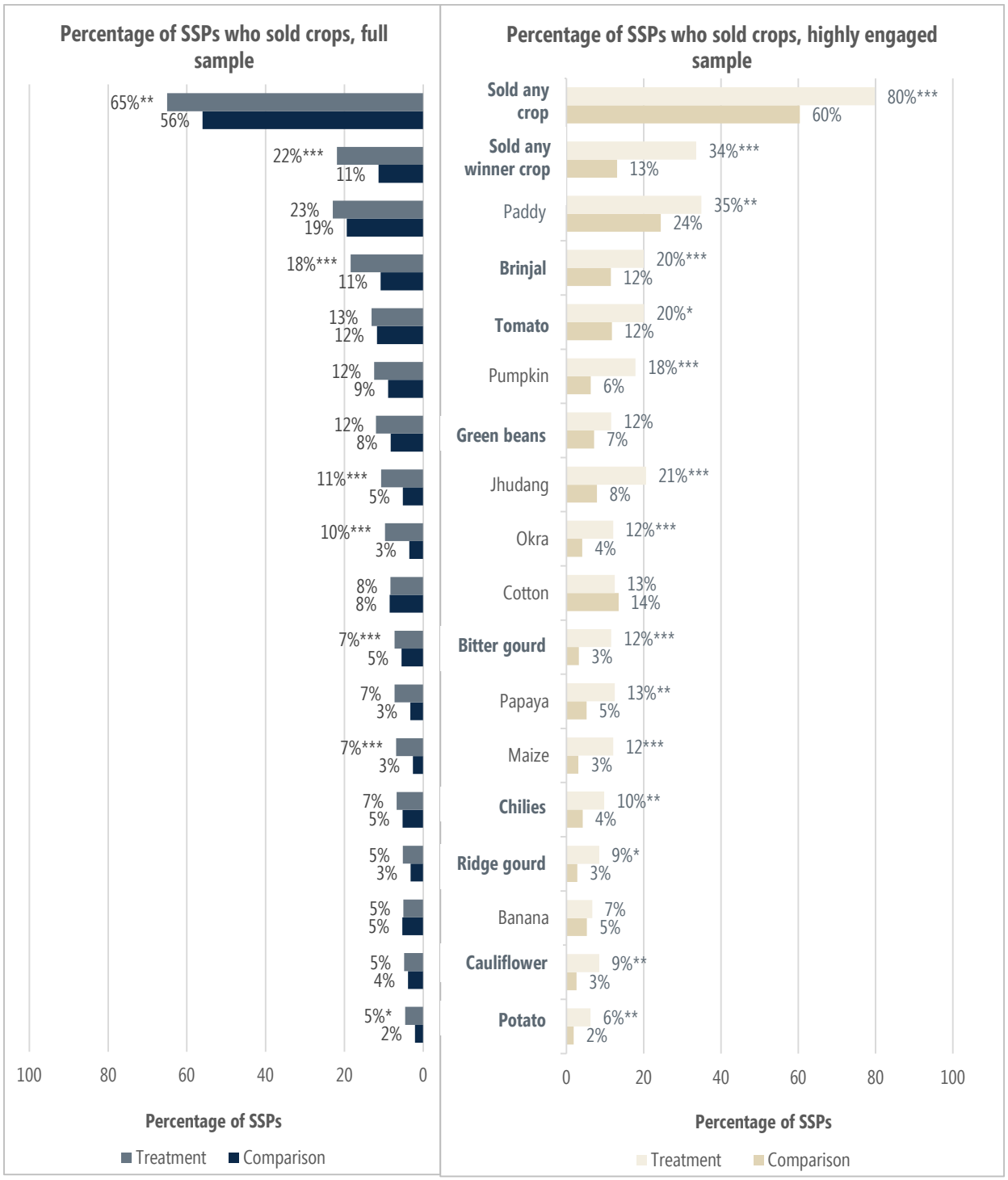
Source: APC *rabi* endline survey.

Notes: Only the top 15 most commonly sold crops among treatment SSPs in the full or highly engaged samples are included. Winner crops in the 2023-2024 *rabi* season are italicized but vary across blocks.

Sample size: 707 treatment SSPs and 982 comparison SSPs in the full sample, 186 treatment SSPs and 674 comparison SSPs in the highly engaged sample

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

Figure IV.15. Crop sales in the 2024 *kharif* season, among all SSPs



Source: APC zaid/*kharif* endline survey.

Notes: Only the top 15 most commonly sold crops among treatment SSPs in the full or highly engaged samples are included. Winner crops in the 2023-2024 *rabi* season are italicized but vary across blocks.

Sample size: 701 treatment SSPs and 974 comparison SSPs in the full sample, 223 treatment SSPs and 703 comparison SSPs in the highly engaged sample

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

E. Cultivation, production, and sales in *zaid*

In the APC *zaid*/kharif endline survey, we collected data from SSPs on agricultural production, sales, revenues, and income for the 2024 *zaid* season. As noted earlier, the *zaid* season is a shorter, dry-season cropping period that spans just over two months—end of March to May—and has historically seen low levels of agricultural activity. Our survey data reflected this pattern, with relatively few SSPs engaging in crop production during this time. Given the limited number of SSPs who both cultivated during the *zaid* season and met the criteria for active engagement with the APC project, our analysis for this season focuses on the full sample only.

Crop production was limited during the *zaid* season, though treatment SSPs cultivated slightly larger areas than comparison SSPs, likely due to increased access to irrigation facilitated through convergence efforts. In the 2024 *zaid* season, only about one-half of SSPs in each of the treatment and comparison groups cultivated crops (**Table IV.4**). Treatment SSPs cultivated a larger area of land on average (0.06 vs. 0.03 hectares), supported by greater use of irrigation (29 vs. 23 percent of SSPs, with 0.04 vs. 0.02 hectares irrigated on average). Fruit-tree crops such as mango, jackfruit, and papaya dominated cultivation during this season, while winner crop cultivation was low across both treatment and comparison groups (8 vs. 6 percent). There were no systematic differences between the two groups in terms of harvest quantities or crop yields. In terms of sales, fewer than one-third of SSPs in either group sold crops, and sales of winner crops was minimal. Overall, these results indicate that the APC project had limited impacts on crop-related outcomes during this season.

Table IV.4. Crop cultivation, production, and sales outcomes in the 2024 zaid season

	Full sample		
Indicator	**Treatment mean**	**Comparison mean**	**Difference**
Full sample cultivation pattern (%)			
Cultivated any crops	57	53	4
Used irrigation	29	23	6*
Cultivated winner crops	8	6	2
Cultivated area (hectares)			
Area under cultivation	0.06	0.03	0.03**
Area under irrigation	0.04	0.02	0.02*
Area under winner crops	0.01	0.00	0.01
Percentage of households who cultivated crops, by crop (%)			
Mango	20	24	-4
Jackfruit	19	18	1
Papaya	16	18	-2
Moringa	10	9	1
Banana	6	6	0
Crop harvest for the most common crop varieties, among those cultivating each crop (kg)			
Mango	42	40	2
Jackfruit	108	112	-4
Papaya	7	9	-2

Indicator	Full sample		
	Treatment mean	Comparison mean	Difference
Moringa	2	2	0
Banana	10	10	0
Yield for the most common crop varieties, among those cultivating each crop (kg per hectare)			
Mango	404,482	455,476	-50,994
Jackfruit	1,443,710	1,274,788	168,921
Papaya	299,966	378,496	78,529
Moringa	66,386	50,412	15,974
Banana	112,664	117,320	-4,655
Percentage of households who sold crops (%)			
Sold any crop	29	27	2
Sold winner crop	6	4	2

Source: APC zaid/*kharif* endline survey.

Sample sizes: 308 to 701 treatment SSPs and 474 to 974 comparison SSPs in the full sample

As noted before, this table omits results for the highly engaged sample due to very small sample sizes, as only a small proportion of SSPs cultivate during this season and meet the criteria for being highly engaged.

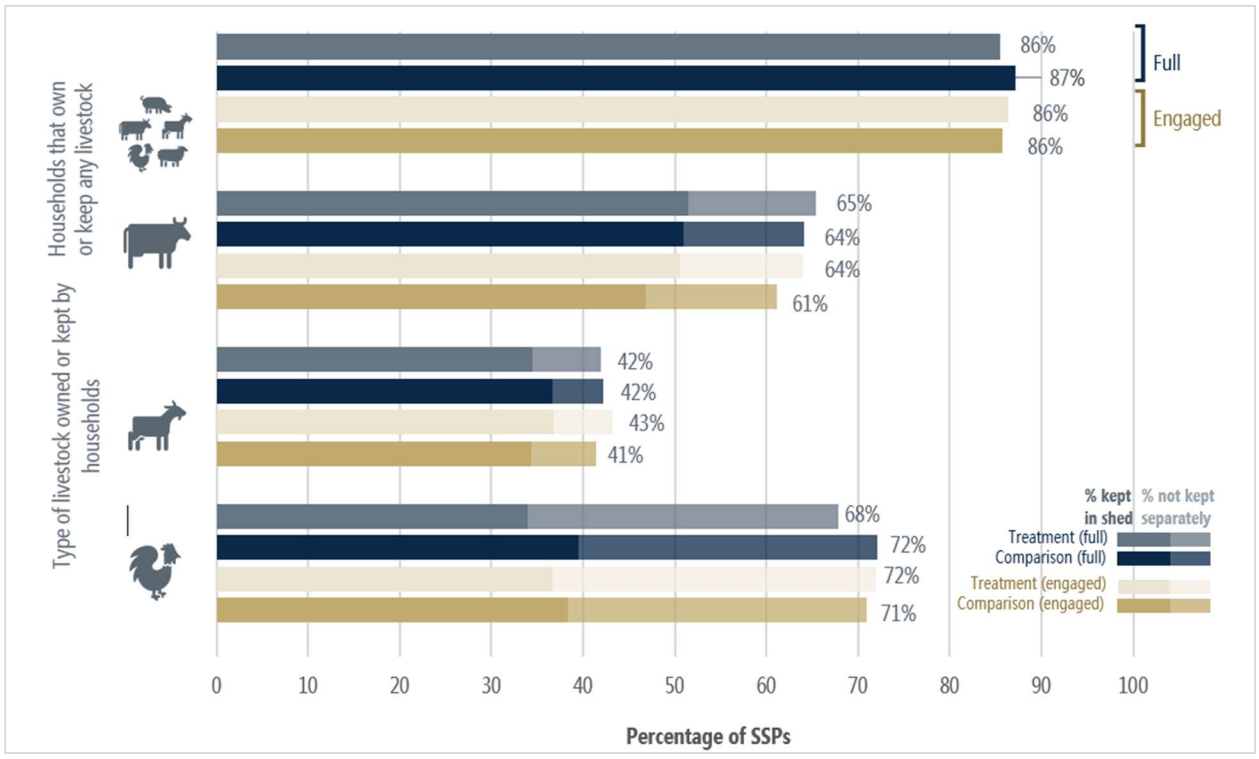
*/**/*** Significantly different from zero at the 0.1/0.05/0.01 level.

F. Livestock holdings and health

The APC project promoted livestock production as a supplementary activity, enabling SSPs—including those who are landless and sharecroppers—an additional opportunity to generate stable income and engage in the market. Project support included training of community animal health workers (*prani mitra*) who provide doorstep services in livestock vaccination, deworming and medication; linkages to vaccine suppliers and the establishment of vaccine cold storage; establishment of improved sheds and shelters to house livestock in healthier and safer conditions; chick-rearing units, and butcher houses; provision of supplementary feed; and market linkages with livestock buyers through PCs. To assess the impacts of the project on livestock husbandry, we compared livestock holdings, livestock housing, use of livestock health services, and livestock health outcomes between treatment and comparison groups in our full and highly engaged samples for the period January 2024 to December 2024, which roughly aligns with the three seasons covered by our crop-related outcomes.

Livestock holdings were broadly similar in the treatment and comparison groups, and there were no positive project impacts on the use of separate sheds to keep livestock. Nearly 9 in 10 treatment SSPs in both the full and highly engaged samples held any livestock, most commonly cattle, poultry, and goats (**Figure IV.16**). These proportions were very similar among comparison SSPs. The average number of livestock held was also generally similar among the treatment and comparison groups across both samples. The APC project promoted the use of separate sheds for keeping goats, and night and day shelters for keeping poultry, but there was no evidence of positive impacts along this dimension. At interim and endline, our qualitative data found that shed construction has been limited by credit constraints that prevented SSPs from paying up front and being reimbursed later (as government schemes require), and by limited labor and raw materials that constraints their ability to build their own sheds following training from the project (Borkum et al. 2024).

Figure IV.16. Livestock holdings and housing at the end of the 2024 *kharif* season, among all SSPs



Source: APC *zaid/kharif* endline survey.

Notes: Pigs and sheep omitted from the "types of livestock" analysis because they are held by relatively few households. No treatment-comparison differences were significantly different from zero at the 0.1 level or better.

Sample sizes: 701 treatment SSPs and 974 comparison SSPs in the full sample, 303 treatment SSPs and 855 comparison SSPs in the highly engaged sample.

Treatment SSPs, particularly those who were highly engaged, were more likely to vaccinate and deworm their livestock and experienced lower rates of goat illness and mortality compared to comparison SSPs across both samples. This assessment focuses on goats and poultry, which were key targets of the APC project's livestock health interventions. In the full sample, there were statistically significant differences between treatment and comparison groups in poultry vaccination (6 vs. 2 percent vaccinated all their poultry, **Table IV.5**), but not in goat vaccination or in deworming. Among highly engaged SSPs, treatment households that held poultry were more likely to have vaccinated all their livestock (9 vs. 2 percent) and goat-holding households were more likely to have dewormed all their livestock (37 vs. 22 percent) relative to equivalent comparison households (**Table IV.5**). These patterns likely reflect the project's efforts to provide training and services to improve rearing practices. In terms of livestock health outcomes, treatment SSPs were consistently less likely to report goat illness across both samples (60 vs. 77 percent in the highly engaged sample) and also reported lower rates of goat mortality (58 vs. 70 percent in the highly engaged sample). In contrast, no significant differences were observed between the two groups in poultry illness or mortality.

Table IV.5. Livestock health services and health outcomes in 2024, among SSP households holding livestock

Indicator	Full sample			Highly engaged sample		
	Treatment mean	Comparison mean	Difference	Treatment mean	Comparison mean	Difference
Percentage of households vaccinating all livestock (%)						
Goat	32	33	1	39	32	7
Poultry	6	2	4**	9	2	7**
Percentage of households deworming all livestock (%)						
Goat	27	21	6	37	22	15***
Poultry	5	4	1	6	4	2
Percentage of households who had any livestock fall ill (%)						
Goats	61	72	-11**	60	77	-17**
Poultry	65	70	-5	61	69	-8
Percentage of households who had any livestock die (%)						
Goat	57	67	-10**	58	70	-12*
Poultry	42	43	-1	67	68	-1

Source: APC *zaid/kharif* endline survey.

Sample sizes: 295 to 476 treatment SSPs and 394 to 654 comparison SSPs in the full sample, 131 to 218 treatment SSPs and 369 to 585 comparison SSPs in the highly engaged sample

*/**/*** Significantly different from zero at the 0.1/0.05/0.01 level.

G. Revenues and income

The APC project's stated aim was to double SSPs' agricultural incomes through the synchronized production and coordinated sales of winner crops, as well as improved livestock production. Therefore, we examined revenue and income from crop production for the three cropping seasons, as well as aggregate revenues and income from crops and livestock for the full agricultural year—November 2023 to October 2024.[21] This enabled us to analyze variation in project impacts by season and provide a full picture of SSPs' earnings.

Seasonal revenues and net income from crop production

Treatment SSPs generated higher revenues and net income from crop production than comparison SSPs in the *rabi* season—and across all seasons for the highly engaged sample—with winner crops contributing meaningfully but not exclusively to these impacts. In the full sample, mean revenues from crop sales in the *rabi* season in the treatment group (7,872 rupees, or $92) were almost twice as high as in the comparison group (4,358 rupees, or $51) (**Figure IV.17**).[22] In the highly engaged sample, they

[21] We report livestock revenue and income for the period January to December 2024, a period slightly misaligned with that covered by the cropping seasons, because structuring the questions this way helped minimize recall error.

[22] The revenue and income indicators in this section account for completed sales as well as projected sales from both stored and unharvested crops. This approach reflects the reality that some common *kharif* season crops, notably the staple paddy, may be stored and sold well after the cultivation season ends, while others, like cotton, are often harvested only at the time of sale. During the survey, SSPs were therefore asked to estimate the value of crops they

were almost three times as high (17,545 rupees, or $204, versus 6,211 rupees, or $72). Winner crops accounted for more than one-third of *rabi* season revenues in both the full and highly engaged samples, indicating their important role in driving these impacts. These findings align with observed increases in the production and sale of winner crops but also suggest that non-winner crops contributed meaningfully to revenue gains. This may reflect broader improvements in cultivation practices—such as improved access to irrigation and/or the adoption of modern equipment—or a general shift toward more commercially oriented farming driven by the APC project.

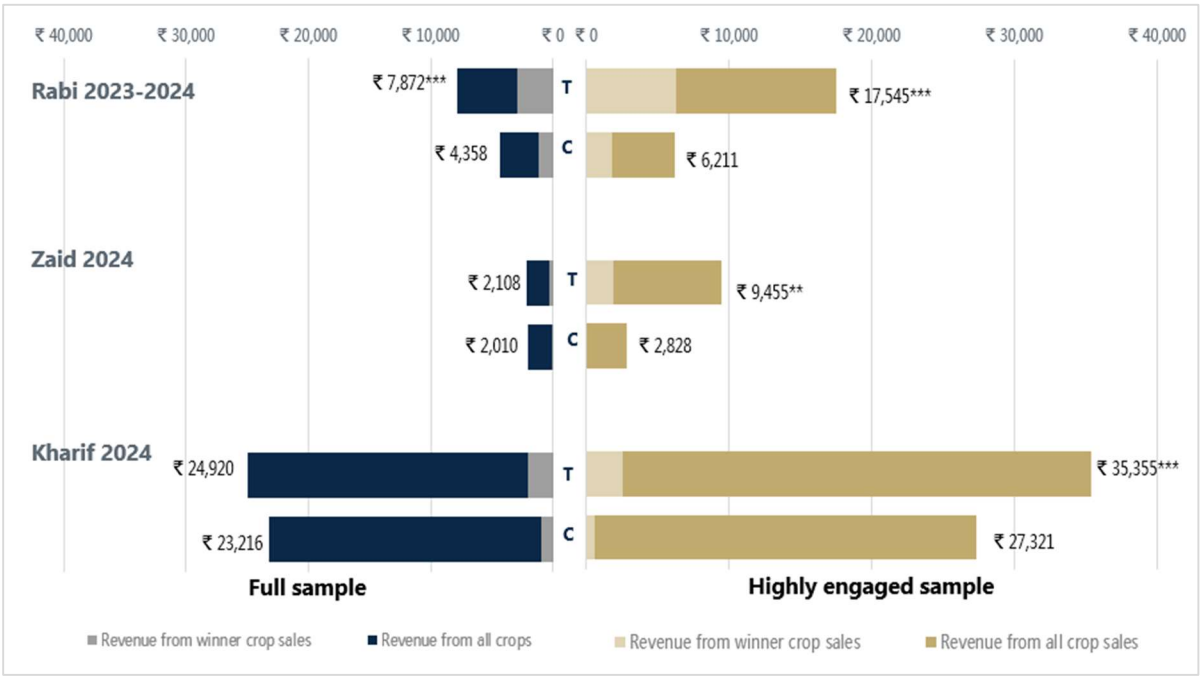
We also examined net income from crop production, including the value of harvest not sold (presumably mostly for home consumption). To do so, we combined revenues from crop sales (completed and projected) with estimated harvest values for crops that were unsold or sold partially (using information on harvest amounts, sales amounts, and sale prices). We then estimated net income by subtracting costs associated with crop production and sales. This measure was also substantially higher in the treatment group relative to the comparison group, on average, for both the full sample (10,387 rupees, or $121, versus 6,645 rupees, or $77) and the highly engaged sample (20,277 rupees, or $236, versus 8,207 rupees, or $95) in the rabi season.

In contrast, project impacts on crop revenues and net income from crop production during the *kharif* season were evident only among highly engaged SSPs.[23] In the endline *kharif* season, there were no substantive treatment-comparison differences in mean revenues for the full sample. However, in the highly engaged sample, treatment SSPs had meaningfully higher mean revenues than comparison SSPs (35,355 rupees [$411] vs. 27,321 rupees [$318]), although the magnitude of these gains was more modest than in the endline *rabi* season. Revenues from winner crops were relatively low in this season, contributing to less than one-tenth of total revenues reported by treatment SSPs in the full and highly engaged samples. These findings highlight the seasonal variation in APC project impacts—producing substantial income gains in the *rabi* season and more moderate gains in *kharif*—and underscore the importance of strong project engagement, as the most pronounced benefits were observed among highly engaged SSPs across all seasons.

had harvested and were storing for sale, as well as those they still planned to harvest and sell. It was not feasible to further delay the endline *kharif* survey until all sales were completed as we were concerned that recall regarding production and completed sales would worsen.

[23] We also observed impacts in the *zaid* season but the sample size for this season was relatively small, which may limit the robustness of the findings. As a result, estimates for the highly engaged in the *zaid* season (shown in Figure IV.17) should be interpreted with caution, as they may be more sensitive to outliers or less representative of broader trends compared to the *rabi* and *kharif* seasons.

Figure IV.17. Seasonal revenues from crop sales, among all SSPs



Agricultural year revenues and net cash agricultural income

The highly engaged treatment sample earned about 37 percent more than the comparison group over the endline agricultural year, driven by crop sales rather than livestock. Despite the large share of SSPs who held livestock in 2024, only about one-quarter of treatment SSPs in the full or highly engaged samples sold or rented livestock to generate revenue, and few sold livestock products such as milk, eggs, and meat during this period (not shown). As a result, average total revenues from livestock were much lower than revenues from crops in both the full sample and highly engaged sample (**Table IV.6**). Consistent with the similarity in livestock holdings between the treatment and comparison groups, there was little difference between these groups in livestock revenues, nor in animal husbandry costs. Combining revenues from crop sales and livestock over a full agricultural year, treatment SSPs in the full sample earned modestly higher total revenues than comparison SSPs (38,998 rupees [$453] versus 32,691 rupees [$380]), but this difference was not statistically significant. However, in the highly engaged sample, the impact on mean total revenues was large and statistically significant, with treatment SSPs earned 55,052 rupees ($640) versus 40,195 rupees ($467) for comparison SSPs.

PG members had an average annual net agricultural cash income about 40 percent higher than the comparison group, and 70 percent higher than the comparison group for PG members who were highly engaged in the project. To assess the APC project's impact on farm profits, we estimated treatment-comparison differences in net cash agricultural income from crops and livestock. We defined net cash agricultural income as the sum of revenue from crop sales and livestock, minus crop production and sales costs and livestock husbandry costs over the full agricultural year.[24] In the full sample, the treatment group generated an average net cash agricultural income of 27,241 rupees ($316) versus 19,292

[24] We analyze this measure of profit based on sales only, excluding self-consumption, because we did not measure the value of self-consumption from livestock and livestock products in the endline surveys.

rupees ($224) in the comparison group (**Table IV.6**). In the highly engaged sample, the treatment group generated a greater net cash agricultural income of 39,549 rupees ($460) versus 23,143 rupees ($269) in the comparison group.[25] The magnitude of the project impacts on net cash agricultural income—7,950 rupees ($92) for the full sample and 16,405 rupees ($191) for the highly engaged sample—are considerable in percent terms. These impacts are greater than the corresponding impacts on revenues because treatment SSPs were able to increase revenues without a proportional increase in production costs (**Table IV.6**). This may be because of improved access to subsidized or cheaper inputs and services—such as seeds, irrigation, and modern equipment—through the PCs and other convergence efforts. Further, impacts on the areas of winner crops cultivated were relatively small, so the marginal cost of applying these inputs to those additional areas might have been modest.

Table IV.6. Agricultural revenues, costs, and income from the 2023–2024 agricultural year

	Full sample			Highly engaged sample		
Indicator	Treatment mean	Comparison mean	Difference	Treatment mean	Comparison mean	Difference
Crops						
Agricultural year (Nov 2023-Oct 2024)						
Total revenue from crop sales (rupees)	34,901	28,472	6,430	49,960	35,347	14,613**
Revenue from winner crop sales (rupees)	4,974	2,223	2,752***	7,835	2,214	5,622***
Crop production and sales costs (rupees)	15,403	15,316	86	19,975	17,237	2,738
Net income from crop production (rupees)[a]	55,590	47,727	7,863	72,790	51,101	21,689***
Livestock (Jan 2024-Dec 2024)						
Total revenue from livestock sales (rupees)	2,712	3,133	-421	3,438	3,990	-552
Livestock husbandry costs (rupees)	1,398	1,621	-223	1,606	2,043	437
Crops (Nov 2023-Oct 2024) and livestock (Jan 2024-Dec 2024) combined						
Total revenue from crops and livestock sales	38,998	32,691	6,306	55,052	40,195	14,857**
Net cash agricultural income from crops and livestock[b]	27,241	19,292	7,950**	39,549	23,143	16,405***

Source: APC *rabi* endline survey and APC *zaid/kharif* endline survey.

Sample sizes: 295 to 476 treatment SSPs and 394 to 654 comparison SSPs in the full sample, 101 to 158 treatment SSPs and 321 to 499 comparison SSPs in the highly engaged sample

*/**/*** Significantly different from zero at the 0.1/0.05/0.01 level.

[a] Defined as revenue from crop sales, plus value of crops harvested but not sold, minus costs of crop production and sales

[b] Defined as revenue from crop and livestock/livestock product sales, minus costs of crop production, sales, and animal husbandry

[25] Our estimate of net cash income for the comparison group is roughly consistent with an estimated mean annual net agricultural income of 23,820 rupees ($277) across the state in 2018-2019 (Poverty and Human Development Monitoring Agency, 2022).

We note that the estimate impacts on net cash agricultural income differ from changes in average annual income reported in project monitoring data, which show an increase from 21,877 rupees ($254) in the 2019-2020 baseline to 64,935 rupees ($755) by 2023-2024, an increase of almost 200 percent. The differences in findings can be attributed to several factors. First, there is a difference in definitions. The project monitoring data defined "income" as revenues only, whereas the evaluation assessed net cash income, defined as revenues minus costs. Second, there is an important difference in samples. The project monitoring data cover all PGs, whereas the impact evaluation cover late-forming PGs only, which were concentrated in a few blocks. Late-forming PGs tended to be in more remote areas and faced greater implementation challenges, which might be associated with lower SSP incomes and smaller project impacts. Restricting the monitoring data to the evaluation blocks and taking 2020-2021 (when evaluation PGs were formed) as the baseline year, the increase in average revenues in the monitoring data is a more modest 38 percent: from 39,930 rupees in 2020-2021 to 54,989 rupees in 2023-2024. Third, the monitoring data assessed changes over time between baseline and endline whereas the impact evaluation assessed differences relative to a comparison group at endline. Given that some increase in incomes over a four year period might be expected due to external factors, the changes estimated from the monitoring data cannot be fully attributed to the impacts of the project alone without a comparison group.[26] Finally, there may have been differences in survey methodology between the monitoring and impact evaluation data collection efforts. Nevertheless, despite this lack of comparability, the findings from the monitoring and evaluation data are qualitatively consistent in the sense of showing large effects of the project on SSPs' incomes.

Overall, these findings suggest that treatment SSPs substantively improved their economic wellbeing between three and four years after their PGs were established, primarily through increased crop production and sales and especially in the *rabi* season. Additionally, the project came close to achieving its goal of doubling SSP incomes in the highly engaged impact evaluation sample, although not for the full sample. As described earlier, however, the generalizability of these findings to the project overall is unclear given that our sample was only representative of late-forming project PGs.

H. Women's economic empowerment

The APC project employed a women-focused approach to inclusive markets: all PG and PC members are female, and female SHGs form the foundation for PGs. Hence, we examined directly whether the participation of female SSPs in the project affected their ability to influence household decision making related to agriculture, including the use of agricultural income. Although the project did not include specific content to address these dimensions of women's empowerment, it is plausible that they might have been influenced by female SSPs' greater engagement in agricultural activities and contribution to income generation. Specifically, we asked female SSP's about the extent of their input into household decisions (input into no or few decisions, some decisions, or most or all decisions) regarding which crops to cultivate, how much area to dedicate to different crops, which buyers to sell crops to, and owning/raising livestock. We also asked about the extent of their input into household decisions around the use of agricultural income generated from the 2024 *kharif* season. These data were collected using the

[26] One indication of this issue is that the monitoring data show an increase in revenues of more than 70 percent between 2019-2020 and 2020-2021, which is likely too large to be plausibly attributed to the project given that PGs had only been in place for a short period.

project-based women's economic empowerment in agriculture (Pro-WEAI) conceptual framework developed by the International Food Policy Research Institute (IFPRI) (see **Annex A** for details on WEAI). Although there were some baseline treatment-comparison differences in equivalent measures (**Annexes C and D**), our analysis statistically controlled for these to obtain valid impact estimates. Because findings on women's empowerment require nuance and context that may not be fully captured through quantitative data alone, we also draw on insights from qualitative data collection with SSPs to develop a more comprehensive understanding of the APC project's impact on women's economic empowerment.

Input in livelihood decisions

A key aspect of women's instrumental agency is the extent to which they can contribute to decision-making regarding their livelihoods. We assess how and to what extent to which women SSPs in the APC project contribute to household decision-making around high-value crop cultivation, marketing of these crops, as well as decision-making around livestock rearing and sales.

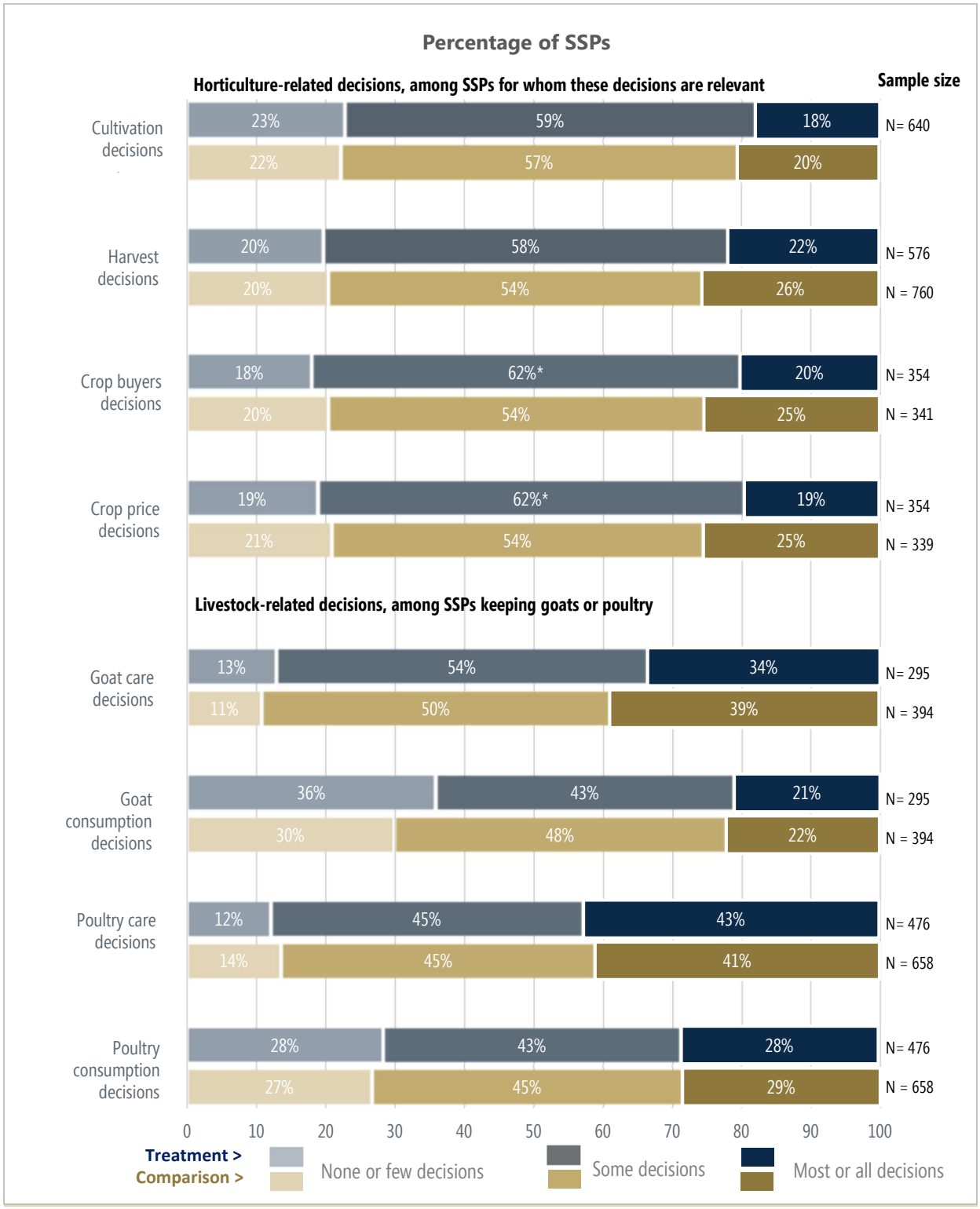
Participation in the APC project to date had no substantive impact on the fraction of how much input women have had in decision-making around horticultural and small livestock activities. More than one-half of the SSPs in both the treatment and comparison groups—regardless of project participation—reported having providing input in some decisions related to horticultural cultivation and harvest; and more than one-quarter indicated they provided input into most or all these decisions (**Figure IV.18**).[27] A similar pattern emerged for small livestock: more than two-fifths of treatment and comparison SSPs reported having provided some input into decisions related to the care and consumption of goats or poultry, while a smaller fraction reported having provided input into most or all such decisions. A relatively small fraction of SSPs fell into the lowest empowerment category of having provided input into few or no decisions related to horticulture and livestock, implying that the vast majority met the WEAI threshold for "adequate" decision-making input (input into some or most decisions). Overall, the quantitative evidence suggests that the APC project did not lead to substantive changes in women's involvement in livelihood decision-making based on this WEAI measure of input into decision-making.

In contrast, women APC members who participated in focus groups frequently reported increased leadership and influence in decision-making in agricultural production and sales, as they are now seen as joint contributors to household income and are confident sharing knowledge they have learned through the project. Many women SSPs who participated in focus groups said that prior to the APC project, men primarily decided which crops their household grew, whether to sell them, and who to sell them to. However, after participating in the project, it became more common for decisions about horticulture farming to be made jointly with men,

> "Previously, farming was associated only with men who owned land. As women, we were confined to household work. Now, we feel proud to be farmers with the ability to make cultivation decisions. Earlier, we were hesitant to speak with others, but now we can manage both cultivation and household responsibilities. This transformation has made us feel like successful farmers."
>
> *Woman SSP and PC board member, Rayagada*

[27] By IFPRI's definition this qualifies most women SSPs in our sample as having an "adequate" level of empowerment related to horticultural decision-making.

Figure IV.18. SSP input into household decisions related to horticulture and livestock



Source: APC *zaid/kharif* endline survey

*/**/*** Significantly different from zero at the 0.1/0.05/0.01 level.

with women often taking the lead or being the primary decision-maker or having greater influence over the ultimate decision. These changes have been driven by several factors. First, women SSPs have demonstrated an ability to bring in a stream of income from horticultural crop sales, which leads men to value their opinions more highly andtrust their suggestions. Some women SSPs noted that disagreements over horticulture crop cultivation have decreased since men are now more accepting of women SSPs' input. Second, women SSPs' confidence in actively sharing their suggestions with men has been boosted by participating in group discussions with other PG members, as well as by the PC's guidance and trainings that have improved women's knowledge and market information. Women have therefore felt more confident in making well-grounded suggestions on farming inputs, seed selection, and cultivation timing to their households. Third, men became more receptive to selling more produce through the PC—as suggested by women—after seeing its income benefits. In contrast, most focus group participants reported that decisions regarding livestock continued to be made jointly by household members, as they had in the past.

> "Now we [women PC members] hold meetings, harvest together on the same day, and provide input on seed selection, which is then implemented by our male family members. Simply suggesting tomato farming would not have convinced the male farmers. It is because of the PC that male farmers are now listening to women farmers' voices."
>
> *Woman SSP, Bolangir*

We hypothesize that the apparent discrepancy between the quantitative and qualitative findings might be because the latter reveal meaningful but more nuanced shifts in women's decision-making power that are likely obscured by the nature of the quantitative measure. In particular, the quantitative measure is limited and might not capture incremental or context-specific shifts in agency. For instance, a woman could increase the number of decisions into which she has had input while still falling within the same categorical threshold of input into "some" decisions, leaving meaningful progress hidden in the quantitative data. Further, this quantitative measure does not reflect who the primary decisionmaker was, the extent to which the input provided ultimately affected the decision itself, or the level of input in decision-making a woman may have in future decisions. In contrast, the qualitative accounts highlight some of these diverse pathways and rich examples through which women's input and confidence have evolved—even if they are not reflected in standard WEAI indicators for a broader sample.

Control over use of income

Control over income is a key domain in measuring women's economic empowerment in agriculture because even if women are key contributors to production, men typically control marketing and sales and then keep most of the income (Alkire et al., 2013). Here, we assess the extent to which women SSPs in the APC project have input into decision-making, and autonomy around the use of agricultural income. We also assess qualitatively how women make decisions around use of agricultural income in their households, and how they address any related conflicts that arise.

Our quantitative findings show that most women SSPs have some input into decision-making around the use of agricultural income, with only marginal differences between those who participated in the APC project and those who did not. Across the survey sample, nearly two-thirds of women SSPs in both the treatment and comparison groups reported providing input into some decisions

about how income from agriculture (spanning both crop and livestock activities) was used (**Figure IV.19**). A smaller fraction indicated providing input into most or all agricultural income use decisions. These findings reinforce a pattern observed across the various women's empowerment indicators: most women already meet a basic threshold of decision-making input, and the proportion with very low levels of input is relatively small. In addition, the lack of a substantive difference between treatment and comparison groups around income use suggest that project participation had limited impact on this dimension of empowerment.

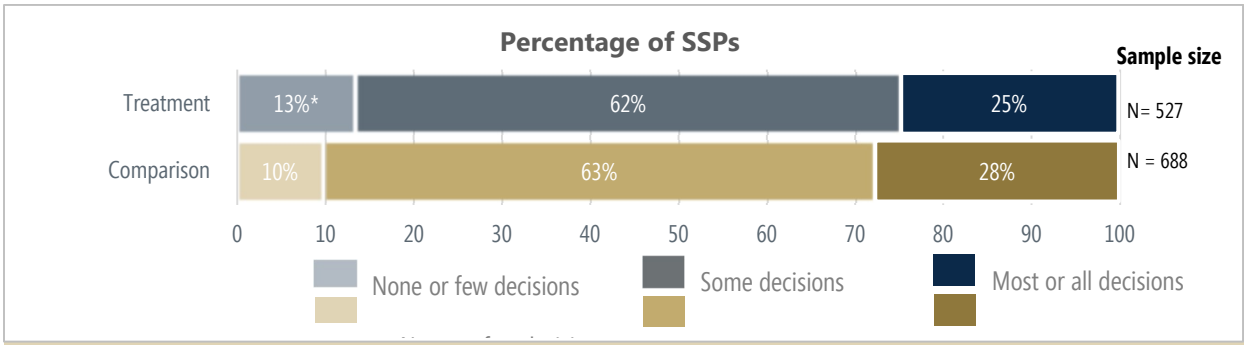
Women SSP focus group participants reported having more disposable income and exercising more autonomy in spending after establishing an income stream through the APC project. Most of these SSPs said that before the APC project, men managed the household's money and expenditures as the primary earners in the household. Since SSPs now generate income through the APC project, they play a larger role in managing the household's earnings. Several women SSPs described being able to make more frequent and more autonomous small or personal purchases using agricultural income by setting some of their earnings aside for personal use.[28] Examples of purchases that are now easier for women SSPs to make independently include clothing and jewelry, household items like toiletries and food, and supporting children's education. Larger purchases such as home repairs or televisions are typically decided on jointly between women and men in the household. Similar to our findings on the input into decisions regarding horticulture and livestock, we hypothesize that the apparent discrepancy in qualitative and quantitative findings is because the nuanced changes in household dynamics described by focus group participants were not captured in the quantitative measures.

> "Earlier, we depended entirely on our husbands [for cash]. Now, the situation has improved, mainly due to our group activities and company work. We keep some money for personal use, like buying sarees, imitation jewelry, and toiletries. We also buy clothes for our children and invest more in their education."
>
> *Woman SSP, Bolangir*

> "[Women] manage the money, since we take care of the household. Even [men] give us their earnings to keep, since they might spend it quickly. Whatever we earn directly, we also keep with us. However, we discuss major expenditures together. For small expenses, we can decide on our own."
>
> *Woman SSP, Laikera*

[28] We do not have clear information about whether or how the household distinguishes between individual earnings and household earnings. Almost all survey respondents reported that they had a bank account in their name, likely because this has been a major policy initiative in India, but buyers pay for crops almost exclusively in cash and it is unclear whether those earnings are deposited into personal bank accounts.

Figure IV.19. SSP input into agricultural income decisions, among SSPs with an agricultural income



Source: APC *zaid/kharif* endline survey

*/**/*** Significantly different from zero at the 0.1/0.05/0.01 level.

Work balance and drudgery

Assessing work balance is an important measure of women's empowerment in agriculture, because as women increase their ability to make productive decisions they may also face the unintended impact of an increase in workload and drudgery in agricultural tasks. While we did not assess work balance quantitatively through a time use survey module, below we present qualitative findings related to women SSPs' work balance and drudgery.

Women SSPs in the APC project now handle more horticultural farming tasks than before, from preparing the land, to harvest, to sales. With the expansion of horticultural cultivation through the APC project, women SSPs' farming responsibilities have likewise increased. Focus group participants commonly reported that before the project their households cultivated smaller areas of land, with men handling most farming tasks and women playing a supporting role in the field. As households have expanded their cultivation activities due to the project, the overall increase in household workload and women SSPs' greater knowledge of horticultural farming practices has led them to play a larger role in horticulture crop farming. Now, women SSPs say they handle most tasks in horticultural crop cultivation, including preparing the land, harvesting, and post-harvest management.

Beyond horticulture, there is a distinct division in households of farming tasks by gender, with men spending more time on livestock grazing, operating heavy machinery, and harvesting staple crops. The APC project has increased availability and affordability of modern farm equipment—although these gender norms do not seem to have been impacted by the project and men often benefit from this equipment more than women SSPs. As described in our first-round evaluation report (Narayan et al. 2022), prior to the APC project, most SSPs reported that they had access to farm equipment through rental, but their usage was limited due to high rental costs, defective machines, and delays due

> "Since we are cultivating more crops now, we spend more time on farming. We prepare the beds, sow the seeds, and carry out weeding at regular intervals. We take care of the crops until harvesting, which requires a lot of effort. Alongside farming, we take care of our children. Since we have no other occupation, we dedicate most of our time to farming."
>
> *Woman SSP, Laikera*

to high demand. The APC project has facilitated SSPs' access to modern farm equipment by supporting the development of Custom Facility Centers and by linking SSPs to government subsidy schemes (such as the input subsidy plan under the Odisha State Direct Benefit Transfer scheme).

SSPs in all three case studies have reported implementing machinery such as tractors, power tillers, and pesticide sprayers on their farms. However, women SSPs describe an implicit allocation of farming tasks by gender. Men are primarily responsible for more physically intensive tasks such as carrying fertilizers to the field, bringing water, operating plows, and taking livestock out for grazing. Because harvesting staple crops such as paddy and millet require operating heavy machinery such as threshers and harvesters, men are primarily responsible for staple crop cultivation with women SSPs supporting in seedbed preparation and fertilizer application. During our interim evaluation, we similarly heard that some equipment (likely power weeders, pesticide sprayers, and tillers) is designed for use by men and can be too heavy and awkward for women to operate.

Overall, women SSPs now have greater responsibility for the horticulture crop tasks described earlier and remain responsible for cleaning cattle sheds and giving water to livestock. Most focus group participants describe little flexibility in the allocation of these tasks, with some suggesting that men do not have enough patience to handle detail-oriented tasks like weeding or post-harvest sorting, and others noting that men are not comfortable completing tasks such as cleaning cattle sheds. As we describe below, this implies that the project has led to a net increase in the demands on some women SSPs' time for agricultural production, although we did not measure survey data to assess this quantitatively.[29]

Although access to mechanized farm equipment through the APC project has reduced drudgery for some farming tasks, these are primarily handled by men; some women SSPs now face increased drudgery from manual farming tasks. Access to mechanized farm equipment through the project—primarily through convergence with government schemes— has reduced drudgery for farming tasks primarily handled by men, whereas the land preparation, cultivation, and harvesting tasks that women SSPs handle must still be conducted manually. Of their responsibilities, women SSPs describe weeding and sowing—which are manual tasks—to be the most time-consuming and laborious tasks, especially on very hot days. In contrast, PC input delivery and harvest pickup at the village has reduced SSPs' need to visit distant markets, to which SSPs often traveled to on foot. Nevertheless, the increased responsibilities for horticulture crop cultivation have led to a reported net increase in time spent on agriculture; among the SSPs we spoke to, most said they spend between four to five hours in the field each day during the season. Some SSPs described difficulty balancing the additional time spent on farming with other household tasks like housework and childcare.

Mobility

A woman SSP's ability to visit important locations is an important measure of empowerment, because gender norms restricting women's mobility can reduce their access to input and output services, markets,

[29] This would typically be accomplished by a time use module with a short recall period. However, because we only conducted our surveys some months after the end of the agricultural season to account for sales to be completed, it was not feasible to include such a module.

and other income-generating opportunities. Here, we assess the extent to which women SSPs in the APC project feel empowered to travel independently for their livelihoods, based on our qualitative data.

Attending PG and PC meetings has increased women SSPs' mobility by providing a reason to travel outside of the village and offering a safe group of women to travel with to and from meetings. Women SSPs said that, before they started travelling for the project, they did not feel comfortable asking others for directions or were concerned about their safety while traveling alone. Women SSPs now often travel in groups to attend PG and PC meetings, which has increased their safety and comfort. They also explain that they have become more familiar with the roads as well as the people in the surrounding area, which eases their confidence in travelling outside of the village.

"Earlier, our mothers-in-law did not allow us to go outside. They told us, "You are young; do not go independently." Now, there is no one to stop us."

Woman SSP, Laikera

"Now, we are confident and no longer afraid. Earlier, we feared speaking up and were too shy to even ask for directions. Now, we travel in groups or even alone when needed. Now, even those with bad intentions fear us because they know we are part of a group and have strong unity."

Woman SSP, Bolangir

Group membership and leadership

The collective agency domain of the WEAI captures the effects of women's inclusion, participation, and leadership in influential groups. While we did not include these measures in our survey due to length constraints, we use our qualitative data to assess the extent to which women SSPs in the APC project experience collective agency through membership in PGs and PCs—through being part of these potentially influential groups, and through increasing their leadership in these groups.

Membership in PGs and PCs has increased women SSPs' collective agency as they inspire and motivate each other, work together toward shared interests, and actively shape agricultural goals in their community. Women SSPs described how seeing and hearing about the successes of women in their PGs and PCs has increased their interest and motivation to participate in farming activities. Coordinated cultivation, harvests, and sales through the PGs and PCs has increased women's collective agency as they work together towards the goal of increasing the agricultural income of PG members. According to PC staff, whereas farming was previously seen as a household occupation requiring male involvement—for example, for travel to markets for input procurement and selling produce—now women SSPs have gained confidence that they can farm independently.

"Through training, we have learned many new things, including how to understand market prices. Many issues have been resolved due to our group activities. We are more confident now and can communicate effectively with others. Earlier, we hesitated to speak due to fear, but now many changes have taken place."

Woman SSP, Bolangir

"Before, these women only spoke their tribal language. Now since being on the PC board of directors, they have become fluent in Odia and are very strong in record keeping– this is a big change. They are now confident leaders. For example, last year we invited a women board member of a 2,000-member PC in Keonjhar to speak about how her PC became "croreparti" [with assets worth 10 million rupees]".

Government official

"Being part of a group allows us to discuss farming matters, which has increased our interest. We now understand what works best and what does not. Earlier, we didn't have these discussions, and our thought processes were not aligned. Now, we think in a similar way and practice farming collectively, which gives us satisfaction."

Woman SSP, Bolangir

"I didn't own land, so I started cultivating hybrid brinjal on a small plot of my uncle's land. Some people doubted me, but I went ahead. Each plant bore more fruit than expected and the PC invited officers and women from other areas to observe my cultivation. That year, I made a profit and saved money. Seeing my success, our group members felt inspired. In the first year, I convinced four women to cultivate brinjal. Some people doubted that as women, we could secure buyers. But that year, the PC vehicle came to our village, collected all the brinjal, and payments were made weekly. Seeing this, more members joined the next year."

Woman SSP, Kolnara

Participation in PGs and PCs has also increased women SSPs' leadership in PCs. Through the APC project, SSPs participate actively in PG and PC discussions, have come into leadership roles through the board of directors of PCs, and have improved their skills in financial and business management. However, most of the roles in PC management remain occupied by male staff members. Women SSPs' leadership has had positive spillover effects on their villages too. Some government staff and private buyers/input sellers we spoke with also described undergoing a shift in perspective, now recognizing women as key contributors to and leaders in agriculture. An increase in APC participants' confidence and motivation has been an important driver of these changes. Several SSPs who participated in focus groups noted that prior to joining the PGs and PCs, they did not feel comfortable voicing their opinions on farming publicly; whereas now they feel confident to do so.

I. Dietary diversity

The APC project could lead SSPs' households towards adopting more diverse diets and improving their nutritional status through (1) increased self-consumption out of increased production, and/or (2) increased food expenditures out of increased agricultural incomes. We used a locally adapted version of the Minimum Dietary Diversity for Women (MDD-W) from the Food and Agricultural Organization as a proxy for diet quality. Specifically, we asked SSPs about their consumption of specific food groups in the past 24 hours when we conducted the APC *rabi* endline survey in July 2024 and *zaid*/*kharif* endline survey in January-February 2025. We used the data to assess the types and total number of food groups that they reported.[30]

Rabi season

The APC project led to modest improvements in dietary diversity for SSPs in the highly engaged treatment sample in the *rabi* season. In the full sample, there was little treatment-comparison difference in consumption of each of the 9 food groups we examined, except that treatment SSPs were *less* likely to consume seeds or nuts than the comparison group (**Table IV.7**). In contrast, treatment SSPs in the highly engaged sample were modestly more likely than comparison SSPs to consume meat, poultry, or fish, eggs, and dark green leafy vegetables. Further, although there was no impact on the mean number of food groups consumed for the highly engaged sample, highly engaged treatment SSPs were significantly more likely to consume at least 5 out of 9 food groups than comparison SSPs (51 percent versus 38 percent). This measure is similar to the standard MDD-W indicator and suggests that the project had a modest positive impact on minimum dietary diversity.

Kharif season

In contrast, the APC project did not lead to meaningful improvements in dietary diversity for treatment SSPs in the full and highly engaged samples in the *kharif* season. In the full and highly engaged samples, there was little treatment-comparison difference in consumption of each of the 9 food groups we examined in the 2024 *kharif* season (**Table IV.8**). There was also no significant impact on the mean number of food groups consumed for the highly engaged sample, nor on our MDD-W equivalent measure. The more modest impacts in this season relative to the *rabi* season are consistent with the more modest impacts on cultivation of non-staple crops and income, the two main anticipated channels for impacts on dietary diversity.

[30] The MDD-W is typically based on 10 food groups, which are those shown in Table IV.20, except with other fruits and other vegetables separated into two distinct categories. We unintentionally combined these into a single category in the endline survey, resulting in 9 rather than 10 food groups. Therefore, we are unable to exactly replicate the standard MDD-W. Nevertheless, the findings are still instructive regarding project impacts on dietary diversity.

Table IV.7. Dietary diversity for female SSPs at the *kharif* endline survey date (May-June 2025)

Indicator	Full sample			Highly engaged sample		
	Treatment mean	Comparison mean	Difference	Treatment mean	Comparison mean	Difference
Percentage of SSPs consuming food group in past 24 hours (%)						
Grains, white roots, and tubers	100	100	0	100	100	0
Pulses	93	95	-2	92	95	-3
Nuts and seeds	14	21	-8***	15	19	-3
Dairy	7	7	1	14	13	1
Meat, poultry, and fish	17	18	-1	23	14	9**
Eggs	8	6	2	10	5	5*
Dark green leafy vegetables	55	55	0	67	56	10*
Other vitamin A rich fruits/veg.	37	31	5	44	36	8
Other fruits and vegetables	82	85	-3	88	89	-2
Number of food groups consumed						
Mean number consumed (max 9)	4.1	4.2	0.1	4.5	4.3	0.2
Consumed at least 5 groups (%)[a]	38	35	4	51	38	13**

Source: APC *rabi* endline survey.

[a] This is slightly different from the standard MDD-W which is typically based on consuming at least 5 out of 10 group rather than 5 out of 9 groups, with other fruits and other vegetables each in their own category.

Sample size: 707 treatment SSPs and 982 comparison SSPs in the full sample, 186 treatment SSPs and 674 comparison SSPs in the highly engaged sample

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

Table IV.8. Dietary diversity for female SSPs at the *kharif* endline survey date (January-February 2025)

Indicator	Full sample			Highly engaged sample		
	Treatment mean	Comparison mean	Difference	Treatment mean	Comparison mean	Difference
Percentage of SSPs consuming food group in past 24 hours (%)						
Grains, white roots, and tubers	100	100	0	100	100	0
Pulses	94	94	0	95	94	1
Nuts and seeds	19	19	0	21	22	-1
Dairy	3	4	-1	4	5	-1
Meat, poultry, and fish	21	18	3	22	17	5
Eggs	6	8	-2	8	11	-3
Dark green leafy vegetables	50	54	-4	58	56	2
Other vitamin A rich fruits/veg.	26	25	1	31	27	4
Other fruits and vegetables	89	91	-2	87	90	-3
Number of food groups consumed						
Mean number consumed (max 9)	4.1	4.1	0	4.3	4.2	0.1
Consumed at least 5 groups (%)[a]	33	33	0	39	36	3

Source: APC *zaid/kharif* endline survey.

[a] This is slightly different from the standard MDD-W which is typically based on consuming at least 5 out of 10 group rather than 5 out of 9 groups, with other fruits and other vegetables each in their own category.

Sample size: 698 treatment SSPs and 970 comparison SSPs in the full sample, 223 treatment SSPs and 699 comparison SSPs in the highly engaged sample

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

V. Conclusion

In this concluding chapter, we summarize the key findings from the APC project endline evaluation in the framework of the evaluation research questions. We also offer lessons for further scale up and replication.

A. Summary of findings

Overall, we find that the APC project has **successfully reached more than 120,000 female SSPs in Odisha** by providing diverse services along the value chain for multiple horticultural and other high-value crops, as well as livestock. The project **fundamentally changed the agricultural market** for SSPs by increasing winner crop production volumes, expanding the number of input sellers and crop buyers to whom SSPs are connected, improving SSP post-harvest management practices, and providing better access to higher-quality inputs and accurate market price information. Relative to a comparison group the APC project **increased the average annual income of women SSPs by 40 percent after four years, and by 70 percent for women SSPs who were highly engaged with the project**. **Table V.1** further summarizes the key findings by research question.

Table V.1. Key evaluation findings, by research question

Research questions and key findings[a]
RQ1. What were the main successes and challenges in project implementation? How were implementation challenges addressed?
• PRADAN has developed a **unique and scalable model** to increase market inclusion, utilizing a **federated FPO structure** mobilizing farmers from the bottom-up to foster community ownership, with **strong linkages to complementary government schemes**. • The project has **successfully reached more than 120,000 female SSPs** in Odisha by providing diverse services along the value chain for **multiple high-value crops selected through a rigorous process.** • **Winner crop uptake among smallholder farmers has increased substantially**, driven by success of early adopters, although some SSPs remain reluctant to adopt unfamiliar crops. Winner crop selection has diversified to meet farmer demand, now including not only horticultural crops but also high-value paddy, oilseeds, and pulses. • **Most APC FPOs are fully operational and financially independent**, having received critical start-up financing, technical support, and experience, although additional **working capital financing is needed** to establish more profitable business lines in processing or value-addition. • **Some PG members have limited engagement with the APC FPOs, and about one third have not yet become PC shareholders**. • One of the **biggest ongoing challenges** with the APC model is determining **how to sustainably finance field-level support** to farmers, especially via the UM and/or AE roles.
RQ2. What were the behavioral, income, and welfare impacts of the project delivery model on SSPs?
• The APC project **increased the annual net income of women SSPs by 40 percent after four years, and by 70 percent for women SSPs who were highly engaged with the project**. These gains were primarily driven by **increased area and frequency of production in off-seasons**, associated with increased irrigation. • **Winner crops contributed meaningfully to these gains**, but so did other crops. Support from the project and associated government convergence thus **had broader positive impacts on the cultivation and commercial orientation of SSPs**. • The project had **mixed impacts on women's economic empowerment**. The quantitative survey shows little impact on input in decision-making around agricultural production and use of agricultural income, which were high to start with. In contrast, qualitative data suggest a more nuanced positive impact on these outcomes and on women's mobility and leadership, but an unintended negative impact on women's time use and drudgery.

Research questions and key findings[a]
RQ4. What were the direct and indirect impacts of the project delivery model on farmer price realization, market engagement, and private sector investment/participation?
• In all three market case studies, **the project resulted in a fundamental shift in SSP market engagement**, including changes in the procurement and use of inputs, increased marketable surplus, and greater linkages and sales to output markets. The impact evaluation confirmed **positive impacts on production volumes and sales for high-value crops.** Private buyers are satisfied with the quantity and quality of their procurement from PCs, while SSPs perceive an increase in income, which motivates them to continue engaging in the market. • Although private sector linkages were initially limited when marketing was fragmented through PGs, the **growth of PCs and agri-clusters has led to more private sector entrants.** • The PCs in all three market case studies have **established relationships with buyers and traders who can procure larger volumes of produce and offer more reliable prices** than buyers SSPs used to sell to (if they used to sell at all), although these buyers do not offer systematically higher prices than other market players.
RQ5. What is the validity of these impacts beyond these specific value chains and market context? Are there specific opportunities or risks in sustaining or scaling the delivery model?
• The **overall project model appears to be broadly applicable across value chains and market contexts**, provided that implementation can be replicated with fidelity. • **Key considerations for successful sustainability and scale up** include: (1) maintaining the intensity and decentralized nature of implementation; (2) identifying a sustainable financing mechanism for on-the-ground handholding support to SSPs; (4) replicating the convergence model, particularly for irrigation access; (5) identifying sources of formal financing for FPO expansion into more profitable business lines in value-addition and processing; and (6) focusing on crop diversification, crop rotation, non-pesticide management and efficient water use for environmental sustainability.
RQ6. What were the impacts on agricultural market system dynamics in Odisha?
• The project has effected **a fundamental shift in the market structure** for the winner crops by facilitating coordinated and increased production and sales by female SSPs who otherwise would not be included in the market. PCs have enabled SSPs to **engage with larger and more distant input and output market actors** than before,. • SSPs now have **access to more accurate market price information through their PCs**, which triangulate information from multiple sources and are perceived by SSPs to be a trusted and reliable source of information.
RQ7. How did national or state government policies and regulations influence implementation and impacts of the delivery model?
• The APC project has **successfully leveraged 6,849 million rupees ($82.2 million) from multiple government departments**, including Horticulture, Agriculture, OLIC, MGNREGA, Mission Shakti, OAIC, ITDA, and OLM. • The APC project is now recognized as a **definitive model for government convergence due to its multi-level advisory structure**, with APC blocks now receiving priority in government scheme allocation**. Convergence with irrigation schemes has been especially critical** to high-value crop cultivation in the *rabi* season. • Strong engagement of government entities at all levels has led to a **sense of ownership and commitment to scale up the delivery model. The project has been formally adopted as a government scheme and scaled to 100 blocks**, with dedicated funding for NGO partners that recognizes their critical role in delivery. • **Challenges remain** with government scheme convergence, including a recent shift **requiring upfront payment for subsidies**, delays in funds disbursal, and staff shortages within the government and partner NGOs.

[a] Research question 3, regarding cost effectiveness, is omitted because it will be addressed in a forthcoming cost-effectiveness and sustainability memo.

B. Scale up and replication

In this section, we begin by describing how the APC model has been scaled to date. We then discuss lessons for further scaling and replicating the APC model based on the evaluation findings.

Scale up to date

The project has been formally adopted as a government scheme and scaled to 100 blocks due to demonstrated success to date. In 2024, the Government of Odisha formally made APC a State Sector Scheme and approved scaling of the project to 60 new blocks, as well as extending financial support for the project in the original 40 blocks for another five years. The government decision to scale up the project was driven by demonstrated SSP-level impact, alignment with policy mandates including Doubling Farmer Income and *Lakhpati Didi* initiatives,[31] and the project's unique positioning as a fully women-led initiative. The expansion indicates government confidence in the project's effectiveness for small and marginal farmers.

> "APC is a torch bearing program for the government of Odisha. It is a flagship, innovative program."
>
> *Government official*

The APC cluster approach has influenced how other government schemes are implemented. Officials emphasized that the APC model of cluster-based farming has shown demonstrable success compared to other more siloed or fragmented approaches to local community development. Due to the success of the APC project to date in Odisha, the government is now considering this model of cluster-based implementation for other ongoing schemes like the Crop Diversification Programme. Government stakeholders explained that this is part of a wider shift in policy implementation for livelihood programs at the district level from target-driven, scheme-centric approaches to more structured and integrated frameworks emphasizing long-term impacts and sustainable development. According to project documentation, PRADAN now serves in a wider advisory role to the Department of Agriculture and Farmer's Empowerment, engaging in committees to identify crops for cluster development in different agro-climatic zones of Odisha. PRADAN has also been selected as a Project Management Unit for the Odisha *Mukhya Mantri Janajati Jeevika Mission* (MMJJM) program under the Department of Scheduled Tribes and Scheduled Castes focused on enhancing livelihoods and fostering sustainable development among tribal communities through a cluster-based approach.

Lessons for scale up and replication

The project's success is underpinned by an intensive and decentralized implementation model, which will need to be maintained for effective scale up and replication. PRADAN and its NGO partners have implemented a highly intensive, decentralized effort to build partner capacity, establish strong PG and PC structures, select winner crops, engage SSPs, and build PCs' capacity to engage effectively with input and output markets. These efforts have been critical to establishing well-functioning PGs and PCs. A "lighter touch" version of implementation would introduce a substantial risk that the fundamentals of the model would not be in place and the investment would not pay off, especially in more remote and otherwise challenging geographies. Successful scale up and replication might therefore require a similarly intense effort, which includes creating and building the capacity of local implementation teams, resourcing them appropriately, and ensuring knowledge transfer from PRADAN and successful partner NGOs in Odisha. New PGs and PCs might struggle to succeed if the intensity of

[31] The GoI set a policy target in its annual budget of 2016-17 to double farmer's income by 2022; after which various schemes and policies were implemented to achieve this goal. *Lakhpati Didi* is an initiative launched in 2023 by the Ministry of Rural Development that strives to empower women SHG members to have an annual household income exceeding 100,000 rupees by adopting sustainable livelihood practices.

support for them—or expertise of those providing that support—is substantively less than provided during the original project.

Identifying a sustainable financing mechanism to support intensive on-the-ground handholding support to SSPs will be key to scale up and replication. As discussed in Chapter II, the staff role of the UM was key to helping SSPs synchronize production and harvests, communicating price information and providing training, and facilitating SSP engagement with the PC. At interim many SSPs emphasized in focus group discussions their reliance on their UM. However, this formal role had largely been phased out by endline due to a lack of sustainable financing beyond the initial three years of government support, although some former UMs continued in their role informally either pro-bono or through honoraria or commissions paid by the PC. Rather, AEs were envisioned to replace this function at the cluster- or PC-level as an alternative. However, the project has faced significant challenges with identifying, training, and incubating these micro-entrepreneurs. Given the demonstrated importance of multidimensional field-level support to SSPs throughout the cultivation, harvesting, and sales processes, it will be important for the project partners to plan for this type of role in future scale up and replication, and consider how to financially sustain this role in the longer-term.

FPOs require financial and technical support for more than five years to stabilize operations and successfully expand into higher-return business lines. Government officials and implementing partners acknowledged that the APC FPOs formed in socio-economically challenged areas needed continued assistance to remain viable and grow beyond the initial five-year project timeline. While the APC model shows that FPOs can mature to a stable stage through early-stage institutional capacity building and working capital financing, alongside technical assistance from implementing partners to build staff capacity, a longer period of support is critical to ensure they can advance to a level of maturity and independence required for long-term sustainability. Formal financing is critical to invest in higher-return business segments like processing and value-addition but is challenging due to strict eligibility and performance documentation requirements from banks and lenders. Alongside financial support, support for governance, leadership training, and staff capacity-building is essential for long-term sustainability and operational resilience. Plans to link FPOs to reliable external sources of financing and to build their capacity for at least seven or eight years will be important for future scale up and replication to succeed.

Behavior change also takes time: farmer reluctance towards adoption of new crops, technologies and improved practices requires years of dedicated support and training, as well as demonstrated success. PC and implementing partners described initial SSP resistance to adoption of new crops, practices and technologies, particularly when they require an upfront investment from SSPs. However, implementing partners explained that this resistance is not purely financial: even when the project secured subsidies or offered preferential prices, farmers still resisted sometimes. Overcoming this resistance to behavior change requires sustained encouragement over time, as SSPs often prefer to take a "wait-and-see" approach: once they have seen evidence of the returns to an investment, they are more willing to make

> "Resistance to change has been a major challenge. Gradually farmers adapt through continuous motivation. For example, we faced challenges with encouraging farmers to adopt mulching due to higher expenses, but once they see other farmer incomes increasing from a practice, they adopt the practice accordingly."
>
> *Implementing partner*

that investment themselves. On-the-ground efforts to encourage behavior change as part of scale up and replication therefore need to be sufficiently intense and effective, and provided over a sufficiently long period

Convergence with government schemes is a major success of the project—particularly for irrigation schemes—but could be further improved. As described in Chapter II, the project's strong engagement with the government has enabled the project to leverage substantial complementary financial and technical resources to support APC-affiliated SSPs. Our impact evaluation found that that convergence with government irrigation schemes was especially critical, by facilitating irrigation and hence high-value crop cultivation in the *rabi* off-season. As the APC project is scaled to and replicated in new geographies, success of this magnitude will only occur if the area can successfully create linkages with such government programs and if the area has similar access to perennial water sources. Although convergence has seen substantial success, both the interim and endline findings also suggest several ways in which it could be further strengthened. First, a faster assessment and approval process for convergence with irrigation schemes especially would be helpful. Second, the recent transition of most scheme payments to Direct Benefit Transfer requiring full upfront payment has added to the challenges of SSPs accessing these schemes—relaxing this requirement for FPO members or supporting them in obtaining the required funds through their PGs would help address this constraint. Third, working to align scheme application requirements and deadlines across schemes—and making that information easily accessible to SSPs—might make it easier for SSPs to identify and take advantage of relevant schemes. For example, in Chhattisgarh, the foundation is funding a digital mobile application for SHG members that enables individual women to see which schemes they are eligible for and what documents they need to apply. Fourth, focusing on promoting a more consolidated list of relevant schemes might help make the promotion of those schemes more effective. As discussed earlier, the government relies heavily on implementation and PG/PC staff for this promotional effort; focusing on a subset of the most relevant schemes like irrigation might facilitate deeper staff familiarity with and greater effectiveness in promoting them to SSPs, given the many demands on staff time. This might be especially relevant to scale up of the model in other states, where it might be challenging to achieve the exceptional extent of state government buy-in and coordination as in Odisha. In those cases, coordinating closely with government schemes for irrigation and related equipment might be a priority.

In areas where gender norms are more restrictive, greater impacts on women's economic empowerment are possible but will require more gender-intentional training and capacity building. Local gender norms around agriculture vary across India; scaling the APC model to areas where women are more constrained in their agricultural decision-making may dilute the impacts (and feasibility) of the scaled model. For example, one government official noted that in tribal districts of Odisha, women play a central role in both household and agricultural activities, making them natural leaders in economic development. However, in Odisha's coastal districts, for example, where farming is male-dominated and women primarily engage in household work, integrating them into agricultural value chains requires a strategic approach. The gender context also likely differs in other states to which the project model might be scaled up. To expand successfully, the project should focus on engaging female SHG members in each area, creating pathways for their participation in farm activities given the local gender context, and building a supportive ecosystem that encourages their involvement.

> "Right now APC is operating in tribal-dominated districts of Odisha where women are the torchbearers of the family: they engage in household and agricultural activities and drive economic development. But when it comes to coastal districts of Odisha, male farmers dominate. Women hardly go to the field; they stay at home and do cooking and other household activities. For the APC project to be successful in these areas, we will have to determine how to engage SHG members in this type of activity."
>
> *Government official*

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Annex A: Evaluation approach

A. Process Evaluation and Market Assessment

1. Data sources and sampling

Both the process evaluation and market assessment are based on three rounds of primary qualitative data collected by Mathematica staff and our local research partner, Intellecap (**Table A.1).** The process evaluation draws on individual and group key informant interviews (KIIs) with government stakeholders and project implementing partners across multiple geographies. We complemented these qualitative data with project monitoring data and progress reports, which we used to summarize the status of the APC project at the end of the implementation period, providing context for interpreting the findings.

Table A.1 APC evaluation qualitative data sources and sampling approach

Stakeholder and location/sampling	Approach			# respondents per round		
	KII	Group inter-view	Focus group	Baseline (2021)	Interim (2023)	Endline (2024)
Gates Foundation						
AgDev team in India	X			1	-	-
Government						
Commissioner cum Secretary, DA&FE (GoI)	X			1	-	-
Director, Directorate of Horticulture (DOH, DA&FE)	X			1	-	-
Director, Odisha Livelihoods Mission (OLM)	X			1	-	-
Mission Shakti	X			1	-	1
APICOL	X			1	-	1
OLIC	X			1	-	-
District collectors / Head district administrators	X			3	-	-
District-level Dpy./Asst. Director of Horticulture (DOH, DA&FE)	X			3	2	3
Block-level Asst. Horticultural Officers (DOH, DA&FE)	X			-	1	1
Village leaders		X		3	-	-
Project implementing partners						
PRADAN leadership		X		2	6	6
District-level implementation staff (PRADAN and NGO partners)[32]		X		-	10	18
PRADAN zonal coordinators	X			1	2	-
PC staff / board member *implementation interviews*		X		-	14	12
PC staff / board member *participatory market mapping*		X		-	14	14
SSPs (PG members and PC shareholders)						
SSP *interviews*: 6 in each block	X			18	-	-

[32] PRADAN district-level implementation staff and block-level implementation staff from PRADAN (Kolnara block), Vikalpa (Khaprakhol block), or SEWA (Laikera block)

SSPs *focus groups*: 2 in each block			X	-	67	40
SSP *participatory market mapping*: 1 in each block		X		-	12	15
Value chain actors						
Village traders/commission agents	X			6	6	-
Institutional and bulk buyers	X			1	6	6
Agri-entrepreneurs	X-			1	3	-
Total respondents						

APMC= Agricultural Produce Market Committee; DA&FW: Department of Agriculture and Farmer Welfare; DOH= Department of Horticulture; PC = farmer producer company; GoI=Government of India; IFFCO= Indian Farmers Fertiliser Cooperative; ITDA= Integrated Tribal Development Agency; KII=key informant interview; SSP = small-scale producer.

Our market assessment draws on localized data collected about three crop-specific value chains in different geographies (brinjal in Kolnara block, Rayagada district; cauliflower in Laikera block, Jharsuguda district, and tomato in Khaprakhol block, Bolangir district). In these case study geographies, we collected data through focus group discussions (FGDs) with SSPs, KIIs with value chain actors (traders/buyers/input sellers), and participatory group market mapping interviews with SSPs and PC staff. Whereas during our interim study in 2023 we collected data on all three value chains, we only revisited the cauliflower and brinjal value chains during our endline study in 2025 because the interim findings suggested that the tomato value chain was very similar to that for brinjal. As a result, our assessment of changes in the market since the beginning of the APC project focuses on cauliflower and brinjal. We draw upon data collected in 2023 on the tomato value chain to synthesize common learnings across all three case studies.

The first round of qualitative data collected in Q3 2021 focused on project implementation, anticipated results and challenges, and the (retrospective) pre-project market characterization for the three case study value chains (given that the APC project started in 2018), for which the findings were presented in a first-round report (Narayan et al. 2022). The objective of the interim round in mid-2023 was to gather detailed information on three value chains, as well as any updates to project implementation and shifts in design, challenges and successes to date, and early project effects. These results were presented in an interim report (Borkum et al. 2024). The endline round in Q4 2024, presented in this report, sought to describe implementation around project close-out, endline effects on SSPs as well as the endline market situation for two of the value chain case studies (cauliflower and brinjal), and challenges and opportunities related to scale up and sustainability.

The sample for qualitative data collection was designed to provide depth and richness of information about the effect of the APC project on SSPs and the development of an inclusive market (as opposed to breadth of information, which we achieved through the SSP quantitative survey described later), focusing on three distinct value chains. We purposively selected one village in each of three blocks across three distinct project districts for our qualitative sample: Kolnara block in Rayagada district, Laikera block in Jharsuguda district, and Khaprakhol block in Bolangir district. For our interim market assessment in 2023, these districts and blocks were the same as those sampled for the first round of qualitative data collection in late 2021, and we also sampled the same village within each block.[33] As mentioned above, due to the

[33] In the first round, district-level sample criteria included: (1) one district from each of three defined agro-climatic zones, (2) two districts where the level of government partnership is more pronounced and one where it is less robust, (3) districts that were not covered under an existing market assessment report, and (4) number of PGs formed under

similarity in market structure and changes observed at interim for tomatoes and brinjal, in 2025 we included two of the blocks in our endline market assessment sample instead of three: Laikera block in Jharsuguda (cauliflower) and Kolnara block in Rayagada (brinjal). Sampling of individual SSPs for the process evaluation and market assessment at interim was primarily based on PRADAN's identification of PG members who met specific criteria and cultivated the three winner crops selected for the market assessment.[34] Selection of the three winner crops was based on input from PRADAN, taking into consideration crops that had been selected as winner crops for more than one year in a row and whose value chains varied in terms of inputs, buyer type, sales point, storage, processing, and sales price.

2. Process evaluation analysis approach

We implemented five steps to triangulate and analyze the qualitative data. First, we organized the raw data from each qualitative data source into usable formats (for example, from audio files to transcripts). Second, we developed a detailed coding scheme to organize findings into categories that were relevant to the research questions and covered implementation-related issues, market changes, and project impacts on farmers. Third, we coded transcripts in Nvivo utilizing a "chunking" process,[35] giving us a holistic view of the data, which we examined in greater depth by running queries across multiple codes and examining the results. Fourth, we reviewed and synthesized data into summaries based on stakeholder type and organized by research question. Finally, we triangulated findings across FGDs, interviews, and project documentation to highlight mechanisms, contexts, and similarities and differences in perspectives. While incorporating data from the process evaluation and market assessment into one data set allowed us to better triangulate information, we also reviewed data for the market assessment on its own to produce the market assessment case studies, which explored market changes that have occurred in the selected geographies to date.

3. Market assessment analysis approach

The objective of the participatory market mapping exercise was to enhance our understanding of the value chains for the three selected winner crop value chains and to document how those markets have changed since the launch of the APC project. As described above, we initially selected three winner crops for the market assessment: brinjal in Kolnara block, Rayagada district; cauliflower in Laikera block, Jharsuguda district; and tomato in Khaprakhol block, Bolangir district. Participatory mapping was conducted separately with SSPs and with PC staff and project implementing partners, enabling us to triangulate findings from the perspectives of both project beneficiaries and project leadership.[36]

the program. Block- and village-level sample criteria included: (1) one block that is relatively remote in terms of access to roads and markets and one that is relatively less remote, (2) variation in physical infrastructure and facilities (for example, storage and road connectivity), and (3) PGs launched in the first quarter of 2021.

[34] PRADAN provided a list of PG-affiliated SSPs growing these crops, their socio-economic attributes, and PC shareholder status. Based on these data, we selected farmers to obtain variation in winner crop activities (net area sown, production volume, and sales volume) as well as farmer characteristics (age, education, socio-economic status, land tenure status, and so on.)

[35] The "chunking" process involves reading through transcripts and categorizing small chunks of text by codes representing thematic areas.

[36] Conducting the participatory market mapping exercise separately with SSPs and with PC staff and implementation partners also minimized risk of response biases—especially among SSPs, who may have altered their responses to please PC or implementation staff had they all been included in the same group interview.

Specifically, participatory market mapping with SSPs enabled us to explore who SSPs interact with in the market and how, as well as the challenges they face, both currently and in the past. For PC staff and implementation partners, the market mapping enabled us to better understand the PCs' role in the market, how SSPs interact in the market via the PC, and how the PC has changed market engagement among SSPs in the selected geographies.

To carry out the participatory market mapping exercises through group interviews, interview facilitators from Intellecap were trained by Mathematica staff and the tool was piloted in a village in an out-of-sample district. At the beginning of each group interview, the facilitator explained the activity and presented participants with a map template drawn on a large piece of paper that would be used to record participants' responses.[37] During the interviews, facilitators and participants discussed which market actors and dynamics were common amongst them and identified divergent experiences, which allowed for consensus-building led by the interview facilitator. As discussions progressed, facilitators (and in some cases, participants themselves) drew pre-defined symbols on the map to record the types of actors present in the market, the services they provide to SSPs, the quality of relationships between market actors and SSPs, and how their relative importance to SSPs has changed over time, as described and agreed upon by participants. As mentioned earlier, we conducted the participatory market mapping exercises for all three case studies in 2021 and 2023 and for two of the case studies in 2025. The resulting participatory market maps for each location were rich and provided detailed information on markets in the two selected endline geographies (see **Annex B, Figure B.1** for the interim tomato market map). We then synthesized participatory market maps completed by SSPs, PC staff, and implementing partners in each block, and triangulated them with market-relevant information captured in other interviews and FGDs to create the market maps presented in each of our market assessment case studies. Finally, we synthesized the findings across all three case studies, identifying similarities and differences in market changes over time that we highlight in the cross-case synthesis in Chapter III.

Participatory market mapping exercise

Each participatory mapping exercise aimed to explore the following focal areas, with reference to both the past (prior to the launch of the APC project) and present:

- WHO are the main market actors in the selected geography;
- WHAT aspects of the market the actors are involved in;
- WHERE those actors are located;
- HOW SSPs interact with those actors;
- WHY SSPs interact with those actors (examining the quality of those relationships – benefits, constraints, and challenges). ◢

[37] The map template was a large piece of paper with five rectangles drawn or printed on it; each rectangle represented a market component to be discussed with participants: farming inputs, price information, quality assessment (including post-harvest processing), storage, and sales. A depiction of a female SSP was placed in the center of the page to denote that they are the center of the program and to allow for connections to be drawn between the five rectangles and the SSP.

B. Impact Evaluation

1. Data sources and sampling

The endline impact evaluation draws on two phases of endline follow-up surveys conducted with a sample of female SSPs in treatment and comparison villages who were surveyed in the first round of data collection in late 2021, which served as a retrospective baseline for the impact evaluation. Below, we describe the village- and SSP-level sampling approaches, as well as the endline survey effort.

Treatment village sample. As described in more detail in the first-round report (Narayan et al. 2022), the initial sample of treatment villages for the evaluation comprised 81 villages in which 44 PGs were formed between December 2020 and March 2021, the last PGs to form under the APC project. These treatment villages cover 15 of the 40 blocks in which the APC project is being implemented (**Table A.2**); about half of these villages are in just 3 blocks (Baliguda, Muniguda, and Phulabani). Therefore, the impact evaluation sample is not representative of the project geographies; it is important to bear this in mind when interpreting the findings given the potential for differences in impacts across geographies. Specifically, as described in the interim report (Borkum et al. 2024), these late-forming PGs were less well-established and experienced more challenges than those created earlier in the project (starting in January 2019), which PRADAN views as "model" PGs. Nevertheless, examining the impacts on SSPs in these late-forming PGs may be informative of impacts likely to be experienced in further scale-up of the project, where implementation conditions are likely to be less ideal than those experienced by early-forming PGs. For example, PRADAN was playing a greater direct role in implementation and/or working with NGOs who were already established in the local areas of the early-forming PGs, and these PGs tended to be located in relatively less remote areas with better market opportunities.

Table A.2. Village sample for the impact evaluation

	Treatment villages in which PGs were formed		Treatment villages in the evaluation sample		Comparison villages in the evaluation sample	
Block	Number	Percent of total	Number	Percent of total	Number	Percent of total
Baliguda[a]	88	4.2	14	17.3	14	14.4
Bangomunda	25	1.2	2	2.5	2	2.1
Boriguma	24	1.2	3	3.7	4	4.1
Jamankira	51	2.5	1	1.2	2	2.1
K. Nuagaon	75	3.6	7	8.6	9	9.3
Kalyanasingpur	116	5.6	4	4.9	4	4.1
Kankadahad	23	1.1	3	3.7	4	4.1
Khaprakhol	24	1.2	4	4.9	5	5.2
Kolabira	24	1.2	2	2.5	3	3.1
Kolnara	85	4.1	5	6.2	6	6.2
Laikera	26	1.3	5	6.2	7	7.2
Muniguda	78	3.8	12	14.8	14	14.4
Nandapur	75	3.6	3	3.7	4	4.1
Patana	49	2.4	2	2.5	3	3.1

Block	Treatment villages in which PGs were formed		Treatment villages in the evaluation sample		Comparison villages in the evaluation sample	
	Number	Percent of total	Number	Percent of total	Number	Percent of total
Phulabani[b]	120	5.8	14	17.3	16	16.5
Total	**883**	**42.8**	**81**	**100**	**97**	**100**
All other blocks	*1,194*	57.2	*n.a.*	*n.a.*	*n.a.*	*n.a.*

[a]Comparison villages are from the neighboring Tumudibandha block.

[b]Comparison villages are from the neighboring Phiringia block.

The total number of villages in the first column for "all other blocks" is likely to be slightly overestimated because they include some hamlets that are part of the same village. We corrected this for the evaluation sample, but not for the broader set of treatment villages.

Comparison village sample. As described in more detail in the first-round report (Narayan et al. 2022), we used a multistep approach at the block level to identify 97 comparison villages that were similar to the 81 treatment villages in terms of village and SSP characteristics. To identify an initial pool of potential comparison villages, we used secondary village-level data on socio-demographic characteristics, the Normalized Difference Vegetation Index, access to rivers or water bodies, and access to paved and primary roads. These comparison villages were generally located in the same blocks as treatment villages but in different *Gram Panchayats*, to increase contextual similarity while limiting spillovers.[38] Second, PRADAN and its partner NGOs qualitatively assessed the initial list of potential comparison villages for each treatment village and attempted, based on their field knowledge, to identify comparison villages that did not have other major livelihoods programs and that had sociodemographic and agricultural characteristics similar to those of the treatment village. Finally, our local data collection partner, Development Corner (DCOR), administered a village and SSP listing in these treatment and comparison villages to help us further assess the similarity between them based on socio-demographic characteristics, agricultural characteristics, infrastructure, and livelihood program activity, and winnow the comparison villages accordingly.

SSP sample. At endline, we attempted to follow up with the same sample of female SSPs in treatment and comparison villages that were surveyed in the retrospective baseline survey conducted by DCOR. In treatment villages, the baseline sampling frame of SSPs comprised a list of PG members provided by PRADAN, whose membership status was confirmed by DCOR as part of the listing. In comparison villages, DCOR spoke to community health workers and/or the village leadership to identify female SHGs in the village, and then spoke to the SHG leadership to obtain a list of group members who were active in agriculture (that is, members who were SSPs). These SSPs would have been the targets of PG recruitment efforts if the project had been implemented in these villages. As part of the listing, DCOR confirmed that they were members of an SHG and were active in agriculture. To select the baseline treatment and comparison SSP samples, we randomly selected SSPs from those who were listed until we reached our village-level SSP sampling targets. Prior to interim data collection, we dropped one treatment village from our study sample as PRADAN indicated that no PG had been formed in this village since baseline. Before the endline data collection, we dropped an additional 6 treatment villages as the PGs in these villages were inactive at interim, as well as SSPs who had not consented to the interim survey or reported that

[38] In two blocks where there were no viable comparison villages, we identified a neighboring block with similar agricultural characteristics and used all villages in that block as the initial comparison pool.

they had never been part of a PG. Thus, the targeted sample for the endline survey comprised 888 SSPs from 74 treatment villages and 1,180 SSPs from 97 comparison villages who completed the interim survey, DCOR successfully followed up with 871 of these SSPs in treatment villages and 1,144 in comparison villages—a response rate of about 97 percent of the targeted endline sample in both the treatment and comparison groups.[39,40]

Data collection. The data collection approach accounted for the fact that Odisha has three main agricultural seasons in a year: the dry winter *rabi* season, the short hot summer *zaid* season, and the wet *kharif* season. DCOR conducted the endline survey in person in two rounds: (1) one round conducted in July 2024 covered the 2023–2024 *rabi* season (November 2023 to March 2024); and (2) another round conducted between January and February 2025 covered the 2024 *zaid* season (end of March 2024 to May 2024) and the 2024 *kharif* season (June 2024 to December 2024). This covered the third full *rabi* seasons and fourth full *zaid* and *kharif* seasons since the PGs in treatment villages were formed.

Each endline round contained several modules (**Table A.3**) and prompted SSPs to recall agricultural information from the relevant season. We conducted the survey some months after the end of the season to account for post-season sales. Nevertheless, harvests and sales of some crops from the *kharif* season (for example, paddy and cotton) were not yet fully completed by the survey date, and waiting longer risked increasing recall error. We therefore captured information on harvested crops that were being stored for sale, as well as crops that were still unharvested. In Chapter IV, we describe how we used this information as part of our estimates of SSP revenues and income. The survey also measured women's economic empowerment, which we complemented with questions in our qualitative focus groups, as described in more detail in **Box A.1**.

Table A.3. Endline survey modules

Module	Key topics covered
SSP characteristics	Demographic information for the SSP, such as age, gender, relationship to household head, and marital status
Household information	Identification information of household members; demographic information for the household head, such as age, gender, marital status
Crop cultivation, input use and costs, production, and sales (seasonal)	*Rabi* and *zaid/kharif* seasons: plot cultivation area; irrigation sources; types of crops cultivated; crop cultivation area; crop tenancy status; crop irrigation area; crop harvest amounts; cultivation methods; use of modern farm equipment; list of crop buyers; coordination of crop sales, use of crop storage and processing, crop sales volumes (by buyer); crop sales prices (by buyer); crop processing; quantity of pesticides and herbicides; agricultural costs *Kharif* season only: quantity of harvests stored or set aside for future sales, planned sales of stored and unharvested crops
Livestock holding (full year January 2024-December 2024)	Types and number of livestock; livestock accommodation; information on livestock health such as illness episodes, deaths, vaccination, and deworming

[39] These numbers are based on SSPs who completed both the APC *rabi* endline survey or the APC *kharif/zaid* endline survey.

[40] Largely because of variation in the number of listed SSPs across villages at baseline, the number of endline survey respondents varied substantially across villages, from 1 to 28.

Module	Key topics covered
Livestock husbandry (full year January 2024-December 2024)	Housing management of livestock; income from livestock meat production, egg sales, renting or selling livestock, and milking livestock; livestock expenses
Household decision making on agriculture production and income (seasonal)	Input into decision making around crop production and sales, livestock husbandry, and use of agricultural income (additional questions on each of these topics were included in the *kharif/zaid* survey)
Minimum dietary diversity (seasonal)	Consumption of 9 categories of foods

Box A.1. Measurement approach: women's empowerment

While different conceptual definitions and frameworks exist for measuring women's empowerment, the field has largely coalesced around Kabeer's (1999) definition of empowerment as the process by which people expand their ability to make strategic life choices. Our measurement approach draws on the project-based women's economic empowerment in agriculture (Pro-WEAI) index and conceptual framework developed by the International Food Policy Research Institute (IFPRI). The Pro-WEAI (and the related Pro-WEAI+MI focused on market inclusion) measures women's empowerment in agriculture related to three domains: (1) intrinsic agency ("power within", or a person's internal voice, self-respect, or self-confidence); (2) instrumental agency ("power to", or a person's ability to make decisions in their best interest); and (3) collective agency ("power with", or the power a person gets from acting together with others) (Malapit et al 2019, IFPRI 2021).

Following discussions with the foundation, PRADAN, and IFPRI, we focused our quantitative survey and qualitative focus groups on the domains of instrumental agency (primarily focused on women's economic empowerment) and collective agency. These discussions suggested that these domains are the most relevant to the APC model and theory of change and are also feasible to measure accurately in this cultural and linguistic context. We therefore included survey questions related to two instrumental agency indicators about the primary value chain(s) in which women SSPs work (horticultural crops and livestock): (1) input into livelihood decisions, and (2) control over use of income. We included additional questions in our qualitative focus groups about the instrumental agency indicators of (3) work balance and drudgery and (4) mobility, as well as the collective agency indicators of (5) group membership and membership (and leadership) in influential groups. To ensure the WEAI questions were properly translated and validated, we also drew on IFPRI's WEAI survey instruments from the ANEW project (in Hindi) and for the WINGS project (in Odia), as well as WEAI's sample qualitative protocols.

2. Analysis approach

We use a quasi-experimental matched comparison group design to measure the impacts of the APC project on SSPs. Specifically, we compare the outcomes of SSPs who are members of a PG in treatment villages to the outcomes of similar SSPs in comparison villages that do not have PGs. Below, we describe the statistical matching approach that we implemented to improve the similarity between the treatment and comparison groups. We also describe how we applied this approach to two analysis samples of

treatment SSPs: (1) all SSPs who were members of the PG and (2) a group of SSPs who were highly engaged with the PG.

Statistical matching approach. We use a coarsened exact matching (CEM) approach (Iacus et al. 2012) to improve the similarity between the treatment and comparison groups. Under this approach, we divided respondents to the endline survey into unique bins defined by block and several indicators measured at baseline: irrigation in the *kharif* season, cultivation in the *rabi* season, cattle ownership at the end of the *rabi* season, having used agricultural credit in the *kharif* or *rabi* seasons, and having revenues from crops in the *rabi* season above or below a cutoff (5,000 rupees, which is approximately the 90th percentile across the full sample). We selected these variables because (1) the baseline differences between the treatment and comparison groups for these variables were relatively large for the analysis samples at endline, and (2) they are likely to be correlated with key outcomes that we measured at endline. We then reweighted the comparison observations so that the distribution of the comparison sample across bins was equal to that of the treatment sample. Intuitively, this adjusts the baseline characteristics and outcomes of the comparison sample that were used to form the bins to make them equivalent to the treatment sample; the assumption is that, in so doing, this can also improve the similarity between the treatment and comparison groups along other dimensions.

We used the CEM weights to estimate endline impacts by applying the following weighted regression model:

$$Y_{ij,endline} = \alpha + \beta T_j + \gamma Y_{ij,baseline} + \delta C_{ij} + \varepsilon_{ij} \quad (1)$$

where $Y_{ij,endline}$ is an outcome of SSP i in village j measured at endline, T_j is a binary treatment variable that is one for the treatment group and zero for the comparison group, $Y_{ij,baseline}$ is the same outcome measured at baseline,[41] C_{ij} is a set of SSP and village-level characteristics measured at baseline,[42] and εij is an error term. Controlling for the baseline outcome and baseline village- and SSP-level characteristics helps to address treatment-comparison imbalances that remain after matching and improve the precision of the impact estimates. We cluster standard errors by village to account for the correlation in outcomes among SSPs in the same village. Where $Y_{ij,endline}$ was a continuous variable, we examined its joint distribution across the treatment and comparison groups to check for outliers that might have a large influence on the estimated means. On a case-by-case basis, we adjusted for these outliers either by removing one or two observations or by top-coding the variable at the 95th or 99th percentile (and bottom-coding at the 5th percentile for net income indicators, which could be negative).

Analysis samples. We identified two samples of treatment SSPs that were of interest at endline, out of the 870 treatment SSPs who completed an endline survey:

[41] For a few endline outcomes, we did not measure the same outcome at baseline. In those cases, we used a closely related baseline outcome instead.

[42] Village-level baseline controls are the number of households in the village and its square, village has a market in the village or nearby, village has a bank or automatic teller machine in the village or nearby, village has a regular electricity supply, village has a cellphone signal, and village is accessible by paved road. SSP-level baseline controls are household size, household is in poverty, household has a female household head, SSP age, SSP belongs to a scheduled caste or tribe, SSP is illiterate, and SSP cultivated solely on owned land in the relevant baseline season (or in either season, for outcomes that cover both *kharif* and *rabi* seasons together).

1. All treatment SSPs who were still members of functioning PGs at endline (which we refer to as the "full sample"). This comprised almost all treatment SSPs surveyed at endline, except for 5 villages where DCOR's field observations suggested that the PG was functioning in a very limited way (if at all), and 22 SSPs who indicated that they were no longer members of the PG. The impacts for this sample can be interpreted as the average impacts on SSPs who were members of functioning PGs in the treatment villages at endline, which include SSPs with varying levels of PG-related activity. These impacts are relevant because they show how the population of SSPs that the project targeted in these villages was affected by it.
2. A sample of treatment SSPs who were the most highly engaged with the PGs at endline (which we refer to throughout this report as the "highly engaged sample"). We used our survey data to identify these SSPs as those who reported selling crops with the support of the PC in the endline *kharif*, *rabi*, or *zaid* seasons (15 percent of treatment SSPs surveyed at endline), and/or had purchased or received inputs through the PC in the endline seasons (36 percent), and/or had purchased or used equipment through the PC in the endline seasons (16 percent). There was some overlap across these criteria, so that about 40 percent of all treatment SSPs surveyed at endline met at least one of these criteria.[43,44] The impacts for this sample can be interpreted as the average impacts on SSPs who were highly engaged with the PG, based on our measures of engagement.[45] These impacts are relevant because they illustrate the potential of the project to affect SSPs once they become properly engaged with it; it is possible that more SSPs will become actively engaged with the PG and PC over time and experience these effects.[46] These impacts are likely to be larger than those for the full sample, if anything, but are also harder to statistically detect because the sample size is smaller.

We then conducted matching separately for each of these two treatment analysis samples to obtain a plausible matched comparison group for each. Although CEM offers a relatively simple and intuitive approach to improve balance between the treatment and comparison groups, it typically leads to some loss in sample size. Specifically, observations in bins that have only treatment or only comparison observations receive a weight of zero and will not contribute to the impact evaluation. For the full sample, we were left with 701 treatment and 974 comparison SSPs for the analysis; for the highly engaged sample, we were left with 303 treatment and 855 comparison SSPs (**Table A.4**).

[43] As noted in the body of the report, we also identified season-specific highly engaged samples to analyze seasonal indicators on crop production, sales, and revenues and income.

[44] We recognize that this measure might not fully capture SSP engagement with PGs and PCs, which is complex and multi-dimensional; further, as noted in Chapter IV, it was challenging to accurately capture collective sales. Nevertheless, this measure captures several key dimensions of engagement in terms of inputs and outputs.

[45] The impacts for the highly engaged sample might be higher than those for the full sample given that the latter are diluted by PG members who are not very active with the PG, if at all. However, it is more challenging to statistically detect impacts for the highly engaged sample given smaller sample sizes.

[46] SSPs who become highly engaged at a later stage might have different characteristics from those who became engaged earlier and might not experience the same effects. Nevertheless, positive impacts on the highly engaged sample would be suggestive of the potential for broader impacts if more PG members become highly engaged.

Table A.4. Sample sizes for the endline analysis after matching

	Survey sample	Analytic sample, full sample	Analytic sample, highly engaged sample
Treatment group	871	701	303
Comparison group	1,144	974	855
Total	***2,015***	***1,675***	***1,158***

We used the baseline survey data to assess the balance between each of the two treatment groups (the full sample and highly engaged sample) and the respective comparison group. To do so, we considered the magnitude and statistical significance of treatment-comparison differences in village, household, and SSP characteristics, as well as outcomes related to agricultural production and sales (**Annex D, Tables D.1-D.9**). For the full sample at interim, these differences were almost all small in magnitude, and the number of statistically significant differences fewer than one would expect by chance. The only exception was our baseline measure of female economic empowerment, which was somewhat more favorable in the treatment group. These conclusions are similar for the highly engaged sample at interim (**Annex E, Tables E.1-E.9)**; although the smaller sample size implies that baseline treatment-comparison differences are harder to statistically detect than for the full sample, the magnitude of these differences is typically small.

Because there are only small differences in baseline measures between the treatment and comparison groups, we can be confident that any differences between the treatment and comparison groups at interim are not the result of those baseline differences, but rather the impacts of the APC project. Nevertheless, we control for these baseline differences using the regression framework described above, further mitigating this concern.

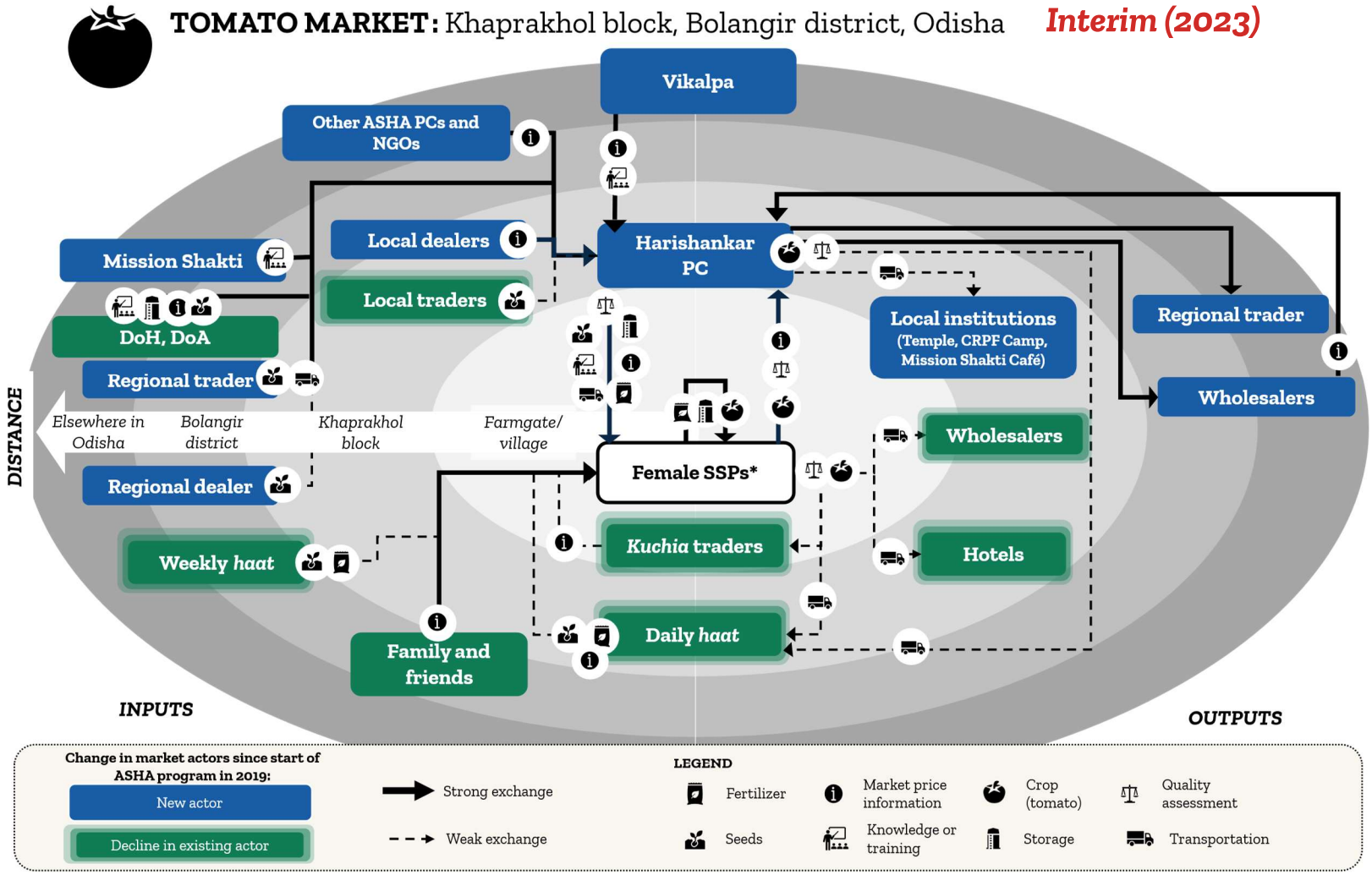
Annex B. Tomato market interim assessment

The APC project has been implemented in Bolangir district by a partner NGO called Vikalpa since 2019, and the Harishankar PC was established in 2021. As of our interim market assessment in 2023, the project's promotion of tomato as a winner crop increased SSPs' engagement in the tomato market, as they began collectively cultivating and selling larger volumes of tomatoes and had easier and more reliable access to larger input sellers and tomato buyers through the PC. While greater access to micro-irrigation facilitated increased production in the rabi *off-season, limited perennial water sources and poor transportation remained barriers to further growth.* ***Table B.1*** *describes how each key area of the market had shifted as of the interim study, as illustrated in* ***Figure B.1****.*

Table B.1. APC project interim effects on the tomato market in Khaprakhol, Bolangir

	Pre-project (before 2019)	Interim effects (mid-2023)
Cultivation	SSPs only grew small amounts of tomatoes, primarily during the rainy *kharif* season.	SSPs have increased tomato production volumes to sell to the PC. Convergence with government subsidies for micro-irrigation and borewell facilities has increased SSPs' ability to cultivate in the *rabi* off-season; however SSPs still primarily cultivate during the *kharif* season due to limited access to perennial water sources.
Access to inputs	SSPs relied on daily and weekly *haats* and local traders to purchase seeds, fertilizers, pesticides, and herbicides. *Haat* pricing was variable, quality was often poor, and SSPs had to travel long distances. Local traders provided high-quality seeds but at high prices.	SSPs now purchase (sometimes on credit) higher-quality and affordable seeds from the PC, which procures from regional traders and dealers. The PC promotes organic manure production and application; however, SSPs still purchase chemical fertilizers from *haats*.
Access to market price information	SSPs relied on *haats*, *kuchias* (whose information was often inaccurate), and their relatives (who are perceived as trustworthy).	SSPs trust that their PC provides accurate price information (collected from tomato dealers and wholesalers, other APC PCs and implementing partners, and SSPs themselves) and rely less on *kuchias;* however, they still rely mostly on relatives and *haats* (due to trust and convenience).
Quality assessment and storage	SSPs practiced some quality assessment of tomatoes but did not sort or grade. Because they did not practice aggregation or collective marketing, SSPs only stored tomatoes in their own homes overnight until sale.	SSPs now sort and grade their tomatoes with guidance from the PC and sell multiple grades to different buyers. The soft, perishable tomato variety limits the usefulness of storage but SSPs now store in *godowns* overnight prior to sale, and the PC's cold storage facility can extend the sales window for leftover produce by a couple of days.
Transportation and sales	SSPs grew tomatoes only for home consumption or small volumes of local sales to *kuchias* (who offered unreliable and lower prices) and *haats* (which was time-consuming).	SSPs now mostly sell through the PC to district traders and wholesalers. Produce is collected from a village *godown*; transportation is sometimes arranged by the buyers and sometimes by the PC. Lack of cold transportation restricts their access to buyers in further-flung markets. Leftover or smaller volumes are sold to other block wholesalers or traders or are in the *haat*.
Income and price realization	SSPs did not earn much income from tomatoes as they primarily grew them for home consumption and prices for the small volumes they sold through local *haats* were relatively low and variable.	SSPs perceive that they now earn more income from tomato sales through the PC, due to larger sales volumes and better prices. However, the PC has not yet shared profits with shareholders.

Figure B.1. Tomato market map (Khaprakhol block, Bolangir district): Interim APC project market assessment

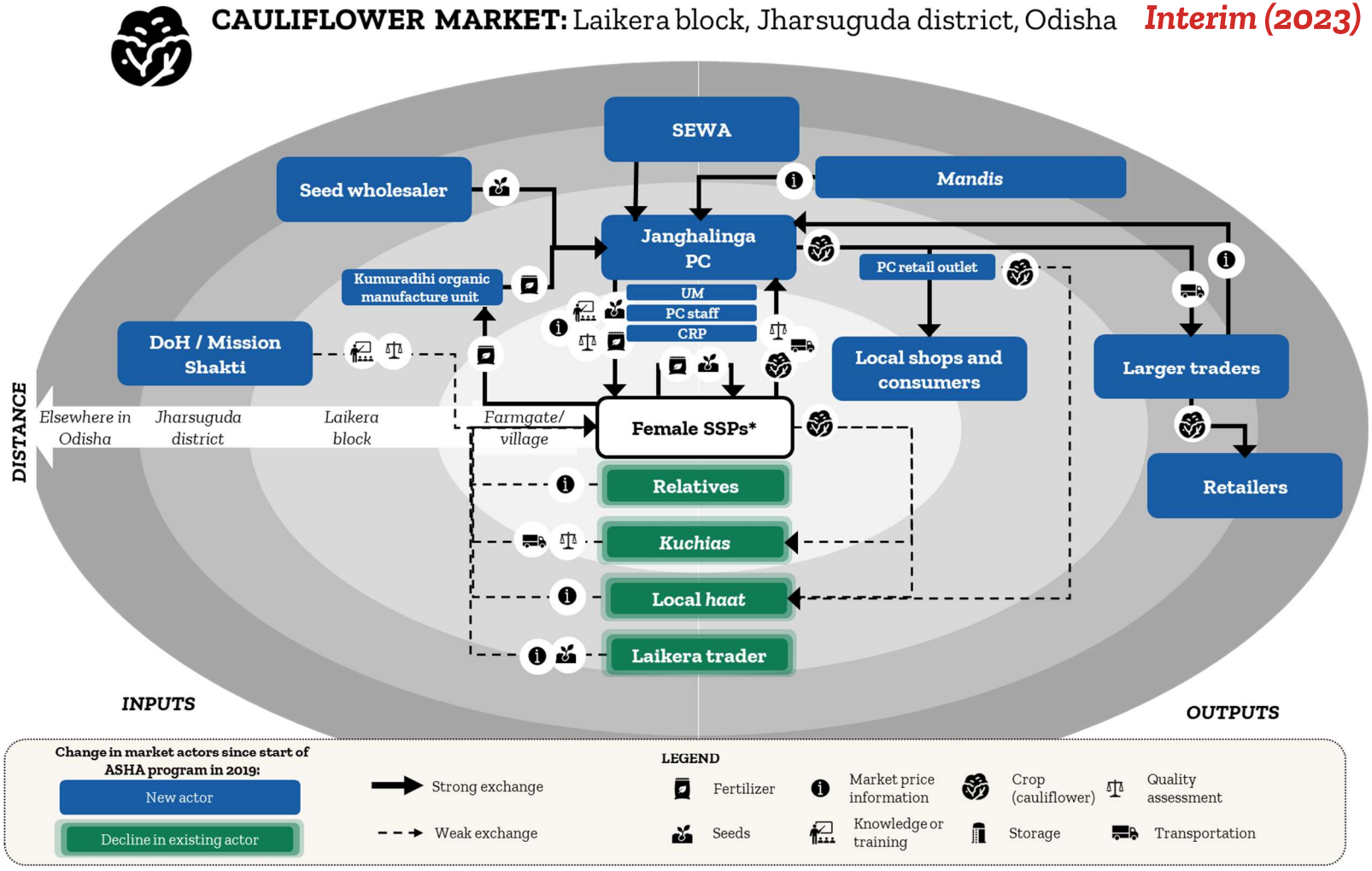


*The arrow and icons pointing from female SSPs to themselves represent self-sufficient services (producing organic manure, storage in own home, home consumption of tomatoes).

Acronyms: ASHA = Augmentation in Small Holders' Prosperity through Agricultural production clusters; CRPF = Central Reserve Police Force; DoA = Department of Agriculture; DoH = Department of Horticulture; ITDA = Integrated Tribal Development Agency; NGO = non-governmental organization; PC = Producer Company; SSP: small-scale producer

Annex C. Cauliflower market interim assessment

Figure C.1 Cauliflower market map (Laikera block, Jharsuguda district): APC project **interim** market assessment (2023)



*The arrow and icons pointing from female SSPs to themselves represent self-sufficient services (production of organic manure, seed-saving).

Acronyms: ASHA = Augmentation in Small Holders' Prosperity through Agricultural production clusters; CRP = community resource person; DoH = Department of Horticulture; PC = Producer Company; SEWA = Social Awareness for Women's Education; SSP: small-scale producer; UM = *Udyog Mitra*

Annex D: Baseline equivalence for the full analysis sample in the *rabi* endline

Table D.1. Village baseline characteristics, full sample

	Treatment sample size	Comp. sample size	Treatment mean	Comp. mean	Difference	p-value
Mean number of households in SSP's village	707	982	125	162	-37	0.314
Weekly or daily market or mandi in village or within 5 km (%)	707	982	56.4	49.6	6.8	0.410
Bank or ATM in village or within 5 km (%)	707	982	38.0	33.8	4.3	0.593
Cellphone signal in some or all parts of SSP's village (%)	707	982	84.2	85.3	-1.1	0.847
Regular electricity supply throughout day in SSP's village (%)	707	982	76.8	73.5	3.3	0.648
SSP's village accessible by paved road (%)	707	982	68.0	61.1	7.0	0.374

Source: APC baseline village listing survey.

ATM = automatic teller machine.

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

Table D.2. Household and SSP baseline characteristics, full sample

	Treatment sample size	Comp. sample size	Treatment mean	Comp. mean	Difference	p-value
Household characteristics						
Household size (number)	707	982	4.8	4.8	0.0	0.981
Household in poverty (%)[a]	707	982	41.3	39.3	2.0	0.624
Household head characteristics						
Female (%)	707	982	17.3	15.4	1.8	0.507
Hindu (%)	707	982	93.8	90.3	3.4	0.367
SC/ST (%)	707	982	78.2	73.3	4.9	0.366
SSP characteristics						
Mean age (years)	707	982	41	40	1	0.363
Married (%)	707	982	87.1	87.4	-0.3	0.901
Education of SSP (%)						
Illiterate (did not attend school)	707	982	61.7	53.9	7.7*	0.078
Completed primary or less	707	982	16.8	19.1	-2.3	0.448
Completed middle	707	982	7.8	9.8	-2	0.281
Completed secondary or above	707	982	13.7	17.2	-3.5	0.272

Source: APC baseline survey.

SC/ST = scheduled caste/scheduled tribe

[a]Based on the Progress out of Poverty Index (http://www.progresssoutofpoverty.org/).

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

Table D.3. Cultivation in the baseline 2020 *kharif* season, full sample

	Treatment sample size	Comp. sample size	Treatment mean	Comp. mean	Difference	p-value
Cultivated in *kharif* season (%)	707	982	99.7	99.9	-0.2	0.360
Among all SSPs						
Area under cultivation (hectares)	706	982	0.90	1.03	-0.13	0.166
Cultivated any winner crops (%)	707	982	51.1	52.6	-1.6	0.736
Area under winner crops (hectares)	707	982	0.02	0.02	0.00	0.864
Used irrigation (%)	707	982	28.0	28.0	0.0	1.000
Area under irrigation (hectares)	706	982	0.16	0.16	0.00	0.977
Percent of SSPs cultivating the most common crop varieties (%)[a]						
Paddy	707	982	91.2	92.7	-1.5	0.537
Brinjal	707	982	43.0	45.9	-2.9	0.543
Maize	707	982	39.6	36.9	2.7	0.613
Chilies	707	982	38.8	43.6	-4.8	0.239
Jhudang	707	982	34.1	28.3	5.8	0.118
Pumpkin	707	982	31.4	40.1	-8.7**	0.049
Green beans	707	982	30.7	30.6	0.1	0.99
Okra	707	982	30.4	29.8	0.7	0.877
Tomato	707	982	25.0	27.3	-2.3	0.482
Ragi	707	982	23.9	23.7	0.2	0.971
Area cultivated of the most common crop varieties(hectares)[b]						
Paddy	706	982	0.57	0.72	-0.15*	0.075
Brinjal	707	982	0.01	0.01	0.00	0.844
Maize	707	982	0.02	0.02	0.01*	0.064
Chilies	707	982	0.00	0.00	0.00	0.196
Jhudang	707	982	0.01	0.01	0.01**	0.045

Source: APC baseline survey.

Note: Winner crops at baseline are italicized but vary across blocks.

[a]Ten most cultivated crops are shown.

[b]Five most cultivated crops are shown.

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

Table D.4. Cultivation in the baseline 2020–2021 *rabi* season, full sample

	Treatment sample size	Comp. sample size	Treatment mean	Comp. mean	Difference	p-value
Cultivated in *rabi* season (%)	707	982	54.0	54.0	0.0	1.000
Among all SSPs						
Area cultivated (hectares)	707	982	0.08	0.07	0.01	0.498
Cultivated any winner crops (%)	707	982	20.2	18.1	2.1	0.597
Area under winner crops (hectares)	707	982	0.01	0.01	0.00	0.556
Used irrigation (%)	707	982	50.6	48.9	1.8	0.729
Area under irrigation (hectares)	707	982	0.07	0.06	0.01	0.553
Percent of SSPs cultivating the most common crop varieties (%)[a]						
Potato	707	982	27.4	22.2	5.3	0.269
Tomato	707	982	18.7	21.6	-2.9	0.398
Onion	707	982	18.1	15.8	2.4	0.507
Radish	707	982	14.3	15.2	-0.9	0.772
Brinjal	707	982	14.3	17.7	-3.4	0.286

Source: APC baseline survey.

Note: Winner crops at baseline are italicized but vary across blocks.

[a]Five most cultivated crops are shown.

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

Table D.5. Use of inputs and services in the baseline 2020 *kharif* and 2020–2021 *rabi* seasons, full sample

	Treatment sample size	Comp. sample size	Treatment mean	Comp. mean	Difference	p-value
2020 *kharif* season						
Used storage, among those cultivating (%)	705	981	98.9	98.1	0.8	0.260
Stored crop at own home or another's home, among those who used storage (%)	697	957	100.0	100.0	0.0	1.000
2020–2021 *rabi* season						
Used storage, among those cultivating (%)	382	347	78.5	79.4	-0.9	0.826
Stored crop at own home or another's home, among those who used storage (%)	300	270	100.0	100.0	0.0	1.000
Used post-harvest processing, among those cultivating (%)	496	410	81.0	78.1	2.9	0.480
2020 kharif and 2020–2021 *rabi* seasons						
Used modern farm equipment (%)[a]	707	982	64.5	66.2	-1.7	0.718

Source: APC baseline survey.

[a]Includes harvester, harrow, rotavator, reversible plough, happy seeder, grass or paddy choppers and cutters, weeder, treadle pump, solar panel, generator, chain linking machine, dryer, transplanter, marker, drip sprinkler, and ridger.

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

Table D.6. Crop sales in the baseline 2020 *kharif* and 2020–2021 *rabi* seasons, full sample

	Treatment sample size	Comp. sample size	Treatment mean	Comp. mean	Difference	p-value
2020 *kharif* season						
Sold any crop (%)	707	982	74.3	73.9	0.4	0.920
Sold any winner crops (%)	707	982	22.9	23.3	-0.4	0.929
2020–2021 *rabi* season						
Sold any crop (%)	707	982	30.4	29.7	0.7	0.858
Sold any winner crops (%)	707	982	13.6	10.8	2.8	0.379

Source: APC baseline survey.

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

Table D.7. Livestock holding and husbandry in the baseline 2020-2021 *rabi* season, full sample

	Treatment sample size	Comp. sample size	Treatment mean	Comp. mean	Difference	p-value
Household owns or keeps livestock (%)	707	982	90.1	87.9	2.2	0.362
Type of livestock owned or kept by household (%)						
Cattle	707	982	74.7	74.7	0.0	1.000
Goats	707	982	42.3	40.5	1.7	0.715
Poultry	707	982	66.8	66.9	-0.2	0.970
Number of livestock owned or kept by household, among those keeping them (number)[a]						
Cattle[b]	528	673	4.1	4.0	0.0	0.882
Goats[b]	299	381	6.4	5.6	0.7	0.252
Poultry	472	622	8.6	9.7	-1.1	0.285

Source: APC baseline survey.

[a]Pigs and sheep omitted because of small sample sizes.

[b]Indicator is top-coded at the 99th percentile. All values above the top-coding threshold are replaced with the top-coding threshold.

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

Table D.8. Revenues and income from the baseline 2020–2021 *rabi* season, full sample

	Treatment sample size	Comp. sample size	Treatment mean	Comp. mean	Difference	p-value
Crops						
Revenue from crop sales (rupees)[a]	707	982	2,223	2,605	-382	0.643
Revenue from winner crop sales (rupees)[a]	707	982	707	843	-136	0.720
Crop production and sales costs (rupees)[a]	707	982	2,011	2,491	-480	0.291
Net income from crop sales and harvest (rupees)[a,b,c]	703	976	2,160	2,376	-216	0.753
Total revenue from livestock (rupees)	706	982	1,841	2,476	-635	0.181
Livestock husbandry costs (rupees)[d]	706	981	1,418	1,691	-273	0.319
Crops and livestock combined						
Total cash revenue from crops and livestock[a,e]	707	982	3,926	4,585	-659	0.471
Net cash income from crops and livestock[a,b,f]	707	982	181	278	-97	0.859

Source: APC baseline survey.

PG = farmer producer group; PC = farmer producer company.

[a]Indicator is top-coded at the 95th percentile. All values above the top-coding threshold are replaced with the top-coding threshold.

[b]Indicator is bottom-coded at the 5th percentile. All non-zero values below the bottom-coding threshold are replaced with the bottom-coding threshold.

[c]Includes the value of crops harvested but not sold.

[d]Indicator is top-coded at the 99th percentile. All values above the top-coding threshold are replaced with the top-coding threshold.

[e]This indicator is defined as the sum of revenue from crop sales and livestock.

[f] This indicator is defined as the sum of revenue from crop sales and livestock, minus crop production and sales costs and animal husbandry costs. It excludes the value of crops harvested but not sold, as well as the value of self-consumption from livestock.

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

Table D.9. SSPs' input into decisions around agricultural income at baseline, full sample

	Treatment sample size	Comp. sample size	Treatment mean	Comp. mean	Difference	p-value
Little to no input in decisions	577	722	11.4	4.8	6.7***	0.000
Input into some decisions	577	722	63.4	78.7	-15.3***	0.000
Input into most or all decisions	577	722	25.1	16.5	8.6***	0.005

Source: APC baseline survey.

Note: Respondents who reported that there were no household decisions made related to income (likely because income was limited) are omitted. These respondents comprised 18 percent of the treatment sample and 21 percent of the comparison sample.

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

Annex E: Baseline equivalence for the highly engaged analysis sample in the *rabi* endline

Table E.1. Village baseline characteristics after matching, highly engaged sample

	Treatment sample size	Comp. sample size	Treatment mean	Comp. mean	Difference	p-value
Mean number of households in SSP's village	186	674	156	208	52	0.364
Weekly or daily market or mandi in village or within 5 km (%)	186	674	63.4	53.2	10.3	0.334
Bank or ATM in village or within 5 km (%)	186	674	36.0	32.5	3.5	0.727
Cellphone signal in some or all parts of SSP's village (%)	186	674	87.1	88.3	-1.2	0.838
Regular electricity supply throughout day in SSP's village (%)	186	674	69.4	72.0	-2.6	0.791
SSP's village accessible by paved road (%)	186	674	76.9	67.7	9.2	0.298

Source: APC baseline village listing survey.

ATM = automatic teller machine.

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

Table E.2. Household and SSP baseline characteristics after matching, highly engaged sample

	Treatment sample size	Comp. sample size	Treatment mean	Comp. mean	Difference	p-value
Household characteristics						
Household size (number)	186	674	4.8	4.9	-.1	0.441
Household in poverty (%)[a]	186	674	35.5	39.8	-4.3	0.49
Household head characteristics						
Female (%)	186	674	22	12.1	10.0**	0.025
Hindu (%)	186	674	91.4	93.6	-2.2	0.665
SC/ST (%)	186	674	75.8	67.8	8.0	0.345
SSP characteristics						
Mean age (years)	186	674	42	40	1.9	0.136
Married (%)	186	674	83.9	90.3	-6.5	0.122
Education of SSP (%)						
Illiterate (did not attend school)	186	674	55.4	46.8	8.6	0.193
Completed primary or less	186	674	18.3	23.3	-5.0	0.315
Completed middle	186	674	10.2	10.6	-0.3	0.906
Completed secondary or above	186	674	16.1	19.3	-3.2	0.516

Source: APC baseline survey.

SC/ST = scheduled caste/scheduled tribe

[a]Based on the Progress out of Poverty Index (http://www.progresssoutofpoverty.org/).

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

Table E.3. Cultivation in the baseline 2020 *kharif* season, highly engaged sample

	Treatment sample size	Comp. sample size	Treatment mean	Comp. mean	Difference	p-value
Cultivated in *kharif* season (%)	186	674	99.5	99.8	-0.3	0.573
Among all SSPs						
Area under cultivation (hectares)	186	674	1.00	1.19	-0.19	0.288
Cultivated any winner crops (%)	186	674	54.3	52.4	1.9	0.79
Area under winner crops (hectares)	186	674	0.03	0.02	0.00	0.962
Used irrigation (%)	186	674	32.3	32.3	0.0	1.000
Area under irrigation (hectares)	186	674	0.2	0.17	0.03	0.566
Percent of SSPs cultivating the most common crop varieties (%)[a]						
Paddy	186	674	91.4	92.8	-1.4	0.731
Brinjal	186	674	45.2	46.0	-0.9	0.904
Chilies	186	674	44.1	39.7	4.4	0.47
Okra	186	674	40.3	27.8	12.5*	0.071
Jhudang	186	674	39.2	28.6	10.6*	0.085
Pumpkin	186	674	34.4	35.9	-1.5	0.786
Tomato	186	674	32.3	28.3	4.0	0.518
Maize	186	674	31.7	30.4	1.3	0.843
Ridge gourd	186	674	28.0	17.6	10.3*	0.050
Bitter gourd	186	674	25.3	20.1	5.1	0.345
Area cultivated of the most common crop varieties (hectares)[b]						
Paddy	186	674	0.65	0.84	-0.19	0.224
Brinjal	186	674	0.01	0.01	<0.01	0.495
Chilies	186	674	<0.01	<0.01	<0.01	0.597
Okra	186	674	<0.01	<0.01	<0.01	0.265
Jhudang	186	674	0.01	<0.01	0.01	0.193
Among SSPs who cultivated in *kharif* season						
Cultivated only on owned land (%)	185	673	51.9	60.3	-8.4	0.162
Practiced mixed cropping or double cropping (%)	185	673	72.4	67.3	5.1	0.412

Source: APC baseline survey.

Note: Winner crops at baseline are italicized but vary across blocks.

[a] Ten most cultivated crops are shown.

[b] Five most cultivated crops are shown.

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

Table E.4. Cultivation in the baseline 2020–2021 *rabi* season, highly engaged sample

	Treatment sample size	Comp. sample size	Treatment mean	Comp. mean	Difference	p-value
Cultivated in *rabi* season (%)	186	674	64.0	64.0	0.0	1.000
Among all SSPs						
Area cultivated (hectares)	186	674	0.10	0.09	0.02	0.558
Cultivated any winner crops (%)	186	674	28.5	29.4	-0.9	0.897
Area under winner crops (hectares)	186	674	0.01	0.01	0.00	0.781
Used irrigation (%)	186	674	58.1	58.4	-0.3	0.963
Area under irrigation (hectares)	186	674	0.08	0.07	0.01	0.600
Percent of SSPs cultivating the most common crop varieties (%)[a]						
Tomato	186	674	29	30.2	-1.2	0.838
Potato	186	674	25.8	21.7	4.1	0.511
Onion	186	674	23.7	17.5	6.1	0.273
Brinjal	186	674	19.9	20.3	-0.4	0.934
Radish	186	674	18.3	15.7	2.6	0.576
Among SSPs who cultivated in rabi season						
Cultivated only on owned land (%)	119	223	81.5	89.1	-7.6	0.167
Practiced mixed cropping or double cropping (%)	119	223	69.7	76.3	-6.5	0.301

Source: APC baseline survey.

Note: Winner crops at baseline are italicized but vary across blocks.

[a]Five most cultivated crops are shown.

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

Table E.5. Use of inputs and services in the baseline 2020 *kharif* and 2020–2021 *rabi* seasons, highly engaged sample

	Treatment sample size	Comp. sample size	Treatment mean	Comp. mean	Difference	p-value
2020 *kharif* season						
Used storage, among those cultivating (%)	185	673	100.0	98.4	1.6**	0.017
Stored crop at own or another's home, among those who used storage (%)	185	659	100.0	100.0	0.0	1.000
2020–2021 *rabi* season						
Used storage, among those cultivating (%)	119	223	72.3	76.6	-4.4	0.546
Stored crop at own or another's home, among those who used storage (%)	86	168	100.0	100.0	0.000	1.000
Used post-harvest processing, among those cultivating (%)	119	223	83.2	77.7	5.5	0.373
Used pesticides and insecticides, among those cultivating (%)	119	223	58.0	56.8	1.2	0.871
Used herbicides and weedicides, among those cultivating (%)	119	223	7.6	9.6	-2.1	0.645
2020 kharif and 2020–2021 *rabi* seasons						
Used modern farm equipment (%)[a]	186	674	75.8	74.8	1.0	0.860
Used agricultural loans (%)	186	674	28.0	28.0	0.0	1.000
Used agricultural insurance (%)	186	674	7.0	7.9	-0.9	0.819

Source: APC baseline survey.

[a]Includes harvester, harrow, rotavator, reversible plough, happy seeder, grass or paddy choppers and cutters, weeder, treadle pump, solar panel, generator, chain linking machine, dryer, transplanter, marker, drip sprinkler, and ridger.

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

Table E.6. Crop sales in the baseline 2020 *kharif* and 2020–2021 *rabi* seasons, highly engaged sample

	Treatment sample size	Comp. sample size	Treatment mean	Comp. mean	Difference	p-value
2020 *kharif* season						
Sold any crop (%)	186	674	82.8	75.6	7.2	0.148
Sold any winner crops (%)	186	674	26.3	25.9	0.4	0.949
2020–2021 *rabi* season						
Sold any crop (%)	186	674	39.8	35.7	4.1	0.54
Sold any winner crops (%)	186	674	21	18.2	2.8	0.641

Source: APC baseline survey.

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

Table E.7. Livestock holding and husbandry in the baseline 2020–2021 *rabi* season, highly engaged sample

	Treatment sample size	Comp. sample size	Treatment mean	Comp. mean	Difference	p-value
Household owns or keeps livestock (%)	186	674	87.1	85.6	1.5	0.705
Type of livestock owned or kept by household (%)						
Cattle	186	674	69.9	69.9	0.0	1.000
Goats	186	674	42.5	37.1	5.4	0.431
Sheep	186	674	5.4	5.4	-0.1	0.985
Pig	186	674	4.8	5.1	-0.3	0.933
Poultry	186	674	66.1	69	-2.9	0.634
Number of livestock owned or kept by household, among those keeping them (number)[a]						
Cattle[b]	130	469	4.2	4.1	0.1	0.891
Goats[b]	79	277	7.7	5.6	2.1*	0.090
Poultry	123	432	9.2	9.8	-0.6	0.643

Source: APC baseline survey.

[a]Pigs and sheep omitted because of small sample sizes.

[b]Indicator is top-coded at the 99th percentile. All values above the top-coding threshold are replaced with the top-coding threshold.

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

Table E.8. Revenues and income from the baseline 2020–2021 *rabi* season after matching, highly engaged sample

	Treatment sample size	Comp. sample size	Treatment mean	Comp. mean	Difference	p-value
Crops						
Revenue from crop sales (rupees)[a]	186	674	3,141	3,094	47	0.974
Revenue from winner crop sales (rupees)[a]	186	674	1,093	787	305	0.545
Crop production and sales costs (rupees)[a]	186	674	2,539	3,165	-626	0.356
Net income from crop sales and harvest (rupees)[a,b,c]	185	669	2,981	2,614	366	0.751
Total revenue from livestock (rupees)	185	674	2,896	2,823	73	0.922
Livestock husbandry costs (rupees)[d]	185	674	1,212	1,974	-762	0.145
Crops and livestock combined						
Total cash revenue from crops and livestock[a,e]	186	674	5,716	5,522	194	0.900
Net cash income from crops and livestock[a,b,f]	186	674	1,340	510	830	0.415

Source: APC baseline survey.

[a]Indicator is top-coded at the 95th percentile. All values above the top-coding threshold are replaced with the top-coding threshold.

[b]Indicator is bottom-coded at the 5th percentile. All non-zero values below the bottom-coding threshold are replaced with the bottom-coding threshold.

[c]Includes the value of crops harvested but not sold.

[d]Indicator is top-coded at the 99th percentile. All values above the top-coding threshold are replaced with the top-coding threshold.

[e]This indicator is defined as the sum of revenue from crop sales and livestock.

[f] This indicator is defined as the sum of revenue from crop sales and livestock, minus crop production and sales costs and animal husbandry costs. It excludes the value of crops harvested but not sold, as well as the value of self-consumption from livestock.

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.

Table E.9. SSPs' input into decisions around agricultural income at baseline after matching, highly engaged sample

	Treatment sample size	Comp. sample size	Treatment mean	Comp. mean	Difference	p-value
Little to no input in decisions	155	509	6.5	3.2	3.2	0.129
Input into some decisions	155	509	60.6	79.5	-18.9***	0.001
Input into most or all decisions	155	509	32.9	17.3	15.6***	0.003

Source: APC baseline survey.

Note: Respondents who reported that there were no household decisions made related to income (likely because income was limited) are omitted. These respondents comprised 16 percent of the treatment sample and 23 percent of the comparison sample.

*/**/*** Significantly different from zero at the 0.10/0.05/0.01 level, two-tailed test.