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भारत

Strengthening the Spice Value Chain in India and Improving Market Access through Capacity Building and Innovative Interventions

STDF/PG/517 (MTF/IND/198/STF)

END OF PROJECT ASSESSMENT REPORT



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Independent Evaluator

Insight Development Consulting Group (IDCG)

PROJECT INFORMATION

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ABBREVIATIONS

APMC	Agricultural Produce Market Committees
BL	Baseline
EL	Endline
e-NAM	e-National Agriculture Market
EOI	Expression of Interest
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FGD	focus group discussion
FIG	farmer interest groups
FPO	farmer producer organization
FSSAI	Food Safety and Standards Authority of India
GAP	Good Agriculture Practices
GHP	Good Hygiene Practices
GMP	Good Manufacturing Practices
HH	Household
ICS	internal control system
IEC	information, education, and communication
IndGAP	India Good Agriculture Practices
IPM	Integrated Pest Management
KII	key informant interviews
KVKs	Krishi Vigyan Kendras
MIDH	Mission for Integrated Development of Horticulture
MoUs	memorandum of understanding
MRLs	maximum residue limits
NABARD	National Bank for Agriculture and Rural Development
NCRCP	National Contaminant and Residual Control Programme
NGO	Non- Governmental Organization
NSSP	National Sustainable Spice Networking Programme
OBC	Other Backward Caste
OECD DAC	Organization for Economic Cooperation and Development's Development Assistance Committee
PIA	Project Implementing Agency
PIC	Project Implementation Committee
PKVY	Paramparagat Krishi Vikas Yojana
PMKSY	Pradhan Mantri Krishi Sinchayee Yojana
POP	package of practices
QMS	quality management system
SB	Spices Board
SC	Scheduled Caste

SDG	Sustainable Development Goals
SPS	sanitary and phytosanitary
ST	Scheduled Tribes
STDF	Standard and Trade Development Facility
ToTs	Training of Trainers
US	United States
USD	United State Dollar
WTO	World Trade Organization

1. Executive summary

The Strengthening Spice Value Chain in India and Improving Market Access through Capacity Building and Innovative Interventions project, implemented from October 2020 to August 2024, aimed to enhance the safety, quality and marketability of Indian spices – specifically, black pepper, coriander cumin and fennel. The project was developed through a Standards and Trade Development Facility (STDF) project preparation grant ([PPG 517](#)) which was implemented from 2017-2018. The project was a collaboration among the Spices Board of India, the Food and Agriculture Organization of the United Nations (FAO) and STDF. Focusing on the states of Andhra Pradesh, Gujarat, Madhya Pradesh and Rajasthan, the project sought to elevate India’s spice sector by equipping stakeholders along the spice value chain with the skills, knowledge and linkages necessary for complying with international quality and safety standards, and improving global competitiveness. The overall objective of the project was to raise the incomes of smallholder farmers through direct market access, sustainable practices and capacity-building interventions.

Through the establishment and strengthening of farmer producer organizations (FPOs), the project created pathways for smallholder farmers to connect directly with buyers, helping them retain a greater share of profits and build long-term business relationships. Other project beneficiaries included women and tribal farmers, who were empowered through targeted outreach efforts to participate more actively in the spice value chain. The engagement of export agencies, processors and certification bodies further amplified the project’s reach, enabling a collective focus on quality enhancement and compliance with Sanitary and Phytosanitary (SPS) standards.

Assessment methodology

The endline assessment used a participatory and consultative methodology to capture varied perspectives on the project’s performance and outcomes. This involved structured household surveys covering 400 farming households, focus group discussions (FGDs) with community groups, and key informant interviews (KIIs) with stakeholders across the spice value chain, including government representatives, exporters and FPO members. The methodology facilitated an in-depth analysis of the project’s outcomes, revealing insights into its relevance, coherence, efficiency, effectiveness and sustainability, following the Organization for Economic Cooperation and Development’s Development Assistance Committee (OECD-DAC) Evaluation Framework.

Key findings

The endline assessment brought out that the project interventions yielded positive outcomes on all the core evaluation criteria:

Relevance: The project was highly relevant as it directly addressed critical challenges faced by the Indian spice sector, particularly in four spice-producing states – Andhra Pradesh, Gujarat, Madhya Pradesh and Rajasthan. Farmers in these states grappled with SPS compliance gaps, pesticide residue issues and limited access to high-value international markets. These challenges were compounded by frequent rejections of Indian spices in key export markets like the European Union and the United States of America, primarily due to aflatoxins, pesticide residues and Salmonella contamination, as evidenced by 149 European Union alerts and 1 053 rejections from the United States between 2014 and 2017. Such gaps in SPS adherence posed significant risks to consumer health, reduced market access and undermined the economic potential of Indian spices. By aligning with SPS priorities of

local and international stakeholders, the project responded to the urgent need for quality improvement and safety standards in the spice value chain. It leveraged the expertise and resources of various institutions – including the Spices Board of India, Ministry of Agriculture and Farmers Welfare, National Bank for Agriculture and Rural Development (NABARD) and the Ministry of Commerce and Industry – to promote good agricultural practices (GAP), organic certifications and post-harvest management. These efforts positioned the project as a vital intervention to enhance export competitiveness, improve livelihoods and foster sustainable development in the spice-producing regions.

Coherence: The project was in line with ongoing initiatives in India’s agricultural sector, specifically the spice sub-sector, through initiatives leveraging synergies with FAO, World Trade Organization (WTO) and the Spices Board of India. Nationally, it aligned with the Spices Board’s ongoing initiatives, such as Spice Parks and the National Sustainable Spice Networking Programme (NSSP) portal, enhancing infrastructure and promoting food safety and value addition. Internationally, it aligning with international standards like Codex Alimentarius, ensuring compatibility with global trade regulations and market requirements. This dual alignment strengthened the integration of national efforts with international food safety frameworks.

The project demonstrated coherence with national and regional strategies by leveraging key government schemes and policies aimed at agricultural modernization, food safety and farmer welfare. Government programmes like the Mission for Integrated Development of Horticulture (MIDH) supported improved practices and infrastructure for spices, while initiatives like e-National Agriculture Market (e-NAM) facilitated better market linkages. Complementary schemes such as the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) and Paramparagat Krishi Vikas Yojana (PKVY) ensured irrigation support and promoted organic farming, fostering sustainability. For tribal areas like Paderu in Andhra Pradesh, targeted funding by the Ministry of Tribal Affairs enhanced black pepper production and marketing, advancing tribal development objectives.

To ensure synergies, the project collaborated with state-level programmes and established district-level Project Implementation Committees (PIC). Biannual PIC meetings facilitated coordination, addressed challenges related to the production and post-harvest management of spices and integrated project interventions with state schemes, avoiding duplication and maximizing resource use. The National Contaminant and Residue Control Programme (NCRCP), a key project component, aligned with European Union and American safety requirements, enhancing the competitiveness of Indian spices in international markets. This cohesive approach amplified the project’s impact while supporting long-term sustainability goals.

Effectiveness: Comprehensive training programmes in GAP and Good Hygiene Practices (GHP) exceeded initial targets, reaching 1 700 farmers (535 women and 1 165 men) and 200 value chain actors against planned targets of 1 200 farmers and 50 actors. Farmers benefited from diverse training methods, including videos, class room modules, exposure visits, street plays and pamphlets, tailored to their varying cognitive abilities. These methods improved spice quality, reduced contamination risks and supported compliance with global standards.

Key achievements included promoting pre-sowing activities, efficient irrigation methods, and sustainable inter-cultural operations such as Integrated Pest Management (IPM) and organic fertilizer use. Post-harvest management was enhanced through mechanized threshing, safe drying and storage practices like blanching in black pepper, reducing microbial loads. The NCRCP, established under the project, ensured compliance with Codex maximum

residue limits (MRLs), increasing the competitiveness of Indian spices. Two pesticide residue testing labs were established, supporting quality assurance and international market access.

Efficiency: The project demonstrated strong efficiency by aligning funding, expertise and time with its intended outputs. The initial budget of USD 892 030, sourced from STDF (USD 508 830), the Spices Board (USD 283 200 in-kind) and FAO (USD 100 000), was utilized efficiently. Following a mid-term assessment, FAO India provided an additional USD 100 000, raising the total budget to USD 992 030 and ensuring smooth project execution. Approximately 95 percent of the STDF funds and the full contributions from FAO India and the Spices Board were utilized to deliver key activities within the planned timeframe. These included training programmes for over 1 700 farmers and 200 stakeholders, deployment of digital extension tools for GAP and GHP, and buyer-seller meetings to strengthen market linkages. Despite initial budget constraints, critical outputs, such as refresher training for Master Trainers, digital communication materials and awareness campaigns, were completed on schedule. The timely signing of the Letter of Agreement with Digital Green facilitated effective deployment of digital tools, such as the VISTAAR app and animation videos, which expanded outreach in a cost-effective manner.

Cost-effectiveness was achieved by optimizing resource allocation and leveraging in-kind contributions. Localized training sessions minimized logistical costs, while partnerships with the Spices Board and FAO enabled cost-sharing for capacity-building initiatives. Reallocation of funds addressed high-priority activities, including preparation for India Good Agriculture Practices (IndGAP) certification and pesticide residue testing, without compromising other planned interventions. Collaborative efforts ensured that resources were used judiciously to deliver quality outputs. The additional USD 100 000 from FAO India was pivotal to addressing financial gaps and avoiding delays in field-level implementation. This funding supported critical activities such as buyer-seller meetings and compliance testing for Codex MRLs, which were essential to achieving project goals. While efficiencies were gained through in-kind support and streamlined operations, the financial adjustments enabled comprehensive delivery of outputs, including training farmers and facilitating direct procurement agreements.

Impact: The project catalysed substantial improvements in farmer incomes, quality compliance, and market access. The average income from spice crops increased by 58 percent, from INR 78 107 at the baseline to INR 123 478 at the endline. Membership of targeted farmers in FPOs increased from 30 percent to 67 percent, enabling better market access and collective bargaining. Over 80 percent of tested spices met Codex MRL standards, enabling exports to premium markets like the European Union and the United States. FPOs across the intervention states signed 25 formal agreements in the form of memorandums of understanding (MoUs) and expressions of interest (EoIs) with exporters and trading companies. These linkages provided farmers with stable prices and access to larger markets. Enhanced awareness of SPS practices, rising from 14 percent at baseline to 83 percent at endline, was a key achievement. Adoption of GAP and GHP reduced post-harvest losses and improved the quality of produce. Innovations like mechanized threshing and clean storage practices further boosted market readiness. The project's focus on empowering marginalized communities ensured inclusive growth, addressing both economic and social dimensions of development.

Sustainability: The project's exit strategy centred on establishing NCRCPL laboratories (labs) and strengthening FPOs, ensuring that the infrastructure and capacity for sustained quality compliance remain even after the end of the project. The NCRCPL helped in the identification of labs and testing of spices in certified labs to monitor and control the levels of contaminant residues in spices, ensuring that spices meet safety standards by assessing and

managing chemical residues, including pesticides and antibiotics. This initiative was implemented to maintain product quality and ensure compliance with national and international food safety regulations, ultimately protecting consumer health and supporting market access for spice producers. A large pool of master trainers, 150 against a target of 60, was created to provide ongoing training, while sustainable farming practices were widely adopted, ensuring long-term benefits.

Aligned with India's agricultural priorities, the project leveraged key government schemes like PMKSY, PKVY and the Soil Health Card Scheme. Collaboration with the Spices Board and state-level programmes facilitated GAP development, organic certification and post-harvest management. Partnerships with institutions like the Food Safety and Standards Authority of India (FSSAI) and the Export Inspection Council enhanced SPS compliance through robust testing and monitoring systems. Innovative approaches, such as localized training videos and digital platforms, ensured accessible knowledge transfer and empowered farmers to adopt best practices. Stakeholders, including exporters and FPOs, committed to supporting sustainable practices and ongoing training, solidifying the project's impact. However, continued investment in testing facilities and resilience-building measures remains critical to address future challenges.

Lessons learned

The project highlighted the importance of gender inclusion, digital tools and decentralized infrastructure. Gender-sensitive training methods, such as women-led street plays, increased participation and engagement. Digital resources, including localized videos and WhatsApp advisories, proved effective in scaling outreach. The need for accessible post-harvest facilities emerged as a critical area for improvement. Expanding organic farming required financial incentives to offset transition costs. The success of buyer-seller meetings underscored the value of structured market linkages. Institutionalizing practices like NCRC sampling and compliance monitoring can serve as a model for future projects. Leveraging these insights can enhance the scalability and impact of similar initiatives, fostering inclusive, sustainable agricultural ecosystems.

Recommendations

Collaborate with women trainers for gender-sensitive programmes: Establishing a cadre of women trainers can drive higher women engagement and ensure that training programmes are relevant and accessible to all farmers, fostering gender inclusivity in the spice sector. To further enhance women's participation in the future, stakeholders could organize women-only sessions, collaborate with self-help groups (SHGs) and cooperatives, develop family-centric training modules, offer flexible schedules and childcare support, provide digital training resources tailored for women, and establish incentives and recognition for women engagement.

Increase access to post-harvest inputs: Ensuring that essential post-harvest tools like tarpaulins, drying equipment, and processing and packaging resources are readily available will support farmers in meeting quality standards and achieving higher market prices.

Expand access to bio-inputs and digital pest management: Providing farmers with access to a wider set of bio-inputs and climate-resilient spice varieties, combined with additional digital farm advisory tools for pest management, will enable them to manage crops sustainably amidst changing weather patterns.

Establish advanced testing labs at APMC markets: Building decentralized testing labs at Agricultural Produce Market Committees (APMCs) will make quality testing more accessible, ensuring higher compliance with safety standards and enhancing market competitiveness.

The evaluation showcases the project's remarkable success in piloting India's spice value chain's transformation through innovative approaches and comprehensive capacity-building efforts. Additionally, the strengthening of FPOs proved invaluable in delivering long-term advantages by enhancing market access, improving financial stability and empowering farmers to negotiate better prices as well as farm inputs and services.

2. Introduction

2.1 Project description

The Strengthening Spice Value Chain in India and Improving Market Access through Capacity Building and Innovative Interventions project was initiated in 2020 by the Spices Board and the FAO, with support from the STDF which is based at the WTO.

The overarching goal of the project was to expand exports of safe and high-quality spices – namely black pepper, coriander, cumin and fennel – from India to international markets. This is against the backdrop of Indian spice exports facing rejection in markets like Australia, the European Union and the United States due to non-compliance with SPS measures. In doing so, the project aimed to contribute to improved food safety and consumer health, both in Indian and overseas markets. Its focus was on building the capacity of those involved in the spices value chain through various activities designed to improve agricultural practices, strengthen the connections between farmers and exporters, and introduce traceability and certification systems. Additionally, the project sought to boost incomes for small-scale farmers, empower women farmers and producers belonging to marginalized (tribal) communities, and support efforts to reduce poverty (Sustainable Development Goal 1 or SDG 1) and hunger (SDG 2) in select spice-producing pockets of India.

The project's objective was to build the capacity of stakeholders within the spice value chain, enabling them to enhance the safety and quality of these spices. This, in turn, was expected to increase their market access through better compliance with global food safety standards. The project was implemented for the duration of almost four years – October 2020 to August 2024 – and had four main components:

 <p>1. Improved capacity of public, private, and academic sectors to deliver training on risk-based assessments and Good Practices in spice value chains</p>	 <p>2. Enhanced capacity of farmers and other value chain actors to adopt GAP / GHP to improve yields, quality, and safety of spices</p>
 <p>3. Marketing and links to buyers (exporters/importers) strengthened</p>	 <p>4. Establishment and implementation of a National Contaminant and Residue Control Programme (NCRCP) for identified spices</p>

The project, which spanned four states –Andhra Pradesh, Gujarat, Madhya Pradesh and Rajasthan – had a total budget of USD 992 030. Key activities included:

- **Implementing Good Practices:** The project promoted the adoption of GAP and GHP throughout the value chain, from cultivation to processing and packaging.
- **Building capacity:** Extensive training and awareness programmes were conducted for farmers, processors, traders and exporters, equipping them with the skills needed to maintain high-quality standards.
- **Strengthening market linkages:** Direct connections between farmers and exporters were established, reducing the need for intermediaries and ensuring that farmers received fair compensation.
- **Introducing certification systems:** Certification mechanisms were introduced to ensure that the spices met international quality and safety standards, which in turn helped improve market penetration and access to newer markets.

The project utilized innovative training techniques such as simplified video dissemination and street plays (*nukkad natak*) to effectively engage farmers and stakeholders. This ensured that knowledge related to GAP and GHP was easily comprehensible and adopted at the grassroots level. Since the four project states are home to a large tribal population, the project, by targeting women and tribal communities, emphasized inclusive growth, aiming to create sustainable improvements in the livelihoods of producers belonging to marginalized groups through increased market access and enhanced agricultural practices.

As a result, the project led to safer, higher-quality spices, increased competitiveness in global markets and boosted the incomes of smallholder farmers.

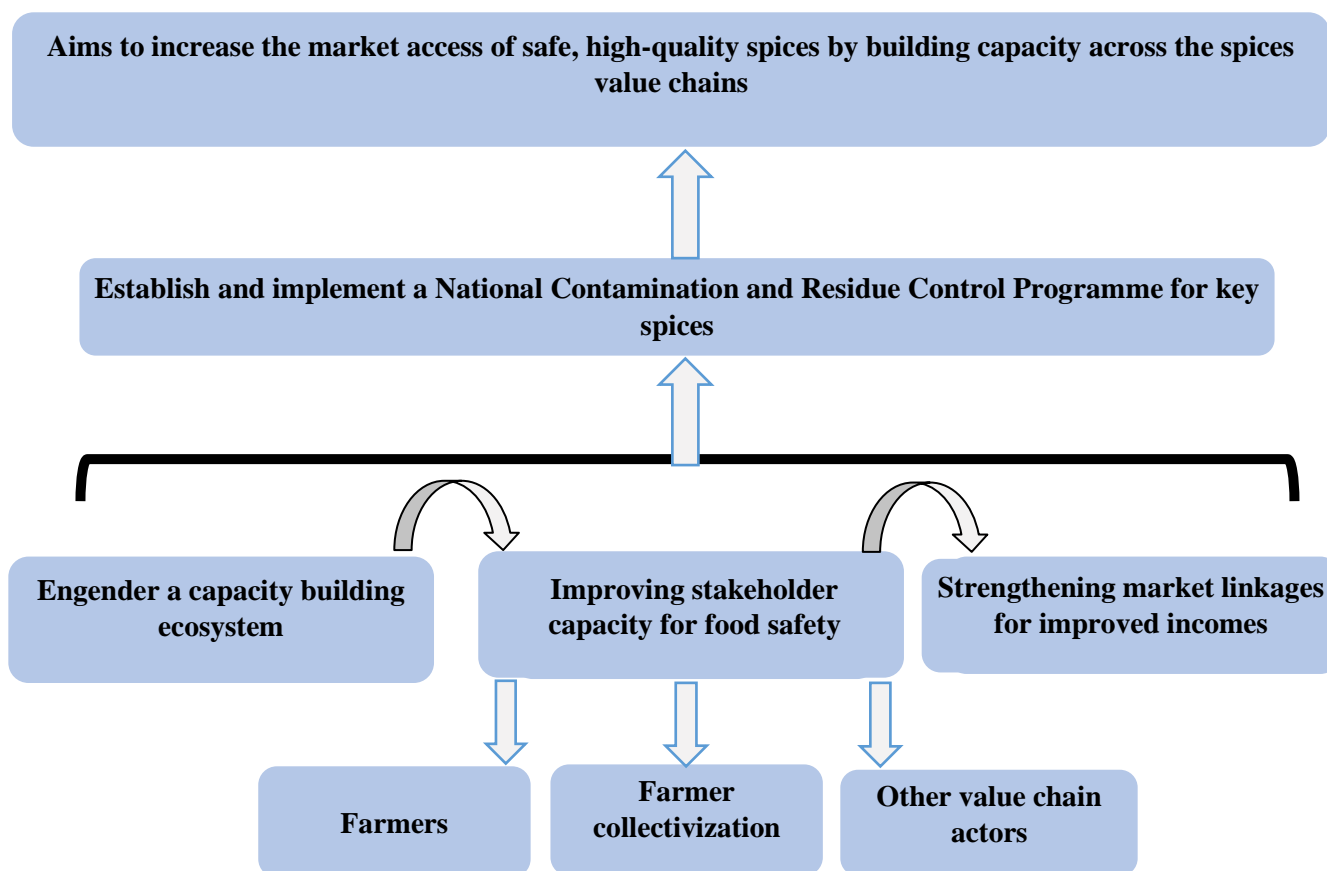
2.2 Theory of Change

The Theory of Change (Figure 1) for this project was designed to enhance market access for safe, high-quality spices by building capacity across the spice value chain. At its core is the establishment of a National Contamination and Residue Control Programme, which aims to ensure food safety standards for key spices. Supporting this programme are three strategic pillars:

- creating a capacity-building ecosystem that empowers farmers to adopt GAP and GHP;
- strengthening stakeholder capacity to uphold food safety standards among farmer collectives, processors and other essential actors in the value chain; and
- improving market linkages to secure better income opportunities by connecting farmers and other stakeholders with quality-sensitive markets.

Together, these elements create a sustainable framework that not only tackles contamination and residue management but also boosts farmers' livelihoods by increasing their access to high-value markets and enhancing their income potential.

Figure 1: Theory of Change for the project



2.3 Policy context and institutional environment

The project was carried out through a multi-level collaboration among Union Government ministries, State Government departments, other government agencies (Spices Board), FAO, and other partners, including donors and the private sector. The project's implementation was guided by key national and international policies that emphasized sustainable agricultural practices, food safety and better market access.

FAO and the Spices Board took the lead in designing and executing the project. Meanwhile, multiple not-for-profit organizations and research organizations such as Digital Green Trust, S.D. Agricultural University, South-Asia Biotechnology Centre and Krishi Vigyan Kendras (KVKs) in the project states played an essential role in building capacity and delivering training programmes. Collaboration with the private sector helped strengthen traceability systems, forge direct farmer-to-exporter connections and introduce certification mechanisms to ensure that the spices met the required safety standards.

2.4 Implementing partners and beneficiaries

2.4.1 Stakeholder consultation and selection criteria

The stakeholders consulted were critical to the spices value chain and were selected on the basis of their involvement in the project's activities. Selection criteria were based on the stakeholders' relevance to the project's outcomes, their geographical location and their role in the spice value chain and project management. These stakeholders were:

- **Farmers and FPOs:** Key beneficiaries who were involved in adopting good practices and improving spice quality, and marginalized men and women belonging to tribal groups in the Paderu region.
- **Exporters and traders:** Actors involved in the supply chain, helping in the dissemination of knowledge on safety and quality standards.
- **Other stakeholders:** Agro-dealers, producers, operators of market yards/auction centres and storage godowns, processors, transporters and traders, research institutions, Spices Board staff, extension workers of state governments and other organizations.

Annexure IV has a detailed list of stakeholders.

2.4.2 Implementing partners and governance

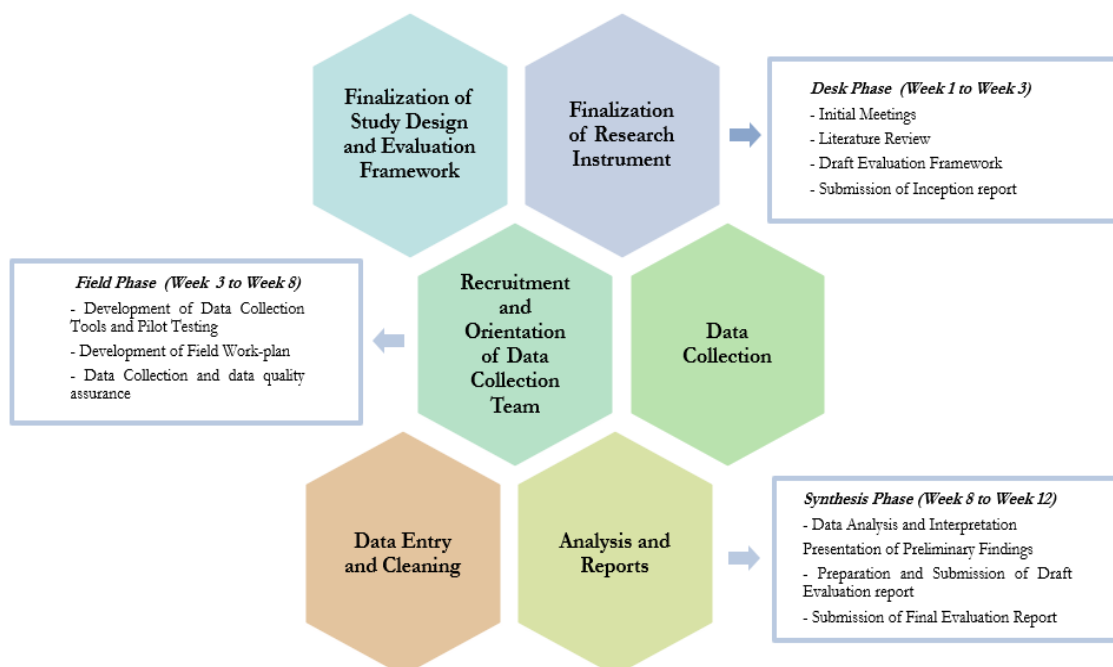
- **FAO India :** Budget holder, responsible for implementation and overall supervision of project with technical backstopping from FAO Regional Office for Asia and the Pacific..
- **Local partner:** Spices Board: Ensuring implementation of all local activities and their coordination.
- **Steering Committee:** Chaired by the Spices Board with participation from relevant Union and State ministries/departments, and stakeholders as members. The committee meets every six months to review the overall progress of the project.
- **Project Implementation Committee:** Established for each project State, chaired by the Spices Board and comprising representatives from traders, exporters, farmers and government institutions/departments. The committee meets biannually to review the progress of activities in accordance with the work plan and timeline.

3. Methodology

3.1 Methods and techniques of data collection and analysis

The evaluation adopted a consultative and participatory approach, utilizing various data collection methods (Figure 2) to gather comprehensive insights.

Figure 2: Phase-wise implementation plan for the evaluation



3.1.1. Inception phase

While preparing this report, all relevant documents related to the assignment/context/subject were reviewed to obtain insights into the objective of the project, various interventions undertaken and stakeholders involved. The documents reviewed were **project documents, monitoring and evaluation framework, project indicators, baseline report, baseline tools, state/district wise intervention list, district-wise specific interventions**. Based on the desk review, the evaluation team developed an impact evaluation framework (details in Annexure I).

3.1.2. Execution/data collection phase

After receiving approval from FAO on the draft data collection tools submitted by Insight Development Consulting Group (IDCG), these tools were tested on a pilot basis at **Guna, Madhya Pradesh**, in discussion with the project team. A three-day training session on household survey tools and Computer Assisted Personal Interviews (CAPI) operations was organized for the enumerators and supervisors. A range of quality assurance actions like spot checks and back checks were conducted.

3.1.3. Reporting phase

The data collected in the field phase was analysed and preliminary findings were determined and triangulated with data collected from other sources and tools. After the preliminary findings, IDCG prepared a draft presentation which highlighted the methodological limitations, identified key concerns and presented evidence-based findings, consequent conclusions, recommendations and lessons. The presentation was made to the programme staff from FAO and STDF on the 27 September 2024. The final report presents a comprehensive overview of all findings, including detailed information on the locations surveyed and the individuals involved. The endline results were assessed using the OECD DAC Framework, evaluating the project on key parameters: efficiency, effectiveness, sustainability, impact, relevance and coherence.

Sampling strategy

The sampling strategy (Table 1) used for the evaluation was designed to ensure a broad and representative assessment of stakeholders using **random proportionate sampling** across the four target states (details of the sampling strategy are presented in Annexure III). Key elements of this approach included:

- **Semi-structured (quantitative) household surveys:** A total of 400 household surveys – 100 in each State – were conducted, focusing on farmers directly involved in the spice value chain who had participated in training or other project activities. One person from each household participated in the survey, **with 26 percent women beneficiaries being covered**. The farmers were also involved in the baseline.
- **Focus group discussions (FGDs):** In each state, four FGDs were held with community-level groups such as FPOs, each FGD covering **8-10 farmers, with 25–30 percent women participants**. These discussions allowed community members to share their experiences and the project's impact on their work.
- **Key informant interviews (KIIs):** Between four and six KIIs were conducted in each State, engaging diverse stakeholders like government officials, representatives from the Spices Board, and other important actors in the spice value chain like traders and exporters, and FPO coordinators.
- **Case studies:** Two detailed case studies were developed in each State to provide deeper insights into specific interventions and highlight notable success stories or challenges.

Table 1: Sampling strategy

State	District	Block	Villages	HH survey	FGDs	KIIs	Case Studies
Andhra Pradesh	Alluri Sitaram Raju (ASR)	Paderu and Araku Valley	2	100	2	4-6	1-2
Gujarat	Banaskantha	Vav Tehsil	2	50	2	4-6	1-2
	Mehsana	Visnagar and Vadnagar	2	50	2		
Rajasthan	Jodhpur	Phalodi	2	50	2	4-6	1-2
	Pali	Jaitaran	2	50	2		
Madhya Pradesh	Guna	Guna and Kumbaraj	2	100	2	4-6	1-2
Total			12	400	12	16-24	4-8

This approach ensured that a wide range of voices and experiences were included, providing a well-rounded understanding of the project's impact across different regions and groups.

3.2 Sources of information

The sources of information for the evaluation included:

- **Project documents:** Reports from FAO, baseline surveys, project progress reports and other relevant documents were reviewed to understand the project's design and intended results.
- **Respondents:** Primary data was gathered from a wide range of stakeholders, including farmers, exporters, project staff and government officials. The total number of stakeholders consulted totalled **472, including 425 farmers.** (Annexure IV)
- **Literature and administrative data:** Review of published studies on spice value chains, market access, current state and national level interventions in the area of spice productivity, quality and safety and sustainability practices also helped inform the evaluation process and understand the national and sub-national landscape. Additional data and information provided by supply-side stakeholders during these consultations were also reviewed.

(Details are available in Annexure I)

3.3 Evaluator's independence

IDCG was engaged as an independent evaluator for the project, through a bidding process and had no prior involvement in the design, implementation or management of any project component. This ensured that IDCG approached the evaluation with full objectivity, free from any pre-existing associations or influences and allowed it to conduct a thorough and unbiased evaluation of the project's outcomes, ensuring that findings and recommendations were rooted in evidence. The independent status guaranteed the credibility and transparency of the evaluation process, providing stakeholders with an accurate reflection of the project's impact and areas for improvement.

3.4 Limitations and challenges of the assessment

- Since the baseline data was collected remotely during the COVID-19 pandemic via telephone surveys, it could not be directly verified. This limitation affected the accuracy and comparability of baseline and endline data in the assessment of some indicators.
- Black pepper presented unique challenges in assessment due to its distinct cropping practices, which differ from those of other spices in the project. These specialized practices meant that some standard evaluation parameters were not fully applicable, requiring adjustments to accurately capture the progress of black pepper within the project's framework. Together, these factors presented limitations in assessing certain outcomes with precision.

4. Key findings

The project to strengthen the spice value chain for black pepper, coriander, cumin and fennel adopted a bottom-up approach, focusing on empowering farmers and fostering collaboration across the value chain. It aimed to enhance the safety, quality and market access of these spices through four interconnected components. The foundation lay in farmer collectivization, where smallholder farmers were organized into FPOs. This enabled resource pooling for shared infrastructure like drying yards and grading facilities, group certifications and collective marketing. These efforts empowered farmers with better bargaining power, access to quality inputs and improved economies of scale, setting the stage for sustainable development.

Building on this foundation, the project focused on strengthening market linkages. Direct connections between farmers and buyers were facilitated, reducing reliance on intermediaries and ensuring fairer price realization. Platforms like the Spice Parks and the National Sustainable Spice Networking Programme (NSSP) portal were leveraged to link producers with markets, while certification such as IndGAP allowed access to premium markets. Improved branding and traceability further aligned the spices with global market demands, enhancing their appeal.

The third component – improving stakeholder capacity for food safety – emphasized training farmers, processors and other value chain actors. These trainings imparted knowledge of GAP and GHP, equipping stakeholders to minimize risks like aflatoxins, Salmonella and pesticide residues. Enhanced awareness and skill development ensured safer production and post-harvest practices, strengthening compliance with international SPS standards. At the top of the framework, the project established and implemented a NCRCPP. This critical intervention addressed contamination risks throughout the value chain, ensuring the spices met the stringent safety requirements of global markets like the European Union and the United States. The programme formed the backbone for quality assurance and supported broader efforts to build consumer trust in Indian spices.

Underpinning all these components was the creation of a capacity-building ecosystem that connected farmers, processors, traders and market stakeholders. By fostering collaboration and knowledge sharing, the project ensured the adoption of improved practices and technologies across the value chain. This ecosystem was designed to sustain the project's outcomes, empowering stakeholders to continue producing high-quality and safe spices. This approach strengthened the spice value chain from the ground up, increasing potential competitiveness in global markets and enhancing incomes for marginalized farming communities.

Key demographics

The project demonstrated inclusivity across lines of gender, caste and landholding patterns among the farming community predominantly engaged in spice cultivation for livelihood. There was a gendered aspect observed in workforce participation, with men dominating decision making in the spice farming activities, while women were more involved in supporting tasks. The different demographical insights drawn from the study are:

- Twenty-six percent of the participants were women, and they had limited leadership role and lower workforce visibility than the men.
- The caste composition was 38 percent Other Backward Class (OBC), 34 percent General, 25 percent Scheduled Tribes (ST) and 3 percent Scheduled Castes (SC).
- Farming was the primary occupation for 99 percent of respondents, with spice cultivation covering 33 percent to 56 percent of agricultural land.

- Average landholding across all districts was 10.8 acres, with 42 percent (4.5 acres) dedicated to spices cultivation.
- Diversity in average landholding was observed across districts. While smallholders were predominant in Alluri Sitaram Raju district in Andhra Pradesh (3.5 acres) and Mehsana in Gujarat (4.1 acres), Jodhpur in Rajasthan showed higher average landholding (29.6 acres).

Detailed findings on demographics are presented in Annexure VI.

Project output summary

The project focused on improving the safety, quality and marketability of four key spices – black pepper, coriander, cumin and fennel – through capacity building, farmer empowerment, market linkage enhancement and implementation of quality control systems. It aimed to train stakeholders on GAP and GHP, strengthen FPOs and establish a NCRCP. By addressing critical gaps in production, marketing and compliance with international standards, the project sought to boost farmers' incomes, increase exports and improve food safety. Most targets (Table 2) were met or exceeded, demonstrating strong execution across all key outputs.

Table 2: Project output and achievement

Output	Indicator	Target	Achievement
Capacity building	Trainers trained, four Package of Practices (POPs)/ Information, Education, Communication (IEC) materials	60 trainers, 4 POPs, 16 IECs	150 trainers, 4 POPs, 16 IECs developed
Farmer capacity	Farmers trained, FPOs formed, exposure visits	Training of 1 200 farmers and 50 value chain actors, 8 FPOs strengthened	1 700 farmers and 200 value chain actors trained, 8 FPOs strengthened across four project states.
Marketing linkages	IndGAP certification, FPOs enlisted, branding activities	Four FPOs certified on IndGAP Four FPOs to enlist on web portals for spices trading	Four FPOs received training and applied for certification Eight FPOs enlisted on NSSP portal Eight buyer-seller meets organized
NCRCP implementation	Labs approved, NCRCP implemented	Labs identification for four spice crops over one cropping season	Two labs dedicated for NCRCP testing, NCRCP developed and implemented for four spices over one cropping season

4.1 Relevance

The project was designed to align with the SPS priorities of both local and international stakeholders, including farmers, government agencies and global buyers. The project was relevant to the specific needs of the targeted four spice-producing states where farmers faced challenges with SPS compliance, pesticide residues and limited market access. These issues were particularly pressing given the high rejection rates of Indian spices in international markets, especially the European Union and the United States, primarily due to aflatoxins, pesticide residues and Salmonella contamination. Between 2014 and 2017, European Union alerts totalled 149 cases, with aflatoxin being the top concern. In the United States, the rejection count reached 1 053, with Salmonella accounting for 688 cases. These issues highlight critical gaps in adherence to SPS standards, significantly affecting consumer health, market access and the economic potential of Indian spices.

Various organizations synergized their efforts to enhance Indian spice quality. The Spices Board drove export promotion, quality control, organic certification and innovation through initiatives like Spice Parks and e-Spice Bazaar, while the Ministry of Agriculture and Farmers Welfare implemented the Mission for Integrated Development of Horticulture (MIDH) to support planting material, area expansion and post-harvest management with subsidies for farmers. The National Bank for Agriculture and Rural Development (NABARD) provided financial support to FPOs for value addition. The Ministry of Commerce and Industry facilitated export promotion, GAP and organic certifications while ensuring quality standards through the Export Inspection Council (EIC). These efforts collectively strengthened the spice value chain from the production stage to exports. The project's targeted approach, designed to meet SPS compliance and market access challenges, also considered the underlying social dynamics that shape agricultural participation.

4.2 Coherence

This project's design prioritized national and international coherence by aligning with both the Spices Board's existing initiatives and other international standards. The project complemented ongoing interventions by FAO and other agencies aimed at improving food safety and hygiene practices in India's agricultural sector. It also strengthened linkages between national and international standards for food safety.

The project demonstrated coherence with national and regional development strategies by aligning with key government initiatives and policies aimed at farmer welfare, agricultural modernization and food safety. These included schemes like the MIDH, which promoted improved agricultural practices, infrastructure, and value addition for spices, and the e-NAM, which supported digital market linkages for better price realization. Additionally, efforts under PMKSY and PKVY facilitated irrigation and organic farming practices, ensuring sustainable resource use. For tribal settlements like Paderu (Andhra Pradesh), the Ministry of Tribal Affairs allocated funds to enhance black pepper production and marketing, furthering tribal development goals. These government efforts created a supportive ecosystem, which the project leveraged to address hygiene, food safety and market access gaps in the spice value chain.

The project reflected strong national coherence by complementing ongoing government initiatives and leveraging existing infrastructure, such as the Spices Board's Spice Parks and NSSP portal. Externally, it aligned with international standards like Codex Alimentarius, ensuring compatibility with global trade regulations. This dual

alignment enhanced the project’s capacity to integrate into larger frameworks, amplify impact and support long-term development goals.

Externally, the project collaborated with State-level initiatives, thereby harmonizing efforts to promote GAP across the spice value chain. The Project Implementation Committees (PIC) at the district level helped develop synergies between programmes of the state-level Horticulture Departments and Spices Board schemes in the states. Regular PIC meetings were organized every six months to address the challenges and plan for strengthening the project interventions through existing state-level schemes in the project areas. This synergy avoided duplication and added value by leveraging existing resources and networks. Notably, the project’s NCRCP aligned with the requirements set by the European Union and United States markets, thus increasing the competitiveness of Indian spices while ensuring compliance with stringent international safety norms.

4.3 Effectiveness

All the farmers participating in the project received comprehensive training in GAP and GHP in order to improve farming and post-harvest techniques. The key concepts were delivered through innovative methods. One of the successes was the capacity-building component that surpassed the initially planned targets. Farmers gained an understanding of GAP and GHP, to enhance spice quality and meet the international food safety standards. Information, Education, and Communication (IEC) materials were widely distributed, ensuring accessibility to skill development for marginalized farmers.

About 408 (96 percent) farmers found videos the most practical and helpful guide for strengthening their conceptual understanding. Written resources like training modules were found beneficial by 323 (76 percent) farmers, while exposure visits to model farms solidified learning for 298 (70 percent) farmers. Additionally, 289 (68 percent) farmers found street plays engaging. These diverse training methods ensured effective knowledge transfer to farmers with diverse cognitive skills, while creating an accessible and impactful learning process.

Since capacity building of farmers played a pivotal role in the success of the project, the survey gathered insights on training of farmers for various practices. Among the surveyed farmers, 408 (96 percent) received training on GAP, which was crucial in promoting sustainable spice cultivation. Other training programmes, such as GHP and SPS, reached 347 (82 percent) and 212 (50 percent) farmers respectively (Table 3). However, specialized training on certification and export preparation appeared to reach only a smaller fraction, as some farmers struggled with recall and tended to underreport or misreport the support they received, often in the hope of securing additional assistance for their activities.

Table 3: Distribution of surveyed farmers who received training on various practices

Types of training received	Number of farmers (n=425)	% of surveyed farmers who received training
GAP: training to grow spices sustainably	408	96
GHP: training on keeping the spices clean and safe	347	82
SPS: training on how to prevent chemical residues in spices	212	50
Training on getting quality certification for spices	82	19
Training on preparing spices for export	55	13

The project made remarkable strides in advancing its objectives, significantly surpassing its original training targets for farmers and FPO members in GAP and GHP. The training modules developed for GAP and GHP practices were based on the risk-based assessment undertaken during the project. By the end of the reporting period, the project had trained approximately 1 700 farmers (535 women and 1 165 men) and 200 other value chain stakeholders like FPO coordinators, government officials, exporters and traders across Andhra Pradesh, Gujarat, Madhya Pradesh and Rajasthan, exceeding the initial goals of 1 200 farmers and 50 stakeholders respectively (Table 4). This progress was achieved through a variety of engaging training formats, such as refresher courses, group activities and exposure visits, alongside the use of digital tools like animation videos with voiceovers. Apart from these, the project also developed 60 concise (3–4 minute) videos on GAP and GHP for the four spices, tailored to local contexts and languages (Gujarati (Gujarat), Hindi (Madhya Pradesh and Rajasthan) and Telugu (Andhra Pradesh) to ensure effective stakeholder engagement. These methods proved highly effective in simplifying complex concepts for farmers with diverse educational backgrounds

Based on ongoing feedback from farmers and FPOs, the project continuously adjusted its approach to better serve local needs. For instance, after introducing animated videos on GAP and GHP, the project team revised these materials in order for them to be more accessible and relatable, directly responding to farmers’ comments. This collaborative refinement made it easier for farmers to understand and apply these practices. Feedback from training sessions also highlighted the importance of including more gender-sensitive content and expanding support for post-harvest processes. In response, the project team added resources specifically designed to address these needs. Regular meetings, including PIC sessions, served as valuable spaces for farmers and stakeholders to share insights, ensuring that the project’s outreach, training and support systems evolved with the challenges and goals of the communities involved.

Table 4: Planned vs. achieved targets for activities (reported in numbers) under Output 2

Activities	Planned	Achieved
FPOs registered/strengthened	8	8
Farmers and value chain actors trained on GAP/GHP	Farmers: 1 200 Value chain actors: 50	Farmers: 1 700 (women: 535 and men: 1165) Value chain actors: 200
Farmers’ groups exposed to practices in other states/area	8	212 farmers including 45 women (21 %)*
Farmers provided with seedling and healthy plants	-	200 black pepper farmers
<i>* Instead of the initially planned eight farmer groups, the study found that 212 farmers including women were exposed to practices in other states/area.</i>		

The project’s output targeted capacity building of farmers and other value chain actors to adopt GAP and GHP. Specific targets included conducting a baseline survey to support monitoring and evaluation, selecting 12 villages, training 1 200 farmers and establishing eight FPOs. The project also aimed to provide one nursery for black pepper seedlings and facilitate eight study visits for farmers.

Table 5: Planned vs. achieved targets for activities (reported in numbers) under Output 1

Activities	Planned	Achieved
Trainers trained on good practices along the identified spice value chains	60	150
POPs on GAP reviewed and strengthened	4	4
POPs on GHP for post-harvest stages developed	4	4
Standardized training modules developed	4	4
IEC material developed and disseminated	16	16

The project’s ambitious yet focused goals entailed developing five key packages – four on GAP for black pepper, coriander, cumin and fennel , and one GHP package each for market yards, auction centres, storage facilities and processing units (Table 5). Besides these, the project aimed to create standardized training modules as reference materials, with flexibility for adaptation based on local needs. This ensured consistency across future training programmes and formulation of valuable resources for trainers in the Training of Trainer (ToT) sessions.

Achievements:

- **Surpassing planned targets for capacity building of trainers through ToT**

The project surpassed its targets by training a total of 150 trainers through its ToT programmes, with significant participation from the public and private sectors as well as academia. The trainers are now better equipped to transfer the knowledge and help farmers and other actors across the spice value chain adopt sustainable and safe practices.

- **Improvement of the POP for each spice**

A comprehensive review and improvement of the POP was conducted for each spice, ensuring that the materials are current and aligned with the best practices in the field.

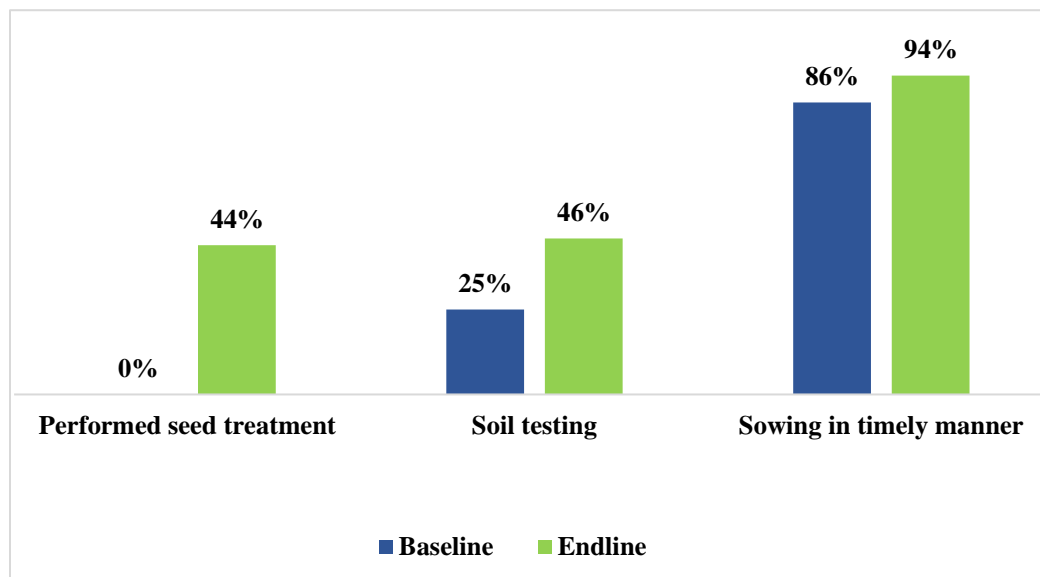
- **Enhancing awareness and adoption through IEC materials**

The project played a key role in developing and disseminating IEC materials. These have been widely distributed to enhance awareness and facilitate the adoption of GAP and GHP throughout the spice-growing and handling community, ensuring a positive impact on the sector’s long-term sustainability.

- **Pre-sowing activities**

Three essential GAP that the project promoted for cultivation of healthy crops in an environmentally sustainable manner are: seed treatment, soil testing and timely seed sowing. The study determined the change in the percentage of farmers adopting these practices prior to and following the training/intervention. As shown in Figure 3, an increase in the percentage of farmers adopting the individual practices was noted across all three practices, showcasing the impact of project interventions (Spices-wise details are given in Annexure VI).

Figure 3: Percentage change in farmers adopting pre-sowing activities (pre and post intervention/training)



- Efficient irrigation practices**

The project promoted improved irrigation techniques to optimize water usage and support healthier crop growth. The study evaluated the change in the percentage of farmers adopting these practices before and after the intervention and found a significant increase (Figure 4). Similarly, there was a noticeable increase in respondents adopting water-efficient techniques like drip irrigation and border irrigation (Figure 5). (Spices-wise details are given in Annexure VI).

Figure 4: Percentage change in farmers adopting improved irrigation techniques (pre and post intervention)

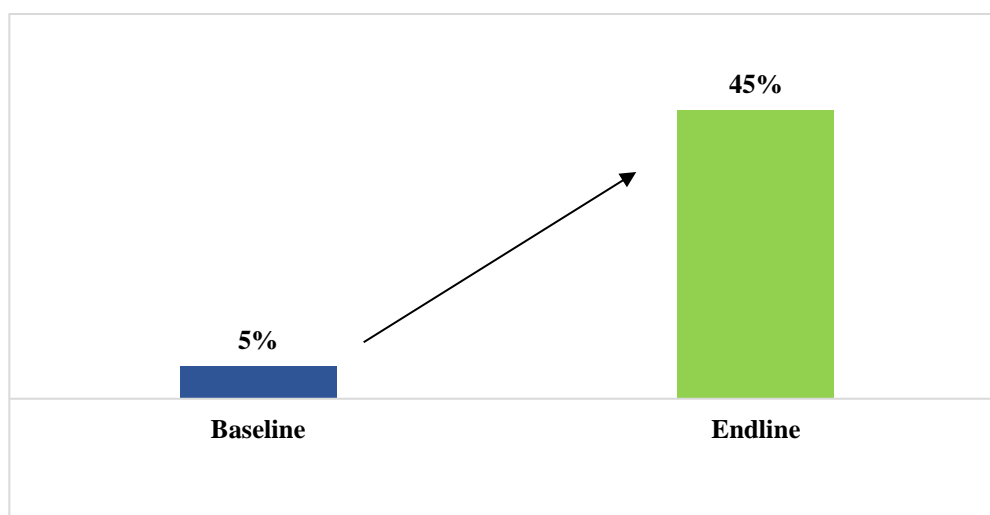
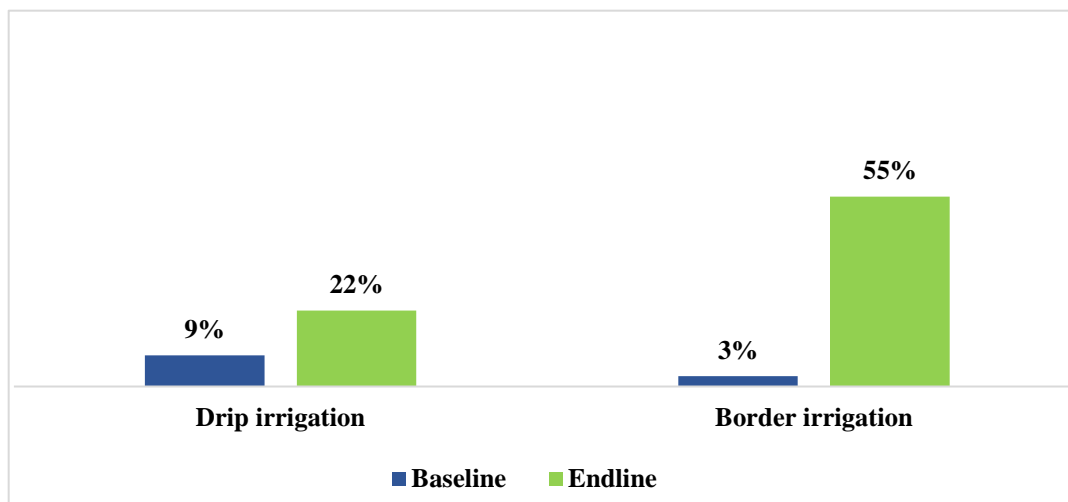


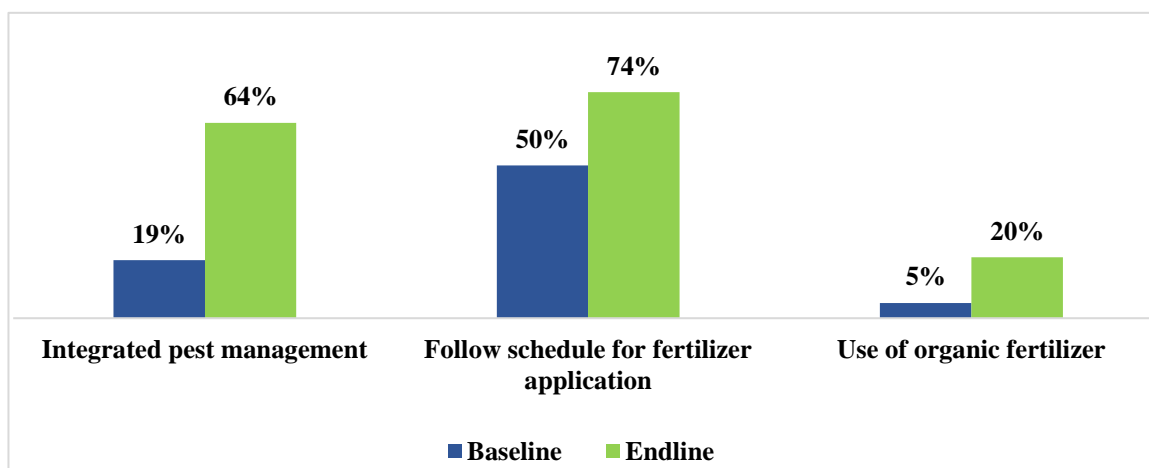
Figure 5: Percentage change in farmers adopting efficient irrigation methods (pre and post intervention)



- **Effective inter-cultural operations**

Intercultural operations focus on nurturing crops post-sowing. For this purpose, the surveyed farmers implemented integrated pest management (IPM) to manage pests in a sustainable way, adhered to a scheduled application of fertilizers to ensure balanced crop nutrition, and used organic fertilizers to promote healthy soil while reducing reliance on chemical inputs. The adoption rates for these practices at baseline and endline are illustrated in Figure 6 and indicate an increase in the adoption of IPM and scheduled application of fertilizers among respondents. A perceptible shift towards organic fertilizers was also noticed during the endline. (Spices-wise details are given in Annexure VI).

Figure 6: Percentage change in farmers following inter-cultural operations (pre and post intervention)



- **Training on GHPs**

The project not only strengthened farmers' connections with FPOs but also empowered them with critical resources and training to improve the quality and marketability of their produce. Farmers benefited from mechanized threshing, which improved seed cleanliness and reduced contamination, as well as the provision of breathable gunny bags for safe storage. Innovations such as blanching were introduced in black pepper to reduce microbial load, and

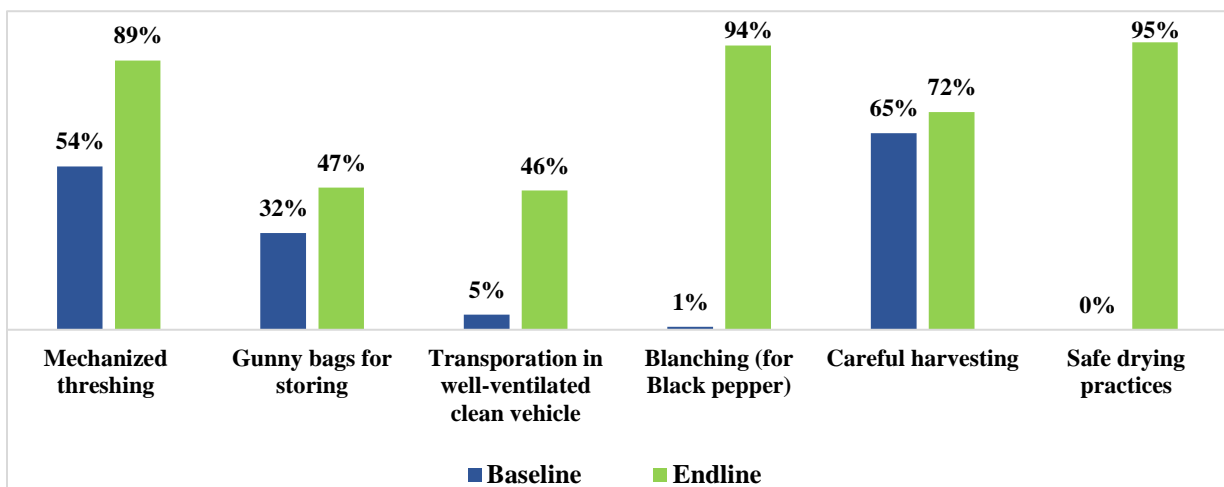
practices like careful harvesting, safe drying techniques and transportation in well-ventilated vehicles ensured product integrity. These initiatives complemented the market access efforts by equipping farmers to consistently meet buyer quality standards, further solidifying their position in both domestic and export markets.

Eighty-two percent (247 men and 100 women beneficiaries) of farmers received training on GHP, which is essential for maintaining the quality and safety of spices throughout post-harvest processes. Spices-wise details are given in Annexure VI. The GHPs they were trained in were:

- **Mechanized threshing:** Improves efficiency in seed separation by minimizing contamination and improving cleanliness.
- **Gunny bags for storing:** Traditional, breathable storage that prevents spoilage and protects against pest infestation.
- **Blanching in black pepper:** A quick boiling pre-processing method that reduces microbial load while ensuring food safety.
- **Careful harvesting:** Gentle crop handling, avoiding contamination and damage during the harvest.
- **Safe drying practices:** Controlled moisture reduction to prevent mould growth and ensure product quality.
- **Transportation in well-ventilated vehicles:** This ensures proper air circulation, maintaining freshness and preventing contamination.

Figure 7 shows the uptake of GHP.

Figure 7: Percentage change in farmers practising safe post-harvest management (pre and post intervention)



Beyond classroom sessions, the project introduced innovative training methods such as video dissemination and street plays (*nukkad nataks*) to make learning more accessible and relatable for farmers. These approaches used storytelling and visual aids to simplify complex concepts like GAP and GHP, thus ensuring greater engagement, practical understanding and widespread adoption of improved practices.

- **Establishment of NCRCP**

Output 4 achieved the successful launch of the NCRCP for the four selected spices. Two labs, M/s Eureka Analytical Lab in Mehsana, Gujarat, and M/s NCML in Visakhapatnam, Andhra Pradesh, were identified and equipped for pesticide residue testing, ensuring compliance with Codex MRLs. The project implemented the NCRCP across all four States, focusing on testing pesticide residues in spices to ensure compliance with international safety standards.

4.4 Efficiency

The project demonstrated efficient use of resources by aligning funding, expertise and time with its intended outputs. Initially, the total budget was USD 892 030, with contributions from STDF (USD 508 830), the Spices Board (USD 283 200 as in-kind), and FAO (USD 100 000). Following a mid-term assessment that highlighted resource constraints, FAO India contributed an additional USD 100 000, raising the total budget to USD 992 030.

The project effectively utilized approximately 95 percent of the STDF funds and the full contributions from FAO India and the Spices Board. These resources supported the timely execution of training programmes for over 1 700 farmers and 200 stakeholders, digital extension tools for GAP and GHP and buyer-seller meets that strengthened market linkages. The efficient deployment of human and logistical resources, coupled with in-kind contributions, ensured that activities were completed within budget and to the required standard. Most project outputs were delivered within the planned timeframe despite initial budgetary challenges. Key activities, such as training programmes for GAP and GHP, awareness campaigns, IndGAP certification preparation and buyer-seller meetings, were executed as scheduled. For instance, the refresher training for Master Trainers and farmers, involving more than 1 700 participants, was completed on time. Similarly, street plays, digital communication materials and market linkage programmes were rolled out in accordance with the project timeline.

The additional financial contribution from FAO India played a pivotal role in mitigating potential delays, particularly for field-level implementation. The timely signing of the Letter of Agreement with Digital Green also ensured that digital tools were effectively deployed for wider outreach within project areas.

The project adhered to cost-effectiveness principles by optimizing the allocation of funds and leveraging in-kind contributions. The use of digital tools, such as the VISTAAR mobile app and animation videos for GAP and GHP, expanded the project's reach while keeping costs manageable. Localized training sessions minimized logistical expenses, while collaborative efforts with the Spices Board and FAO ensured cost-sharing for capacity-building initiatives. Resources were reallocated to address high-priority activities, such as IndGAP certification preparation and pesticide residue testing, without compromising the quality of other planned interventions. The project's ability to adapt and prioritize critical activities underlined its commitment to achieving high returns on investment.

Achieving the same results with fewer resources would have been difficult, given the scope and complexity of the project. The additional USD 100 000 from FAO India was essential to address financial gaps identified during implementation. This funding enabled the completion of critical activities, such as buyer-seller meetings and residue testing for compliance with Codex MRLs. While some efficiencies were gained through in-kind support and streamlined operations, the financial adjustments ensured comprehensive delivery of outputs, including training over 1 700 farmers and facilitating direct procurement agreements. These outcomes highlight that the resource allocation was necessary to achieve the project's objectives within the given constraints.

4.5 Impact

In parallel, the project's support for FPOs has created a platform for community empowerment. The project was instrumental in connecting farmers more closely with FPOs. The number of farmers associated with FPOs increased from 120 (or 30% of 400) during the baseline survey to 284 (or 67% of 425) at endline; helping farmers access larger markets with greater stability (Figure 8). Eight FPOs were registered under the NSSP, enabling them to reach

broader markets, including export channels. Ten moisture meters were distributed to six FPOs across the project states – four to two FPOs in Gujarat, two to two FPOs in Madhya Pradesh and four to two FPOs in Rajasthan.

Additionally, Trichoderma was distributed across ten project villages in Madhya Pradesh, Gujarat and Rajasthan, benefiting a total of 1 000 farmers of seed spices. The formation of an additional 22 farmer interest groups (FIGs) followed by their registration with existing FPOs has been completed. Farmers are grouped into clusters (FIGs) comprising 15–20 individuals at the village level, and their associations are built up to an appropriate federating point, which are FPOs. Through eight buyer-seller meetings (meetings held for potential buyers and sellers for negotiation) and four buy-back workshops agreements where a seller offers to repurchase a product from the buyer at a specified price or under certain conditions), the project facilitated 25 formal agreements between FPOs and exporters. An MoU was signed between ITC Ltd and Jaitaran Farmer Producer Company Ltd, while M/S Nedspice Processing India, purchased 88.3 quintals of black pepper from 17 farmers from the Paderu region. Flavourit Spices Trading Limited has started procuring seed spices from project areas. Nestlé Food Safety Institute India (NFSI) is currently engaged in discussions with the Spices Board to explore collaboration for the direct procurement of spices from FPOs within the STDF project areas. These agreements provided farmers with stable market access and guaranteed prices, effectively reducing the risks of price drops and tackling market instability. ITC Ltd. has assured that they will purchase IPM products from the farmers at a higher price margin.

By creating a direct pathway to buyers and exporters, the project helped farmers move away from uncertain market cycles and secure more predictable incomes. FPOs were equipped to provide the farmers with a range of services as shown in Figure 9.

Figure 8: Farmers associated with FPOs

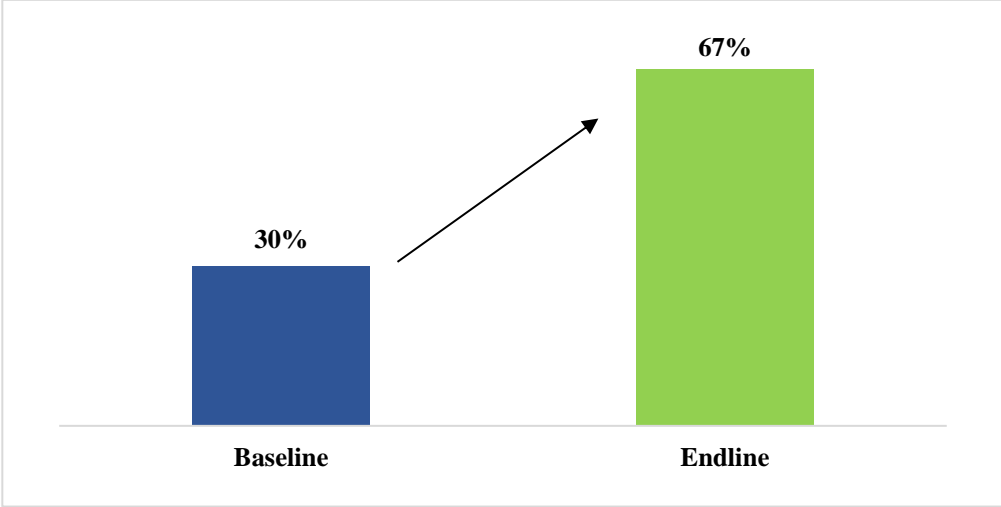
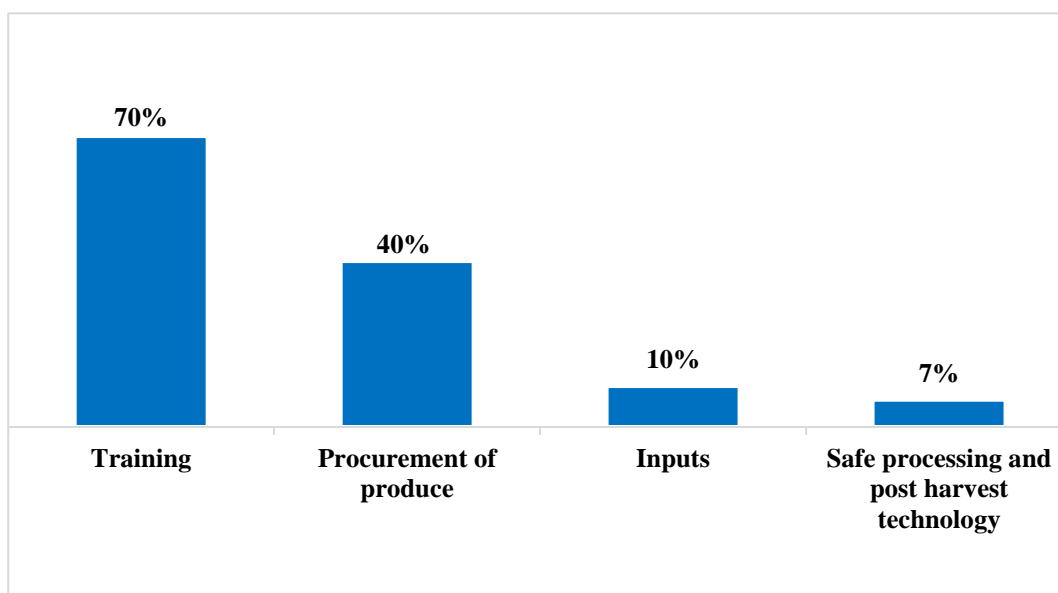


Figure 9: Services provided by FPOs



Six FPOs have been equipped with a quality management system (QMS) for GAP (Logframe Outcome 1, Annex II). By uniting farmers under collective entities, FPOs have provided smallholders –often marginalized in the market – access to training, resources and enhanced bargaining power. The introduction of QMS proved crucial in preparing FPOs for IndGAP certification by helping them standardize record-keeping, monitor quality at every stage of production and manage pesticide residues. QMS ensured that FPOs maintained detailed documentation on farming practices and input usage, which is essential for certification. It also facilitated process improvements, reduced compliance risks and provided training to both FPOs and farmers on IndGAP protocols. QMS streamlined audits, increasing the likelihood of successful certification. As a result, FPOs became better positioned in the market, boosting buyer confidence and supporting long-term sustainability in the spice value chain.

Additionally, FPOs have become instrumental in fostering peer-to-peer knowledge sharing, where early adopters of sustainable practices can influence others, amplifying the project’s impact over time. As these organizations grow and strengthen, they not only improve farmers’ economic resilience, but also establish a lasting support network, vital for sustaining environmentally friendly practices and gender-inclusive growth within the spice industry.

The project strengthened farmer-buyer linkages through FPO services (Figure 8), improving farmers' production practices, market readiness and product quality. Table 6 presents the activities undertaken for achieving the goal, and the achievement reported per activity.

Table 6: Planned vs. achieved targets (reported in numbers) for activities under Output 3

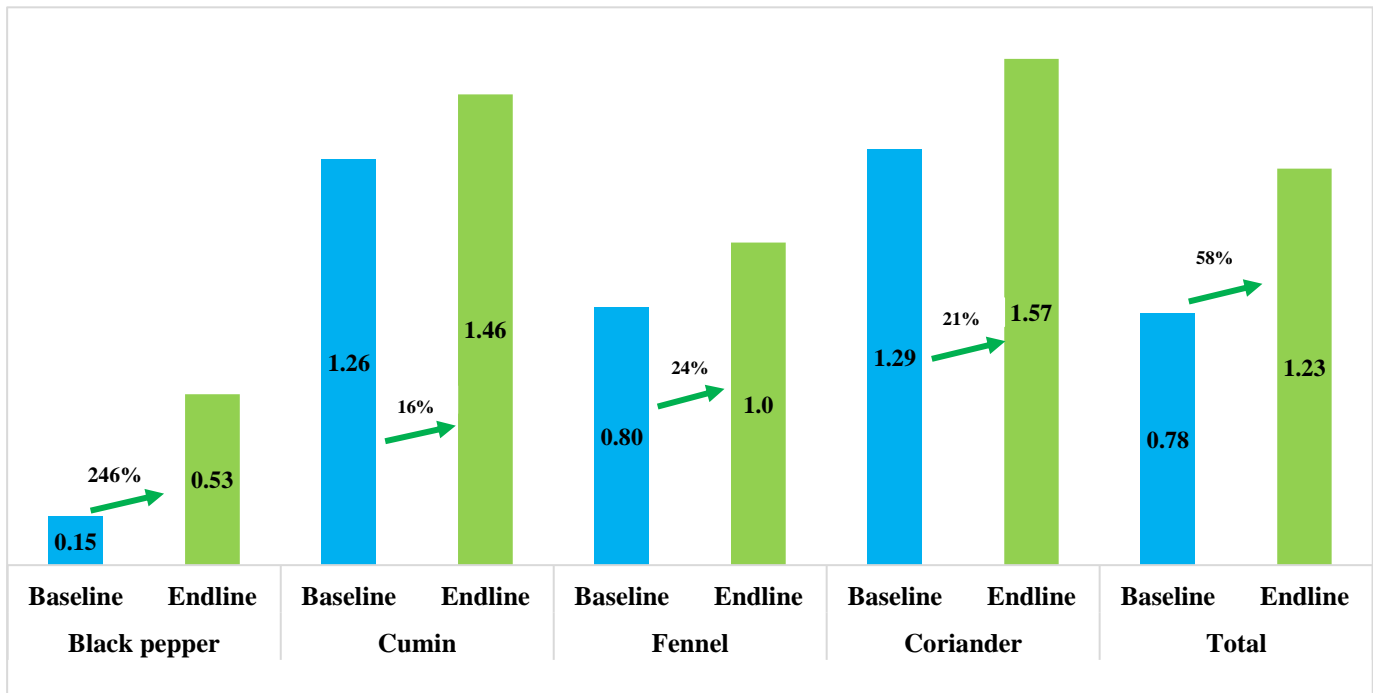
Activities	Planned	Achieved
FPOs certified on IndGAP	4	4 FPOs received training and applied for certification
FPOs enlisted on web-portals for spices trading	4	8
Buyer-seller meets organized across project States	-	8
Buy-back arrangements organized across project States	-	4

The project catalysed significant improvements in income levels, crop quality and market access for farmers in the target regions. Average income from spice crops increased by 58 percent, from INR 78 107 in the baseline to INR 123 478 in the endline (Figure 10).

Additionally, over 80 percent¹ of spices tested under the NCRCP complied with Codex MRLs, increasing their export potential. Samples of key spices like cumin, coriander, fennel and black pepper were collected from various project sites – Jodhpur (44 samples of cumin and 41 samples of fennel), Unjha (5 samples of cumin and 3 samples of fennel), Guna (40 samples of coriander) and Paderu (11 samples of black pepper) – and tested in certified labs. The results showed high compliance with Codex MRLs in most cases, especially for cumin and black pepper, highlighting effective residue control. Key results include 100 percent compliance for 44 cumin samples from Jodhpur and 11 black pepper samples from Paderu. Fennel samples achieved 82.9 percent compliance in Jodhpur and 100 percent in Unjha, while 97.5 percent of coriander samples from Guna passed Codex MRLs. In some locations like Unjha and Jodhpur, however, non-compliance was noted, such as in specific fennel and cumin samples. These findings underscored the need to reinforce GAP and GHP to improve residue compliance further. Through NCRCP, the project boosted the export potential of Indian spices by helping them prepare to meet the stringent requirements of major markets like the EU and US. The programme also contributed to domestic food safety, ensuring that consumers benefit from spices with reduced pesticide residues.

¹ Source: STDF sample analysis report 10092024

Figure 10: Changes in annual spices income (in INR ‘000)



Following the project interventions, significant growth in income levels was seen across the states, influenced by several factors. The adoption of GAP, such as improved irrigation systems, timely sowing and a balanced use of fertilizers, helped farmers enhance both the quality and quantity of the spices. Additionally, buy-back agreements and stronger connections between farmers and exporters provided more stable and fair pricing. The survey also revealed that the need for loans decreased significantly, dropping from 52 percent of farmers availing loans at baseline to 20 percent at endline. This reduction can be attributed to increased incomes² and improved financial stability, reducing farmers’ dependence on external credit.

The adoption of GHP through better post-harvest practices was another key factor in boosting incomes. By using mechanized threshing and tarpaulin sheets provided under the project by the Spices Board, better storage methods and clean, well-ventilated transportation, farmers were able to reduce post-harvest losses and bring more produce to the market in good condition.

The endline survey showed a significant increase in awareness among farmers of SPS practices in spices to prevent contamination and control pests, ensuring safe and quality exports. The number of farmers aware of SPS practices increased from 56 (14 percent) at baseline to 353 (83 percent) at endline, indicating a remarkable 69 percent improvement.

Famers adopted various SPS practices to ensure compliance with safety standards in post-harvest operations:

- **Safety equipment:** Protective kits that shield farmers from exposure to harmful chemicals.
- **Hygiene training:** Reduces contamination risks while handling spices.
- **Pest management plan:** Controls pests sustainably, minimizing use of chemicals.

² The reported income growth in the spice sector reflects improvements in farming practices, market linkages and financial stability. However, it does not account for fluctuations in commodity prices, which may have influenced overall income changes during the three-year project period, which is beyond the control of the project.

- **Equipment cleaning:** Prevents cross-contamination during post-harvest processing.
- **SPS lab access:** Ensures spice safety by testing for contaminants.
- **Chemical preparation:** Controls contamination by preparing chemicals in safe areas.
- **Bee-safe spraying:** Protects pollinators, promoting better crop yields.
- **Drying precautions:** Prevents fungal growth and spoilage during drying.
- **Clean storage:** Maintains product quality by preventing pests and spoilage.

4.6 Sustainability

To ensure sustained benefits, the project focused on building local capacity and institutional support systems. Key initiatives, such as the establishment and strengthening of FPOs and the establishment of NCRCP for labs, have provided a solid foundation for long-term resilience in the spice value chain. A large pool of master trainers, 150 against target of 60, was created to continue providing training master trainers to other spice producers, while FPOs were expanding their membership and encouraging the formation of new ones, replicating successful models. Sustainable farming practices have been adopted at the local level, further ensuring the project's longevity. The launch of the NCRCP enabled farmers from other regions to access similar benefits, promoting broader impact across the sector.

The project aligned closely with India's national agricultural priorities, focusing on improving farmers' welfare and promoting sustainable practices. It integrated seamlessly with key initiatives such as the Soil Health Card Scheme, neem-coated urea, PMKSY and PKVY, supporting organic farming and enhanced productivity. Collaboration with the Spices Board proved vital, leveraging the organization's GAP development, organic certification and the e-Spice Bazaar initiative to expand reach. State-level horticulture missions and the MIDH bolstered efforts in post-harvest management and mechanization. Past initiatives like the UNDP Spices Project and Capacity-building Initiative for Trade and Development (CITD) informed the project's approach to food safety and quality. Training modules, developed under the Collaborative Training Cell with the Spices Board and the United States Food and Drug Administration USFDA, empowered stakeholders across the value chain. The integration of the resources of the FSSAI and the Export Inspection Council enhanced testing and monitoring systems for SPS compliance.

By fostering collaborations among government agencies, research institutions, and private sector actors, the project ensured resource optimization and market alignment. The synergy between departments enabled sustainable improvements in the spice value chain, laying the foundation for long-term scalability.

Innovative training videos in local languages were shared with farmers via WhatsApp, making knowledge easily accessible and practical. Digital Green also introduced helpline and community feedback groups, giving farmers a platform to ask questions and share insights. With open access to these videos, the project ensured a lasting impact, empowering farmers to adopt best practices long after its completion.

Stakeholders, including exporters and FPOs, have committed to supporting sustainable farming practices. Plans for ongoing farmer training, with support from the Spices Board, further strengthen the project's sustainability. However, the ongoing need for accessible testing facilities and the potential for climate-related challenges underscore the importance of continued support and investment in resilience-building measures.

5. Cross-Cutting

5.1 Gender

Beyond its immediate achievements, the project made significant strides in promoting gender inclusion and environmental sustainability, laying the groundwork for lasting changes in the spice value chain. Recognizing the essential role of women in agriculture, the project actively worked to boost their participation by organizing inclusive training sessions and street plays featuring women actors. Of the 1 700 participant beneficiaries, 535 (31 percent) were women farmers. Women's roles were also highlighted in the project's video materials, showcasing their contributions and encouraging broader gender representation in agricultural practices.

A major reason for the project's success was its thoughtful, multi-channel approach, which was designed to be inclusive and responsive to local needs. Initially, involving women fully in the trainings was challenging. However, the project quickly adapted and introduced gender-focused activities that resonated with the community. For example, street plays featuring women theatre artists were held in eight villages to highlight GAP and GHP. These performances drew over 1 500 attendees, of which 35.6 percent (537) were women, providing an engaging way to reach women farmers who might not have attended traditional training sessions. Additionally, women were featured in training videos, giving them a visible role in operations and making the materials more relatable. This inclusive approach helped boost engagement and ensured the training reached a wider audience. Horizontal issues like environmental impacts were also addressed, with 50 percent of respondents trained on SPS practices aimed at minimizing chemical residues in spices (Table 2). Building on the project's focus on SPS compliance and market access, the following sections examine how targeted interventions in training on GAP and GHP, as well as strengthened market linkages, fostered sustainable farming practices and increased export readiness among spice producers.

5.2 Environment, biodiversity and climate change

The project employed innovative strategies to address climate-related challenges, particularly the increasing unpredictability of weather patterns affecting yields, as a result of which farmers were using chemical inputs more than required in order to improve yields. Recognizing this trend, the project introduced real-time weather advisory services via WhatsApp for all regions targeted under the project, a tool both accessible and user-friendly for farmers. These updates offered timely, localized weather insights that allowed farmers to make informed decisions on irrigation, pest control and harvest timing, helping them minimize unnecessary chemical application.

The project empowered farmers to adopt sustainable practices like GAP-compliant methods and weather-aligned crop management strategies, reducing dependence on chemical fertilizers and pesticides. These efforts not only optimized yields but also improved soil health, biodiversity and long-term fertility. By fostering resilient agricultural systems capable of adapting to climate changes, the project is laying a strong foundation for a sustainable spice sector that aligns productivity with environmental stewardship.

These approaches are gradually reducing reliance on chemical fertilizers and pesticides, fostering healthier soil and biodiversity. By embracing these sustainable practices, farmers are creating more resilient agricultural systems capable of adapting to climate changes, which is crucial for the long-term health of the spice sector and the

communities that depend on it. Through these efforts, the project is not only supporting current environmental goals but also strengthening the foundation for a sustainable and inclusive spice industry in the future

By tailoring their crop management strategies to precise weather forecasts, farmers are able to better protect their yields while gradually reducing their dependency on chemical inputs. This approach not only optimized crop outcomes but also contributed to the health of the soil ecosystem. Furthermore, as farmers began adopting organic practices supported by the project, the benefits extended to improvement in soil quality, fostering a more robust soil structure and nutrient profile. This shift toward organic methods is expected to enhance long-term soil fertility and resilience, creating a sustainable cycle that aligns agricultural productivity with environmental stewardship.

6. Lessons Learned

While the project has made significant strides in the promotion and adoption of GAP, GHP and SPS practices and linking farmers to FPOs, there is still much potential for continued growth and sustainability. Expanding the reach of organic farming, increasing women's participation and providing more decentralized testing facilities are critical areas for future development. Additionally, continuous support for FPOs to scale up their operations and explore new market opportunities will be key to ensuring the long-term success of these initiatives.

The project has set a strong foundation for a sustainable and high-quality spice value chain, making strides in areas like farmer empowerment, quality improvement and market access. However, key lessons from the project's innovative approaches offer insights for future endeavours. For instance, the use of street plays proved highly effective in fostering rapid adoption of GAP and GHP, by simplifying complex concepts for farmers in culturally relatable ways. Similarly, enabling women's participation, despite socio-cultural constraints, highlights the importance of tailored engagement strategies that resonate with local contexts.

The successful organization of buyer-seller meetings stands out as a lesson for similar initiatives – the project's ability to secure formal agreements, unlike many past efforts, was rooted in meticulous planning, stakeholder alignment and providing tangible value to both buyers and farmers. Furthermore, the project's success in establishing a new FPO in Andhra Pradesh underscores the need for comprehensive farmer mobilization, access to resources like training and equipment, and incentives such as market linkages and price premiums. The approach to implementing the NCRCP also offers critical takeaways, showing how structured sampling, compliance monitoring and strong institutional backing can effectively align local practices with international quality standards.

Expanding these innovative efforts, while addressing challenges like decentralized testing as well as scaling operations of FPOs, will be critical for building on these achievements. By drawing from these lessons, other projects can replicate the success of this project, fostering inclusive and sustainable agricultural ecosystems.

7. Conclusion and recommendations

7.1 Conclusion

7.1.1 Building a resilient spice value chain through innovation and capacity building

The project aimed at strengthening the spice value chains in India and improving market access through capacity building and innovative approaches, yielding significant results to spice farmers. The initiative has successfully enhanced the quality, safety and marketability of Indian spices and made spice producers aware of the importance of managing spice crops during cultivation and post-harvest operations. Farmers across the four major spice-producing states – Andhra Pradesh, Gujarat, Madhya Pradesh and Rajasthan – have seen improvements in their practices, productivity and incomes.

7.1.2 Challenges

While the project achieved remarkable success, several challenges came to the fore during implementation. However, practical and innovative solutions were introduced to overcome these obstacles.

- **Low participation of women**

One of the barriers was the limited involvement of women in the project's training programmes due to cultural barriers. To encourage more participation, training videos and street plays featuring women artistes were created and performed. By highlighting women's roles in spice farming, the project not only provided inspiration but also fostered a sense of inclusion and representation. Women were actively involved in key farming activities such as sowing, fertilizing, weeding and harvesting. They also played a crucial role in post-harvest activities, including threshing and processing. This recognition of women's contributions not only empowered them but also emphasized their critical role in the overall success of the spice farming value chain.

- **Limited primary processing capacity**

Quality control in post-harvest management was another challenge. Many farmers lacked access to essential processing tools, which affected the quality of the final product. To address this, the project distributed tarpaulins, ladders and threshers through the Spices Board. These tools allowed farmers to handle their produce more effectively, ensuring cleaner, safer and higher-quality spices that meet market standards

- **Slow transition to organic farming**

The transition from chemical-based to organic farming was slow, largely due to concerns over potential income loss during the adjustment period. To encourage this shift, the project established buy-back arrangements with exporters who were willing to purchase produce grown following GAP and GHP. This guaranteed market access helped incentivize farmers to adopt more sustainable practices without the fear of financial instability.

- **Climate-driven increase in chemical inputs**

Erratic weather patterns posed a major challenge, pushing farmers to use more chemical inputs as a safeguard. In response, the project began disseminating real-time meteorological updates via WhatsApp groups. This allowed farmers to make informed decisions about crop protection, reducing their reliance on harmful chemicals while optimizing yields based on accurate weather forecasts.

- **Limited access to testing infrastructure**

A significant hurdle was the farmers' lack of access to testing facilities for their produce. To address this, the project established basic testing labs accessible to multiple FPOs in a central location. This simplified access enabled more farmers to get their spices tested for quality and safety, boosting their competitiveness in the market, although more such local testing facilities will need to be created over time.

Project impact

The project has delivered transformative impacts in India's spice sector. By empowering farmers through training, strengthening of FPOs and market linkages, the initiative aimed to increase participants' incomes by 20 percent. The adoption of GAP, GHP and SPS practices has elevated the quality of spices, opening doors to premium markets in the European Union, United States and Japan. This was underscored by the NCRCF, which achieved over 80 percent compliance with Codex standards in tested samples. Moreover, the project's focus on FPO development has granted farmers greater control over their produce and access to markets, enhancing their resilience and negotiating power. Improvements in post-harvest processing and stable buy-back agreements have further incentivized the transition to sustainable practices.

The evaluator's assessment confirms that the project was not only relevant and coherent in its approach, but also effective in achieving its objectives. Early evidence of impact indicates that the initiative has the potential for long-term sustainability, particularly as farmers continue to adopt improved practices and markets recognize the enhanced quality of Indian spices. The combination of strategic interventions and innovative solutions ensures that the project's benefits will endure, fostering a resilient spice value chain well into the future.

7.2 Recommendations

The key recommendations emerging from the study for strengthening the spice value chain, targeting specific stakeholders responsible for their implementation are presented below. Each recommendation is aimed at addressing identified gaps in capacity building, resource access, quality compliance, and sustainability.

- **Develop a cadre of women trainers to lead gender-sensitive programmes**

To boost women's participation in spice farming and capacity-building activities, it is essential to cultivate women leadership. The Spices Board and local FPOs can collaborate to establish a cadre of women trainers, ensuring that training programmes are relevant and accessible to all farmers. This can drive higher women engagement by fostering gender inclusivity in the spice sector. Women trainers, acting as role models, can make training experiences more relatable, encouraging other women to take up farming and leadership roles. Support from STDF can further enhance women's involvement by funding initiatives like women-only sessions, partnerships with self-help groups (SHGs), and family-focused training modules. Offering flexible schedules, childcare support, and incentives can create an empowering environment, bridging the gender gap and fostering a resilient spice value chain.

- **Increase access to post-harvest inputs**

A key challenge identified during the project was limited access to post-harvest tools and infrastructure. The Spices Board and Government (Agriculture and Allied Departments) can collaborate to ensure the availability of essential post-harvest inputs like tarpaulins, drying equipment, and processing tools, at affordable prices. By supporting the procurement of these resources and their distribution to the farmers, the quality of spices can be improved, reducing losses and aiding in receiving higher market value.

- **Cover income loss during the transition to organic farming**

Transitioning from chemical to organic farming, though has long-term benefits, but often results in short-term income loss due to lesser yield in initial years; discouraging farmers to make the shift. To address this, the Government (Agriculture and Allied Departments) and STDF can collaborate to introduce premium pricing or compensation schemes during the initial years of transition. This incentivization will mobilize and motivate more farmers to adopt organic methods, compensating for lesser yield and thus, less income during the transition time; and promoting enhanced adoption of environment friendly organic practices.

- **Increase access to bio-inputs, climate resilient crops varieties and digital pest management**

As climate-related challenges grow, providing farmers with bio-inputs like organic fertilizers and bio-pesticides becomes vital. The Spices Board and Krishi Vigyan Kendra (KVKs) can collaborate to promote climate-resilient spice varieties, reducing dependence on chemical inputs. The Digital Green Trust and STDF can also support the dissemination of digital information and material for pest management through local platforms like WhatsApp, offering real-time advisory services. This approach will enable farmers to implement sustainable and effective crop management strategies.

- **Establish advanced testing labs for spices at Agricultural Produce Market Committee (APMC) markets**

Ensuring the safety and quality of spices is critical for maintaining market competitiveness. The Government (Agriculture and Allied Departments) and Spices Board should prioritize establishing advanced testing laboratories at Agricultural Produce Market Committee (APMC) markets. These labs would allow farmers to conveniently test for pesticide residues and other contaminants, and ensuring compliance with domestic and international standards. Support from STDF can enhance the awareness among farmers to access and use these facilities, and improving the product quality.

- **Sustainable long-term impact**

While the project has been impactful, its benefits could have been even more widespread and sustainable, had the intervention lasted for a longer duration, ideally covering three to four cropping seasons. Extending the project for multiple cropping seasons would allow farmers to adopt the trainings received and implement GAP/GHP, adapt to new farming techniques in a more gradual manner in a supportive environment. This would also provide better opportunities for monitoring progress and impact, addressing evolving challenges and refining strategies based on real-time results. In this regard, FAO may consider extending the project duration to cover three to more cropping seasons. The Government (Agriculture and Allied Departments), and STDF can contribute by collaborating to secure and provide funding and resources for the extended project duration.

Annexure: Volume I

Annexure I : Evaluation framework

Impact	Outcome	Output	Indicators	Probable Indicators/Data Points	Unit of Measure	National/ State	Level	BL Ref	Type of Data	Source institution	Source documents	Analyses & Disaggregation	
<p>% Increase in safer spices (by clearing tests that determine reduced pesticide residues and contaminants)</p> <p>20% increase in value of the four spices (disaggregated by quality sensitive markets like EU, US, Japan)</p> <p>20% increase in incomes of targeted farmers (disaggregated by poor and marginalized, tribal, and women-headed households)</p>	Capacity of stakeholders built to produce safe spices	Output 1: Capacity (in the public and private sector and academia) to deliver trainings/ awareness programs on risk-based assessments and Good Practices along the identified spice value chains improved		Number of beneficiaries	Number	State	EL		Secondary/Primary	HH, PIAs, SB officials, State functionaries; community representative	Progress reports, HH surveys	Gender; Age; religion, caste, Block, Village, State	
				Net household income	INR	State	BL-EL	C4	Secondary/Primary	HH			Caste, Gender, Activities, Spices, State
				% change in average annual income of households	Percentage	State	BL-EL	C4	Secondary/Primary	HH	HH surveys		Caste, Gender, Activities, Spices, State
				Net income from spices	INR	State	BL-EL	C4	Secondary/Primary	HH	HH surveys		Caste, Gender, Activities, Spices, State
				% change in average household income from spices	Percentage	State	BL-EL	C4	Secondary/Primary	HH	HH surveys		Caste, Gender, Activities, Spices, State
				% change in household expenses	Percentage	State	BL-EL	C2	Secondary/Primary	HH	HH surveys		Caste, Gender, Activities, Spices, State
				% change in beneficiaries availed loan	Percentage	State	BL-EL	H3 & J1	Secondary/Primary	HH	HH surveys		Gender; Caste
				Number of existing post-harvest infrastructure like market yards/ auction centres, storage godowns, pre-processing / simple processing units mapped	Number	State	EL			Secondary/Primary	HH, PIAs, SB officials, State functionaries; community representative	Training modules, progress reports, KIIs, FGDs	

Impact	Outcome	Output	Indicators	Probable Indicators/Data Points	Unit of Measure	National/State	Level	BL Ref	Type of Data	Source institution	Source documents	Analyses & Disaggregation
			Gender and social inclusion	Number of GAP package of practices developed	Number	State	EL		Secondary/Pri mary	PIAs, SB officials, State functionaries	Training modules, progress reports, KIIs,	Spices, Block, Village, State
				Number of GHP package of practices developed	Number	State	EL		Secondary/Pri mary	PIAs, SB officials, State functionaries	Training modules, progress reports, KIIs,	Spices, Block, Village, State
				Number of gender-sensitive and socially inclusive training modules for master trainers developed	Number	State	EL		Secondary/Pri mary	PIAs, SB officials, State functionaries, Trainers	Training modules, progress reports, FGDs KIIs,	Block, Village, State
			Capacity of Trainers in GAP and GHP	Number of Master Trainers Identified	Number	State	EL		Secondary/Pri mary	PIAs, State/district functionaries; Trainers	Training modules, progress reports, KIIs,	Gender; Block, Village, State
				Number of Master Trainers Appointed	Number	State	EL		Secondary/Pri mary	PIAs, State/district functionaries; Trainers	Training modules, progress reports, KIIs, FGDs	Gender; Block, Village, State
				Number of Training Program Conducted for Master Trainers	Number	State	EL		Secondary/Pri mary	PIAs, State/district functionaries; Trainers	Training modules, progress reports, KIIs, FGDs	Block, Village, State
				Number of Master Trainers Trained and certified	Number	State	EL		Secondary/Pri mary	PIAs, State/district functionaries; Trainers	Training modules, progress reports, KIIs,	Gender; Block, Village, State

Impact	Outcome	Output	Indicators	Probable Indicators/Data Points	Unit of Measure	National/State	Level	BL Ref	Type of Data	Source institution	Source documents	Analyses & Disaggregation
				Number of Refresher Training Program Conducted for Master Trainers	Number	State	EL		Secondary/Primary	PIAs, State/district functionaries; Trainers	Training modules, progress reports, KIIs,	Block, District, State
				Number of IEC Material developed	Number	State	EL		Secondary/Primary	PIAs, State/district functionaries;	Training modules, progress reports, KIIs,	Block, District, State
				Number of IEC activities planned and conducted	Number	State	EL		Secondary/Primary	PIAs, State/district functionaries;	Training modules, progress reports, KIIs,	Block, District, State
				Number of Master Trainers Provided Refresher Training	Number	State	EL		Secondary/Primary	PIAs, State/district functionaries; Trainers	Training modules, progress reports, KIIs	Gender; Block, Village, State
			Capacity of farmers in GAP and GHP	Number of workshops conducted on package of practices for faculty of Agriculture Universities and researchers	Number	State	EL		Secondary/Primary	PIAs, district functionaries; Trainers	Progress reports, KIIs	Block, Village, State
				Number of Farmer receive healthy planting materials of black pepper from nurseries	Number	State	EL		Secondary/Primary	PIAs, SB officials, State functionaries, HH	Project activity report, FGDs, HH surveys	SC /ST, Gender; Block, Village, State
				Number of healthy planting materials of black pepper distributed	Number	State	EL		Secondary/Primary	PIAs, SB officials, State functionaries, HH	Project activity report, KIIs,	Block, Village, State

Impact	Outcome	Output	Indicators	Probable Indicators/Data Points	Unit of Measure	National/ State	Level	BL Ref	Type of Data	Source institution	Source documents	Analyses & Disaggregation
				Number of farmers participating in exposure visits	Number	State	EL		Secondary/Primary	PIAs, SB officials, State functionaries, HH	Project activity report, KIIs, FGDs, HH surveys	SC /ST, Gender; Block, Village, State
				Number of information and knowledge sharing meetings amongst farmers groups/FPOs	Number	State	EL		Secondary/Primary	PIAs, SB officials, State functionaries, FPO representatives, HH	Project activity report, KIIs, FGDs, HH surveys	SC /ST, Gender; Block, Village, State
				Number Farmers with farms that have undergone soil test	Number	State	BL-EL	E 24	Primary	HH	HH surveys	SC /ST, Gender; Block, Village, State
				Number Farmers using improved variety/ certified seeds	Number	State	BL-EL	E3, F3,G3,I3	Primary	HH	HH surveys	SC /ST, Gender; Block, Village, State
				Number Farmers practice good sowing method	Number	State	BL-EL	F7-F13; G7-G13;I7-I13	Primary	HH	HH surveys	SC /ST, Gender; Block, Village, State
				Number Farmers practicing seed treatment	Number	State	BL-EL		Primary	HH	HH surveys	SC /ST, Gender; Block, Village, State
				Number Farmers practicing weeding	Number	State	BL-EL	F14, G14, I14	Primary	HH	HH surveys	SC /ST, Gender; Block, Village, State
				Number Farmers planting crops in a timely manner	Number	State	BL-EL	F7-F13; G7-G13;I7-I13	Primary	HH	HH surveys	SC /ST, Gender; Block, Village, State
				Number Farmers practicing inter-cropping	Number	State	BL-EL	F5, G5 and I5	Primary	HH	HH surveys	SC /ST, Gender; Block, Village, State
				Number Farmers practicing mulching	Number	State	BL-EL		Primary	HH	HH surveys	SC /ST, Gender; Block, Village, State

Impact	Outcome	Output	Indicators	Probable Indicators/Data Points	Unit of Measure	National/ State	Level	BL Ref	Type of Data	Source institution	Source documents	Analyses & Disaggregation
				Number Farmers practicing pest management	Number	State	BL-EL	E35, F35 G35, I35	Primary	HH	HH surveys	SC /ST, Gender; Block, Village, State
				Percentage change in farmers with access to irrigated land	percentage	State	BL-EL	E16, F16, G16, I16	Primary	HH	HH surveys	SC /ST, Gender; Block, Village, State
				Number of Farmers trained on GAP/ GHP/ Organic practices	Number							
				Number of farmers Reporting knowledge retention/Usefulness of GHP/GAP/organic practices	Number	State	BL-EL		Secondary/Primary	PIAs, district functionaries, Trainers , HH	Progress reports, KIIs; FGDs; HH surveys	SC /ST, Gender; Block, Village, State
				Number of farmers adopting GHP/GAP/Organic Practices	Number							
				Number of Farmers trained on certification of GHP/GAP/Organic Practices	Number	State	BL-EL	K13 K14	Secondary/Primary	PIAs, State functionaries; Trainers	Progress reports, KIIs; FGDs; HH surveys	SC /ST , Gender; Block, Village, State
				Number of farmer with organic practice & GAP Certifications								
			Certification of value chain actors	Number of value chain actors mobilized to participate in the project	Number	State	BL-EL		Secondary/Primary	PIAs, State/district functionaries	Progress reports, KIIs, FGDs	Gender; Block, Village, State
				Number of value chain actors trained on GMP	Number	State	BL-EL		Secondary/Primary	PIAs, State/district functionaries	Progress reports, KIIs	Gender; Block, Village, State

Impact	Outcome	Output	Indicators	Probable Indicators/Data Points	Unit of Measure	National/State	Level	BL Ref	Type of Data	Source institution	Source documents	Analyses & Disaggregation
				Number of value chain actors receive IndGAP certification	Number	State	BL-EL		Secondary/Primary	PIAs, State/district functionaries	Progress reports, KIIs	Gender; Block, Village, State
			Knowledge, Awareness and Practices	Current market/consumer preferences both at the national and international level		State	BL-EL		Secondary/Primary	PIAs, SB officials, State functionaries; community representative	Progress reports, KIIs; FGDs; HH surveys	Block, Village, State
			Relevance, Coherence	Number of Conflicting priorities across each stakeholders	Number	State	EL		Primary	PIAs, SB officials, State functionaries	KIIs, FGDs	Block, Village, State
				Tradeoff between the conflicting priority		State	EL		Primary	PIAs, SB officials, State functionaries	KIIs, FGDs	Block, Village, State
				Number and type of mechanism to ensure local ownership, and stakeholder participation in the project implementation	Number	State	EL		Primary	PIAs, SB officials State/district functionaries	KIIs	Block, Village, State
				Synergies or conflicts between the project and other interventions, including government policies, programs, or projects?	Number	State	EL		Primary	PIAs, State/district functionaries	KIIs	Block, Village, State

Impact	Outcome	Output	Indicators	Probable Indicators/Data Points	Unit of Measure	National/State	Level	BL Ref	Type of Data	Source institution	Source documents	Analyses & Disaggregation
				Number and type of unintended consequences or negative impacts of the project on existing interventions or policies?	Number	State	EL		Primary	PIAs, State/district functionaries	KIIs	Block, Village, State
				Number and type of mechanism to promote coordination and collaboration between the project and other initiatives within the same institution or Government?	Number	State	EL		Primary	PIAs, State/district functionaries, SB official	KIIs	Block, Village, State
				Key challenges and coping mechanism in building the capacity of farmers and other relevant stakeholders of the value chain	Number	State	EL		Primary	PIAs, State/district functionaries	FGDs; KIIs, HH survey	Block, Village, State
				Unforeseen changes in the project context or risks arise during implementation, impacting resource utilization or project timelines	Number	State	EL		Primary	PIAs, State/district functionaries	Progress reports, KIIs	Block, Village, State

Impact	Outcome	Output	Indicators	Probable Indicators/Data Points	Unit of Measure	National/State	Level	BL Ref	Type of Data	Source institution	Source documents	Analyses & Disaggregation	
		Output 2: Capacity of farmers and other value chain actors to adopt GAP / GHP enhanced to improve yields, quality, and safety of spices	Access to Farmer Interest Groups	Number of spices growing villages selected	Number	State	EL		Secondary/Pri mary	PIAs, State/district functionaries; HH	Progress reports, KIIs, HH survey	Block, Village, State	
				Number of FIG groups formed	Number	State	EL		Secondary	PIAs, State/district functionaries	Progress reports,	Block, Village, State	
				Number of members in FIG groups	Number	State	EL		Secondary	PIAs, State/district functionaries	Progress reports,	SC /ST , Gender; Block, Village, State	
				Number of FPOs identified for strengthening	Number	State	EL		Secondary	PIAs, State/district functionaries	Progress reports,	Block, Village, State	
				Number of FPOs strengthened/established	Number	State	EL		Secondary	PIAs, State/district functionaries	Progress reports, KIIs, FPO	Block, Village, State	
				Access to Farmer Producer Organizations and market linkages	Number of FPOs strengthened/established with at least 50% women members	Number	State	EL		Secondary	PIAs, State/district functionaries	Progress reports, KIIs	Block, Village, State
					Number of strengthened/established FPOs engaging in aggregation, grading, marketing, and primary processing activities	Number	State	EL		Secondary	PIAs, State/district functionaries; FPO members	Progress reports, KIIs	Block, Village, State
				Package of practice compliance	Number of farmers adopting package of practices introduced under the project	Number	State	EL		Secondary/Pri mary	PIAs, State/district functionaries; community representative	Progress reports, FGDs	SC /ST, Block, Village, State
					Number of farmer visits to GHP compliant	Number	State	EL		Secondary/Pri mary	PIAs, State/district functionaries	Progress reports, KIIs	SC /ST, Block, Village, State

Impact	Outcome	Output	Indicators	Probable Indicators/Data Points	Unit of Measure	National/ State	Level	BL Ref	Type of Data	Source institution	Source documents	Analyses & Disaggregation
				facilities of value chain actors								
				Number of farmers visiting GHP compliant facilities of value chain actors	Number	State	EL		Secondary/Primary	PIAs, State/district functionaries	Progress reports, FGDs	SC /ST, Block, Village, State
			Compliance by FIG members/ FPO members	Number of FIG members trained on IndGAP	Number	State	EL		Secondary/Primary	PIAs, State/district functionaries	Progress reports	SC /ST , Gender; Block, Village, State
				Number of FPO groups adopting the control system for IndGAP certificate	Number	State	EL		Secondary/Primary	PIAs, State/district functionaries	Progress reports	SC /ST , Gender; Block, Village, State
				Number of farmers under FPO certified under IndGAP	Number	State	EL		Secondary/Primary	PIAs, SB officials, State functionaries;	Progress reports	Block, Village, State
				Number of farmers from project area getting their produce tested	Number	State	EL		Secondary/Primary	PIAs, SB officials, State functionaries;	Progress reports	SC /ST , Gender; Block, Village, State
				Number of Other stakeholders (APMC, local processor, local traders etc) from project area getting their produce tested	Number	State	EL		Secondary/Primary	PIAs, SB officials, State functionaries;	Progress reports FGDs	Block, Village, State
				Number of FPOs developed/strengthened for improved production and internal control systems (ICS)	Number	State	BL-EL		Secondary/Primary	PIAs, SB officials, State functionaries;	Progress reports FGDs	Block, Village, State

Impact	Outcome	Output	Indicators	Probable Indicators/Data Points	Unit of Measure	National/ State	Level	BL Ref	Type of Data	Source institution	Source documents	Analyses & Disaggregation
				Quality/Retention of all the training mentioned above	NA	State	EL		Primary	HH; FPO members; Trainers	HH surveys FGDs	Block, Village, State
				Number of FPOs key functionaries trained for improved production and internal control system (ICS)	Number	State	EL		Secondary/Pri mary	PIAs, SB officials, State functionaries;	Progress reports FGDs	SC /ST , Gender; Block, Village, State
				Number of FPOs adopting control system (quality management system)	Number	State	EL		Secondary/Pri mary	PIAs, SB officials, State functionaries;	Progress reports FGDs	Block, Village, State
				Number of Improved / Certified Varieties of Planting materials / Seeds Distributed	Number	State	EL		Secondary/Pri mary	PIAs, SB officials, State functionaries; HH	Progress reports	Block, Village, State
			Information dissemination through FPO discussions	Number of information and knowledge sharing meetings amongst farmers groups/FPOs	Number	State	EL		Secondary/Pri mary	PIAs, SB officials, State functionaries;	Progress reports, FGDs	Block, Village, State
				Number of farmers adopting package of practices visited by other farmers for observation	Number	State	EL		Secondary/Pri mary	PIAs, SB officials, State functionaries;	Progress reports, FGDs	Block, Village, State
				Number of information and knowledge sharing meetings amongst groups of value chain actors	Number	State	EL		Secondary/Pri mary	PIAs, SB officials, State functionaries;	Progress reports, KIIs	Block, Village, State

Impact	Outcome	Output	Indicators	Probable Indicators/Data Points	Unit of Measure	National/ State	Level	BL Ref	Type of Data	Source institution	Source documents	Analyses & Disaggregation
			Impact on income, value chain and market linkages	Number of Farmer harvesting crops at appropriate stage & time	Number		BL-EL	E41, F41, G41, I41	Primary	HH	HH surveys	SC /ST , Gender; Block, Village, State
				Number of Farmer performing cleaning the produce	Number		BL-EL		Primary	HH	HH surveys	SC /ST , Gender; Block, Village, State
				Number of Farmer drying the produce	Number		BL-EL	E53, F53, G53, I53	Primary	HH	HH surveys	SC /ST , Gender; Block, Village, State
				Number of Farmer grading the produce	Number		BL-EL	E77, F77, G77, I77	Primary	HH	HH surveys	SC /ST , Gender; Block, Village, State
				Number of Farmer packaging the harvested the produce	Number		BL-EL	E65, F65, G65, I65	Primary	HH	HH surveys	SC /ST , Gender; Block, Village, State
				Number of Farmer practicing pest management in storage	Number		BL-EL	E58, F58, G58, I58	Primary	HH	HH surveys	SC /ST , Gender; Block, Village, State
				Number of FPOs meeting regularly to discuss GAP and GHP package of practices	Number	State	EL		Secondary/Pri mary	PIAs, SB officials, State functionaries;	Progress reports, KIIs	Block, Village, State
				% of farmers by mode of sales	Percentage	State	BL-EL	E70, F70, G71, I70	Secondary/Pri mary	PIAs, SB officials, State functionaries; HH	Progress reports, KIIs; HH survey	SC /ST , Gender; Block, Village, State
				Number of FPOs reporting improved incomes/governan ce	Number	State	EL		Secondary/Pri mary	State functionaries; FPO member	Progress reports, FGDs	Block, Village, State

Impact	Outcome	Output	Indicators	Probable Indicators/Data Points	Unit of Measure	National/ State	Level	BL Ref	Type of Data	Source institution	Source documents	Analyses & Disaggregation
				Number of FPOs strengthening with basic facilities, management systems, equipment, and materials	Number	State	EL		Secondary/Pri mary	State functionaries; FPO member	Progress reports, FGDs	Block, Village, State
				Number of project FPOs signing agreements with exporters	Number	State	EL		Secondary/Pri mary	State functionaries; FPO member	Progress reports, FGDs	Block, Village, State
			Improvement in quality of produce	Volume of produce meeting basic quality parameter like moisture, appearance, colour	Quintal	State	EL		Secondary/Pri mary	PIAs, SB officials, State functionaries;	Progress reports, lab reports, e-portal	Block, Village, State
				Volume of produce without contaminants like glass container and bottles in sorting area	Quintal	State	EL		Secondary/Pri mary	PIAs, SB officials, State functionaries;	Progress reports, lab reports, e-portal	Block, Village, State
	Image and branding of organic/GAP certified spices	Output 3 Marketing and links to buyers (exporters/importers) strengthened	Compliance to safety standards	Number of farmers reporting access to SPS labs	Number	State	BL-EL	K7	Secondary/Pri mary	SB officials, State functionaries; HH	Progress reports, KIIs, HH survey	SC /ST , Gender; Block, Village, State
				Number of farmers reporting test done	Number	State	BL-EL	K8	Secondary/Pri mary	SB officials, State functionaries; HH	Progress reports, KIIs, HH survey	SC /ST , Gender; Block, Village, State
			Market linkage and access to trade portals	Number of farmers aware about E-spice Web Portal	Number	State	EL		Secondary/Pri mary	HH, Progress report	HH surveys, KII, FGD	Block, Village, State
				Number of Farmers Linked to the E-spice Web Portal	Number	State	BL-EL	L1	Secondary/Pri mary	Progress report, HH survey	Progress reports, KIIs	SC /ST , Gender; Block, Village, State

Impact	Outcome	Output	Indicators	Probable Indicators/Data Points	Unit of Measure	National/State	Level	BL Ref	Type of Data	Source institution	Source documents	Analyses & Disaggregation
				Numbers of farmers reporting ease of accessibility and usability of E-spice Web Portal	Number	State	EL		Secondary/Primary	HH survey, FGDs	HH surveys, KII, FGD	Block, Village, State
				Number of farmers reporting challenges using E-spice Web Portal	Number	State	EL		Secondary/Primary	HH survey, FGDs	HH surveys, KII, FGD	Block, Village, State
				Volume of spices sold through E-spice Web Portal	Quintal	State	EL		Secondary/Primary	PIAs, SB officials, FGDs	Progress reports, KIIs	Block, Village, State
				Number of FPOs Linked to the E-spice Web Portal	Number	State	EL		Secondary/Primary	PIAs, SB officials, State functionaries;	Progress reports, KIIs	Block, Village, State
				Number of Buyers/Exporters Linked to the E-spice Web Portal	Number	State	EL		Secondary/Primary	PIAs, SB officials, State functionaries;	Progress reports, KIIs	Block, Village, State
				Number of Farmers and Buyers/Exporters Connected through E-spice Web Portal	Number	State	EL	L1	Secondary/Primary	PIAs, SB officials, State functionaries;	Progress reports, KIIs	SC /ST , Gender; Block, Village, State
				Number of Brands Developed by FPOs being Traded through E-spice Web Portal	Number	State	EL		Secondary/Primary	PIAs, SB officials, State functionaries;	Progress reports, KIIs	Block, Village, State
				Number of Marketing Activities through Trade Fair	Number	State	EL		Secondary/Primary	PIAs, SB officials, State functionaries;	Progress reports, KIIs	Block, Village, State

Impact	Outcome	Output	Indicators	Probable Indicators/Data Points	Unit of Measure	National/State	Level	BL Ref	Type of Data	Source institution	Source documents	Analyses & Disaggregation
			Market situation	Number of farmers reporting market (buyers) rejection	Number	State	BL-EL	E78, F78, G79, I78	Secondary/Primary	SB officials, State functionaries; HH	Progress reports, KIIs; HH survey	SC /ST , Gender; Block, Village, State
				Number of buyers reporting procurement of SPS-certified produce	Number	State	EL		Secondary/Primary	SB officials	Progress reports, KIIs	Block, Village, State
				Number of buyers reporting to buy from women farmers/ women farmer groups	Number	State	EL		Secondary/Primary	SB officials	Progress reports, KIIs	Block, Village, State
				Number of buyers reporting market rejections (on the supply and consumer side)	Number	State	EL		Secondary/Primary	SB officials	Progress reports, KIIs	Block, Village, State
	Links to buyers strengthened	Output 4 Establishment and implementation of a National Contaminant and Residue Control Programme (NCRCP) for identified spices	Accessibility to quality assurance standards	Number of labs available in mandi/project area	Number	State	BL-EL		Secondary/Primary	PIAs, SB officials, State functionaries;	Progress reports, KIIs	State
				Number of functional labs in mandi/Project area	Number	State	BL-EL		Secondary/Primary	PIAs, SB officials, State functionaries;	Progress reports, KIIs	State
				Number of labs upgraded in mandi/project area	Number	State	BL-EL		Secondary/Primary	PIAs, SB officials, State functionaries;	Progress reports, KIIs	State
				Availability of approved NCRCP document/guidelines	Yes /No	State	EL		Secondary/Primary	PIAs, SB officials, State functionaries;	Progress reports, KIIs	State
				Number of Spices Board labs with required certifications for testing	Number	State	EL		Secondary/Primary	PIAs, SB officials, State functionaries;	Progress reports, KIIs	State

Impact	Outcome	Output	Indicators	Probable Indicators/Data Points	Unit of Measure	National/State	Level	BL Ref	Type of Data	Source institution	Source documents	Analyses & Disaggregation
				Number of Spices Board Lab with adequate equipment for tests	Number	State	EL		Secondary/Primary	PIAs, SB officials, State functionaries;	Progress reports, KIIs	State
				Number of samples tested in Spices Board Lab	Number	State	EL		Secondary/Primary	PIAs, SB officials, State functionaries;	Progress reports, KIIs	Spices, State
				% of samples passing all standard qualifications in Spices Board Lab	Percentage	State	EL		Secondary/Primary	PIAs, SB officials, State functionaries;	Progress reports, KIIs	Spices, State

Annexure II: Updated log frame with results

Goal/Outcomes	Project Description	Measurable Indicators / Targets	Results	Sources of Verification	Assumptions and Risks
Goal <i>Improved safety and quality of four spices (fennel, coriander, cumin, and black pepper) to increase market access and support efforts to reduce poverty (SDG 1) and hunger (SDG 2) in the selected project areas in India.</i>	1) Increased exports of safe and high-quality spices from India to overseas markets. 2) Improved food safety and consumer health in India and export markets. 3) Increased/boosted incomes of small-scale farmers, and women and other marginalized (tribal) communities empowered,	1) 50% increase in the number of farmers/value chain actors whose sample spices are safer in terms of reduced pesticide residues and contaminants 2) 20% increase in the incomes of project beneficiary farmers 3) Number of new markets accessed for the targeted spices	<ul style="list-style-type: none"> • Over 80%³ of spices tested under the NCRCP complied with Codex MRLs • 58% increase in spice income of project beneficiary⁴ 	<ul style="list-style-type: none"> • Export data on spices • Test reports before and after the project • Evaluations-baseline and endline 	<ul style="list-style-type: none"> • Economic and political conditions in global and domestic markets conducive. • Weather conditions favourable.
Outcome 1	1) Improved safety and quality of three seed spices (cumin, fennel and coriander) and black pepper for increased market access.	1) 75% farmers have improved understanding of Good Agricultural and Hygiene Practices (GAPs and GHPs) 2) 4 Farmer Producer Organizations (FPOs) have control system (Quality Management System) for GAPs	<ul style="list-style-type: none"> • 409 (96%) (men: 305, women: 104) beneficiaries received training on GAP, 347 (82%) (men: 247, women: 100) received training on GHP • 6 FPOs have control system (Quality 	<ul style="list-style-type: none"> • Project reports • Evaluation reports 	<ul style="list-style-type: none"> • Farmers, exporters, universities and other value chain stakeholders are motivated to join the programme

³ Source: STDF sample analysis report 10092024

⁴ The reported income growth in the spice sector reflects improvements in farming practices, market linkages, and financial stability. However, it does not account for fluctuations in commodity prices, which may have influenced overall income changes during the three-year project period, beyond the control of the project.

Goal/Outcomes	Project Description	Measurable Indicators / Targets	Results	Sources of Verification	Assumptions and Risks
		3) 4 FPOs certified on IndGAP	<p>Management System) for GAPs</p> <ul style="list-style-type: none"> 4 FPOs received training and applied for IndGAP certification 		
Outcome 2	1) Links between exporters and importers facilitated	1) At least 1 FPO per spice* signs a direct procurement agreement with an exporter (* <i>fennel, coriander, cumin, black pepper</i>)	<ul style="list-style-type: none"> 4 buy-back arrangements organized across project states, 25 MoUs / EOIs signed 		
Expected results (Outputs)					
Output 1 Capacity (in the public and private sector and academia) to deliver trainings on risk-based assessments and Good Practices improved.	1.1. Training of Trainers (ToT) on risk-based assessments and Good Practices along the identified spice value chains	1) 60 Trainers trained through TOTs	<ul style="list-style-type: none"> 150 Trainers trained on good practices along the identified spice value chains 	<ul style="list-style-type: none"> Project Reports including documentation like Training records and IEC materials 	<ul style="list-style-type: none"> Support from Agricultural Universities and Research Centres Low motivation of farmers and other value chain actors to implement good practices, and may continue with existing practices
	1.2. Package of Practices (POP) on GAP reviewed and strengthened 1.3. Package of Practices (POP) on GHP for post-harvest stages developed 1.4. Training modules based on POP of GAP and GHP developed-one for each spice	1) 4 POPs on GAP reviewed and strengthened– one for each spice 2) 4 POP on GHP for post-harvest activities developed-one for each spice	<ul style="list-style-type: none"> 4 POPs on GAP reviewed and strengthened 4 POPs on GHP developed one for each spice 		

Goal/Outcomes	Project Description	Measurable Indicators / Targets	Results	Sources of Verification	Assumptions and Risks
	1.5. Information-Education-Communication (IEC) material developed and disseminated	3) 4 training modules based on POP of GAP and GHP developed-one for each spice 4) 4 IEC materials developed for each spice	<ul style="list-style-type: none"> • 4 training modules developed • 16 IEC material developed and disseminated 		
Activities	1) Review of existing POPs for farmers on GAP based on international standards 2) Development of Package of GHPs for market yards/ auction centres, storage godowns, pre-processing / simple processing units 3) Development of standardized training modules based on POPs developed. 4) Organization of workshops on the POPs for related Agriculture University faculties/ others				
Output 2 Capacity of farmers and other value chain actors enhanced to adopt GAP / GHP for improving yields, quality and safety of spices.	2.1. Baseline and endline studies conducted at start and end of project covering different aspects such as level of awareness on Sanitary and Phytosanitary (SPS) issues, income levels, current production data, rejection data, etc.	1) 1 baseline and 1 endline survey conducted 2) 8 FPOs registered/strengthened 3) 1200 farmers and 50 other value chain actors trained on: <ul style="list-style-type: none"> • GAPs/GHPs 	<ul style="list-style-type: none"> • 1 baseline and 1 endline survey conducted • 8 FPOs registered/strengthened • 1700 farmers and 200 value chain actors trained on GAP/GHP 	<ul style="list-style-type: none"> • Registration document for new FPOs/ Report(s) on achievement of strengthening of existing FPOs against • Project Reports • Evaluation studies 	<ul style="list-style-type: none"> • Consensus on equipment to be supplied • Number of farmers interested in organising as a group

Goal/Outcomes	Project Description	Measurable Indicators / Targets	Results	Sources of Verification	Assumptions and Risks
	<p>2.2. Villages and farmers selected, and FPO established/strengthened in each village</p> <p>2.3. Farmers and management representatives FPOs trained on improved production and Control Systems (Quality Management System)</p> <p>2.4. Other value chain actors trained on GHP and certified</p> <p>2.5. Farmers equipped with nurseries, seedlings, and healthy plants</p> <p>2.6. Delivery of trainings of trainers (TOT) programmes.</p>	<ul style="list-style-type: none"> • Good Manufacturing Practices (GMPs) <p>4) 8 other farmer groups exposed to practices in other states/ areas</p> <p>5) Number of farmers provided with seedlings and healthy plants.</p>	<ul style="list-style-type: none"> • Instead of the initially planned 8 farmer groups, the study found that 212 farmers including 45 (21%) women were exposed to practices in other states/area. • 200 black pepper farmers provided with seedlings and health plants 	<ul style="list-style-type: none"> • Reports 	
Activities	<ol style="list-style-type: none"> 1) Identifying and selecting of villages, farmers/ farmer groups and other value chain actors 2) Developing baseline benchmarks (at start of project) for Monitoring and Evaluation (M&E); and comparing the same with progress/ achievement at end of project (endline) 3) Questionnaire(s) for baseline/endline developed 4) Questionnaire(s) filled by farmers/ farmer groups and other value chain actors at beginning 				

Goal/Outcomes	Project Description	Measurable Indicators / Targets	Results	Sources of Verification	Assumptions and Risks
	<p>(baseline) and end of project (endline)</p> <p>5) Developing/ strengthening FPOs at community level for improved production and value-added technologies (including organic / GAP certification)</p> <p>a) New FPOs developed/ existing FPOs strengthened at community levels in each village.</p> <p>b) – Basic facilities/ equipment/ material identified for each village for group use; and procured (based on cost sharing project)</p> <p>6) Developing nurseries and providing seedlings to farmers (only for black pepper)</p> <p>a) Procurement of healthy plants and propagating these in nurseries by Spices Board.</p> <p>b) Supply of plants to farmers by Spices Board.</p> <p>7) Rolling-out training programs for farmers and other relevant stakeholders on the POPs developed under Output 1</p> <p>a. – Trainings on GAP/ organic practices/ certification/ maintaining documentation and</p>				

Goal/Outcomes	Project Description	Measurable Indicators / Targets	Results	Sources of Verification	Assumptions and Risks
	<p>records at individual farmer and group level.</p> <p>b. Assist in establishing ICS and group management</p> <p>c. Facilitate group certification of farmers, including support for first year certification fees (linking with other schemes such as NABARD)</p> <p>d. Communication and awareness generation through street plays, posters, TV programmes.</p> <p>8) Organizing/conducting study visits; and sharing of experiences and lessons learnt</p> <p>a. Visits of 5 farmers from each village to other farms (total 60 farmers)</p> <p>b. Results/ experiences disseminated to other farmers</p> <p>c. Results and experiences shared in national/ stakeholder workshops</p>				
<p>Output 3 Strengthened marketing and links with buyers (exporters/ importers).</p>	<p>1) Connecting farmers and buyers through Web portal e-spice bazaar</p> <p>2) Conducting Branding and marketing exercise(s) for all 4 spices</p>	<p>1) 4 FPOs enlisted on web-portals for spices trading</p>	<ul style="list-style-type: none"> • 8 FPOs enlisted on NSSP portal for spice trading • 8 buyer-seller meet organized 	<ul style="list-style-type: none"> • Project Reports 	

Goal/Outcomes	Project Description	Measurable Indicators / Targets	Results	Sources of Verification	Assumptions and Risks
Activities	<ol style="list-style-type: none"> 1) Enhancing e-spice bazaar portal to cover black pepper cumin, fennel and coriander (to connect farmers with buyers); and also to cover local languages and include foreign buyers: <ol style="list-style-type: none"> a. Portal enhanced b. Information of all farmers/FPOs from selected villages compiled and uploaded on the web portal c. Information of major buyers in the region and/or at national/ global level compiled and uploaded onto the portal. 2) Registering exporters and linking them to producer groups for direct procurement 3) –Organizing image development/enhancement and branding activities for GAP certified spices 4) Making available SPS requirements of major buyers on website 				

Goal/Outcomes	Project Description	Measurable Indicators / Targets	Results	Sources of Verification	Assumptions and Risks
Output 4 Establishment and implementation of a National Contaminant and Residue Control Programme (NCRCP) for identified spices.	1) Labs approved for testing of required parameters 2) NCRCP for spices developed and implemented	1) Report(s) on lab capacities available 2) NCRCP for the 4 spices developed and implemented over 1 crop season	<ul style="list-style-type: none"> • Two labs were chosen for testing seed spices • NCRCP developed and implemented for 4 spices over 1 cropping seasons 	<ul style="list-style-type: none"> • Project Reports 	

Annexure III: Data collection strategy and sampling

Data collection strategy & sampling frame

The inputs for the terminal evaluation were drawn through a mix of techniques like household surveys, key informant interviews, and focus group discussions. These methods were deployed on a sample drawn from project managers, STDF stakeholders, and beneficiaries across states.

Sample size

To calculate the sample size for HH survey from a given population of 1200 smallholder farmers with a 95% confidence interval, the Cochran formula can be used as

$$n = \frac{Z^2 \times p \times (1-p)}{e^2}$$

• n is the required sample size	• Z-score corresponding to the desired confidence level (for 95% confidence, (Z ~1.96)
• e is the desired margin of error	• p is the estimated proportion of the population with a particular characteristic probability is unknown, which is why using p = 0.5 for maximum variability

Random proportionate sampling was used to divide the calculated sample among the four states, as the four states have different proportion of the beneficiaries. Similarly, for each tool sample is given in the Table below-

Table 7: Data collection strategy including qualitative and quantitative

State	Andhra Pradesh		Gujarat		Madhya Pradesh		Rajasthan		Total
Selected Districts	Alluri Sitaram Raju		Banaskantha	Mehsana	Guna		Jodhpur	Pali	6
Selected Block	Paderu Mandal	Araku Valley	Vav Tehsil	Visnagar Tehsil	Guna	Kumbaraj	Phalodi Tehsil	Jaitaran Tehsil	8
Selected Village	Modhapalli	Chinalabudu	Dedava, Tirthgam	Umta, Kharbatiya	Negma	Gulwada	Tekra, Jaseri	Berkalla, Lototi	12
No. HH Survey	50	50	50	50	50	50	50	50	400
FGDs	1	1	2	2	1	1	2	2	12
KIIs	4-6		4-6		4-6		4-6		16-24
Case Studies	1-2		1-2		1-2		1-2		4-8

Annexure IV : List of stakeholders consulted

Gujarat stakeholders interactions

S. No	Name of Person	Designation	Organization
1.	Dr. P J Patel	Research Scientist	SDAU, Jagudan
2.	Dr. Naresh Patel	Senior Pathologist	SDAU, Jagudan
3.	Nayan Soundarva	Horticulture Officer	Horticulture dept, Mehsana
4.	Hardik Prajapati	Horticulture Officer	Horticulture dept, Mehsana
5.	Ranjeet-Bhai Thakur	Branch Manager	Krushidhan PC
6.	Kartik Udayakumar	CEO/Director	Asian Spices
7.	Riddhesh	FPO Coordinator	Digital Green Trust
8.	Sapna Tomar	Deputy Director	Spices Board, Gujarat
9.	Jyotish Kundu	Assistant Director	Spices Board, Gujarat
10.	Parth Kapadia	Field Coordinator	Spices Board, Gujarat
11.	Akash	Field Coordinator	Spices Board, Gujarat

Rajasthan interactions

S. No	Name of Person	Designation	Organization
1.	Jugal Das	Deputy Director	Spices Board, Jodhpur
2.	Dr. Shrishail Kulloli	Senior Field Officer	Spices Board, Jodhpur
3.	Dr. Naresh	Research Fellow	SABC, Jodhpur
4.	Sapna Bhera	Research Fellow	SABC, Jodhpur
5.	Shreya Mishra	Research Fellow	SABC, Jodhpur
6.	Bhardwaj	Research Fellow	SABC, Jodhpur
7.	Purushottam Mundra	Chairman	Jeera Mandi APMC, Jodhpur
8.	Salim Ahmad	CEO	Bhilwada FPC, Jodhpur
9.	Shekhar	CEO	Jaitaran FPO, Jodhpur
10.	Devi Singh	Field Coordinator	Spices Board, Jodhpur

Andhra Pradesh interactions

S. No	Name of Person	Designation	Organization
1.	Kalyani Boddu	Senior Field Officer	Spices Board Paderu Dev FO
2.	Sreekanth	Lead Audit Video Producer	Digital Green Organization
3.	A. Ramesh Kumar Rao	Assistant Director	Horticulture department, Paderu
4.	Shri Ahmedali Zulfiquar Shaik	Owner	Tuba Exim Pvt Ltd
5.	Shri Sijo Paul	Owner	Herbal Isolates(P)Ltd.
6.	Shri G Anand	CEO	Araku Gangammathalli Farmer Producer Organisation
7.	Shri Korra Suri Babu	CEO	Modapalli Farmer Producer Organisation
8.	Madhavi	Field Coordinator	Spices Board Paderu Dev FO
9.	B Lalitha Shankar	FPO Coordinator	Spices Board Paderu Dev FO

Madhya Pradesh interactions

S. No	Name of Person	Designation	Organization
1.	Bharat Gudade	Associate Director	Spices Board, Guna
2.	Ashish Jaiswal	Assistant Director	Spices Board, Guna
3.	Vishu Dev Patel	FPO Coordinator	Spices Board, Guna
4.	G S Raghuvashi	Horticulture Officer	Horticulture dept, Guna
5.	BL Prajapati	Scientist	KVK, Guna
6.	Prem Kumar Meena	Secretary	APMC, Guna
7.	Mayank	CEO	M/S Mayank Industries
8.	Madhav Sahu	CEO	M/S Keshav Grah Udyog
9.	Kendra Singh	FPO Coordinator	Digital Green Trust
10.	Ram Kishore	Field Coordinator	Spices Board, Guna
11.	Suhel Khan	Field Coordinator	Spices Board, Guna

Other stakeholders interactions

S. No	Name of Person	Designation	Organization
1.	Shaneeja	Assistant Director	Spices Board Cochin Adm HO
2.	Kuldeep Rai	Assistant Director	Spices Board Cochin Adm HO
3.	SB Sarma	Assistant Director	Spices Board Cochin Adm HO
4.	Akshay Ojha	Project Manager	Digital Green Organization
5.	Pablo Jenkins	Secretariat	WTO
6.	Vinay Singh	National Project Manager and Food Security & Nutrition Expert	FAO India

Annexure V : Evaluation questions⁵

Relevance: did the project do the right things?

Assessing relevance involves examining the differences and trade-offs between different priorities or needs. It requires analysing any changes in context to assess the extent to which the project can be (or has been) adjusted to remain relevant.

- To what extent did the objectives and design of the project respond to the SPS-related needs, policies and priorities of the beneficiaries, as well as other stakeholders involved (public and/or private sector, regional, international partners, etc.)?
- To what extent were there differences and/or trade-offs between different priorities or needs?
- How were local contexts, ownership, processes and stakeholders taken into account in the design and implementation of the project?
- To what extent did the project remain relevant, even if the circumstances changed over the course of implementation?

Coherence: how well did the project fit?

Assessing coherence covers both internal and external coherence. Internal coherence refers to the synergies and linkages between the project and other interventions carried out by the implementing agency (past and present), as well as the coherence of the intervention with the relevant international norms and standards to which that institution/Government adheres. External coherence refer to the coherence of the project with the interventions of other actors in the same context. This includes complementarity, harmonization and coordination with others, and the extent to which the intervention adds value while avoiding duplication of efforts.

How well did the project fit vis-a-vis other interventions in the particular context (country/region, sector, etc.)?

- To what extent did other interventions (including policies) support or undermine the project, and vice versa?
- What were the synergies and interlinkages between the project and other interventions carried out by the same institution/government?
- To what extent was the project complementary to and/or coordinated with relevant interventions supported by other actors in the same context, including how did it add value while avoiding duplication of effort?

Effectiveness: did the project achieve its objectives?

- To what extent were the project objectives achieved or are likely to be achieved (based on the indicators for expected outputs and outcomes identified in the project's logframe) including any differential results across groups?
- What were the major factors influencing the achievement or non-achievement of the project objectives, outcomes and outputs?
- To what extent were horizontal issues (particularly related to gender and environment) adequately addressed in the project?

⁵ Source: Terms of reference for the evaluation

Efficiency: how well were resources used?

Efficiency refers to the efficient use of available resources and aims to analyse whether the objectives have been achieved at the lowest (financial, human and organisational) cost.

- To what extent did the project deliver results in an economic and timely way, based on the project document?
- What changes and risks, if any, occurred during project implementation, and how was the project able to adapt to these changes and manage risks?
- Was the project a cost-effective contribution to addressing the needs of the beneficiary?
- How well was the project managed?

Impact: what difference did the project make?

Impact refers to the ultimate meaning and potentially transformative effects of the intervention. It involves identifying the social, environmental and economic effects of the intervention that are longer term or broader than those already considered in the effectiveness criterion. This criterion seeks to capture the indirect and potential consequences of the programme beyond the immediate outcomes.

- To what extent did the project generate, or is expected to generate, significant positive or negative, intended or unintended, higher-level effects? (These may cover an improved domestic and/or regional SPS situation, measurable impact on trade, contribution to sustainable economic growth, poverty reduction and food security, etc.)
- What real difference (expected and/or unexpected) has the project made, or is likely to have, on the final beneficiaries including on people's well-being, gender equality and the environment?
- How did the project catalyse any other action or change, for instance raising awareness on SPS challenges and/or mobilizing additional resources for SPS capacity development?

A baseline study was conducted to assess various aspects, including current operational practices by spice farmers, levels of awareness on food safety and SPS issues, income levels, current production data, rejection data, etc. This study also included a brief on the socioeconomic status of farmers, as well as the current practices followed by spice value chain actors (suppliers, pre-processors, and traders). The evaluator should take this information into account in the impact assessment.

Sustainability: will the benefits last?

Assessing sustainability involves examining the financial, economic, social, environmental and institutional capacities of the systems needed to maintain net benefits over time, as well as analysing resilience, risks and potential trade-offs. Depending on the timing of the assessment, it may involve analysing the actual flow of net profits or estimating the likelihood of net profits continuing in the medium to long term.

- *To what extent are the benefits of the project continuing, or are likely to continue over the longer term, after the end of funding support?*
- *To what extent was sustainability addressed at the design stage and during the project, and what are the major factors (including risks) influencing sustainability?*

- *Are the necessary capacities and systems (financial, social, institutional, etc.) in place to sustain the project results over time?*
- *Have commitments been made or efforts and discussions been initiated by the project stakeholders, including the implementing agency, to ensure the sustainability of the project's achievements?*
- *What follow-up activities, if any, are planned and/or required to sustain these results over time?*

Lessons learnt

- *What lessons can be learned from the project regarding the process of project design and implementation?*
- *What lessons can be learned from the project, which may be of importance to the broader donor community and which should be disseminated more widely?*
- *What actions have been taken by the beneficiary or others to disseminate, learn and follow-up on the outcomes of the project?*

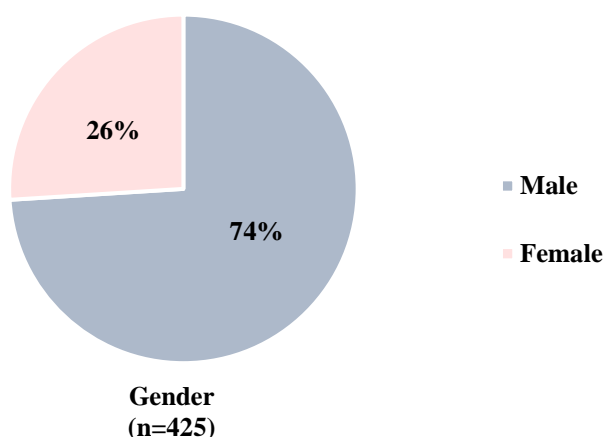
Annexure VI : Detailed findings

Key demographics

Gender composition

Across the districts engaged in spice farming, it was found that while men are more visible in the agricultural workforce, women are also actively engaged in core agricultural activities. Women's roles are typically confined to support activities, and restrictions on their mobility and interaction with male counterparts further hinder their ability to take on visible leadership roles or direct involvement in the agricultural workforce. This was further underlined by the fact that only 26 percent women responded and participated in the survey in the project villages (Figure 11).

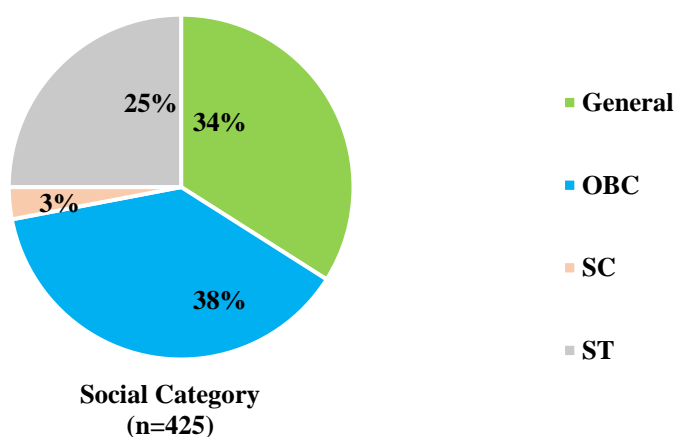
Figure 11: Gender composition of respondents



Caste composition

The social composition of respondents in the project showed that 38 percent, belonged to the Other Backward Classes (OBC) category, followed by 34 percent from the General category and 25 percent from the Scheduled Tribes (ST). Only 3 percent belonged to the Scheduled Castes (SC). This distribution highlights the project's reach across diverse social groups, with significant engagement from both marginalized and non-marginalized communities, reflecting an inclusive approach to improving the spice value chain.

Figure 12: Caste composition of respondents



Occupation

Farming is the primary occupation for most individuals in the target districts, making the spice project highly relevant to their livelihoods (Table 8). With a significant portion of their land holdings – ranging from one-third to half – dedicated to spice cultivation (Table 10), farmers have a vested interest in improving their spice production. The project aligns closely with their primary income source, offering valuable training and resources to enhance yields, quality and market access. By focusing on spices, the project addresses a major component of farmers' agricultural practices, empowering them to maximize returns on their existing land investments and improve the incomes from spice production.

Table 8: Primary and secondary occupation

Occupation	Primary	Secondary
<i>n=</i>	425	
Farmers (crops)	99%	1%
Service/salaried workers	0.8%	5%
Skilled workers	0.2%	3%
Business/traders	-	6%
Agricultural day labour	-	31%
Other self-employment	-	16%
Non-agricultural labour	-	17%
Retired/old age	-	1%
Small/cottage industry	-	0.5%
No secondary occupation	-	35%

Land ownership

The average land holding size of respondents across the project states was 10.8 acres, of which 4.5 acres (42 percent) was allocated to spice crops (Table 9). Land ownership patterns indicate that a majority of farmers are smallholders, especially in districts like ASR (Andhra Pradesh), Banaskantha and Mehsana (Gujarat) where most farmers own less than 2 hectares. In contrast, districts like Jodhpur (Rajasthan) are characterized by larger landholdings, allowing for greater investment in advanced agricultural practices. The project's interventions extended across diverse regions and landholding sizes, offering localized training sessions and making knowledge and resources accessible to farmers with varying scales of production. This approach ensured that even farmers with smaller plots could benefit from productivity-enhancing practices and technologies, fostering equitable growth and inclusivity across the States.

Table 9: Land holding and area under spice cultivation (district-wise)

District	Number of farmers covered	Average land area for agriculture (in acre)	Spices	Average land area for spices crop (In acre)	% of spices cultivation land against the total land available
Total	425	10.8	All	4.5	42
Alluri Sitaram Raju (ASR)	105	3.5	Black pepper	1.7	49
Guna	105	11.9	Coriander	3.9	33

Jodhpur	54	29.6	Cumin	16.2	55
Pali	52	16.6	Fennel	4	24
Banaskantha	52	4.5	Cumin	1.9	42
Mehsana	57	4.1	Fennel	2.3	56

Table 10 highlights the varying land allocations for agriculture and spice cultivation, with cumin showing the highest land use for spices.

Table 10: Land holding and area under spice cultivation (disaggregated by spices)

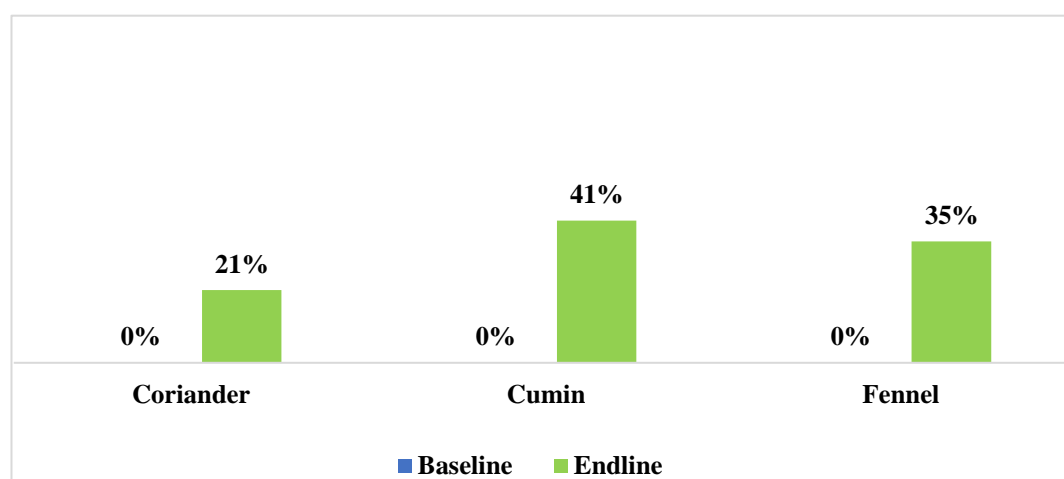
Spices	Number farmers covered	Average land area for agriculture (in acre)	Average land area for spices crop (in acre)	% of spices cultivation land against the total land available
Black pepper	105	3.9	1.9	49
Coriander	105	11.9	3.9	33
Cumin	106	17.3	9.2	53
Fennel	109	10.1	3.1	31

Pre-sowing activities disaggregated by spices

- **Seed treatment**

Figure 13 shows a significant increase in adoption of seed treatment across coriander, cumin and fennel, from 0 percent at baseline to notable percentages at endline. This rise reflects effective communication of the benefits of seed treatment, contributing to better crop protection, productivity and yields.

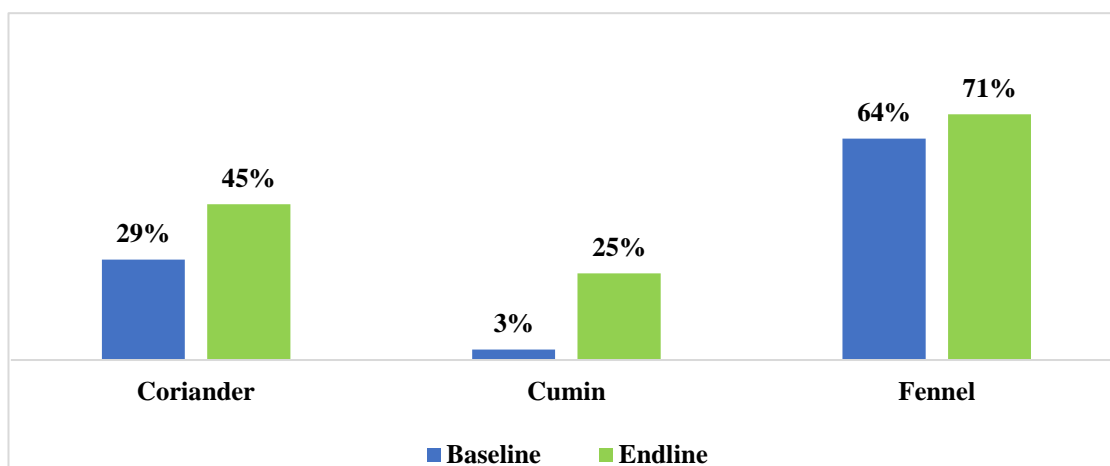
Figure 13: Performed seed treatment



- **Soil testing**

Figure 14 shows a notable increase in soil testing across coriander, cumin and fennel crops. This rise highlights farmers' growing awareness of soil health and the benefits of soil testing, leading to more informed and effective farming practices.

Figure 14: Performed soil testing (disaggregated by spices)



- **Period of sowing**

Table 11 shows a shift in sowing periods for spices like black pepper, coriander, cumin and fennel. Farmers adjusted their sowing patterns, perhaps responding to climate changes or improved agricultural guidance, to enhance crop performance.

Table 11: Sowing period disaggregated by spices

Months	Black pepper		Coriander		Cumin		Fennel	
	Baseline	Endline	Baseline	Endline	Baseline	Endline	Baseline	Endline
January	-	-	-	-	-	-	1%	-
February	-	3%	-	-	-	-	1%	1%
March	15%	-	-	-	3%	-	-	1%
April	5%	3%	-	-	-	-	-	-
May	3%	-	-	-	-	-	-	1%
June	100%	7%	-	-	-	-	10%	6%
July	45%	87%	-	-	-	-	6%	4%
August	-	-	-	-	-	-	42%	39%
September	-	-	-	-	-	-	6%	3%
October	-	-	98%	52%	99%	28%	95%	15%
November	-	-	2%	48%	99%	69%	58%	30%
December	-	-	-	-	-	3%	-	-

Inputs received from Spices Board

Table 12 highlights the inputs received by the project farmers from Spices Board across the four States.

Table 12: Distribution of surveyed farmers who received inputs (pre/post-harvest) during project activities

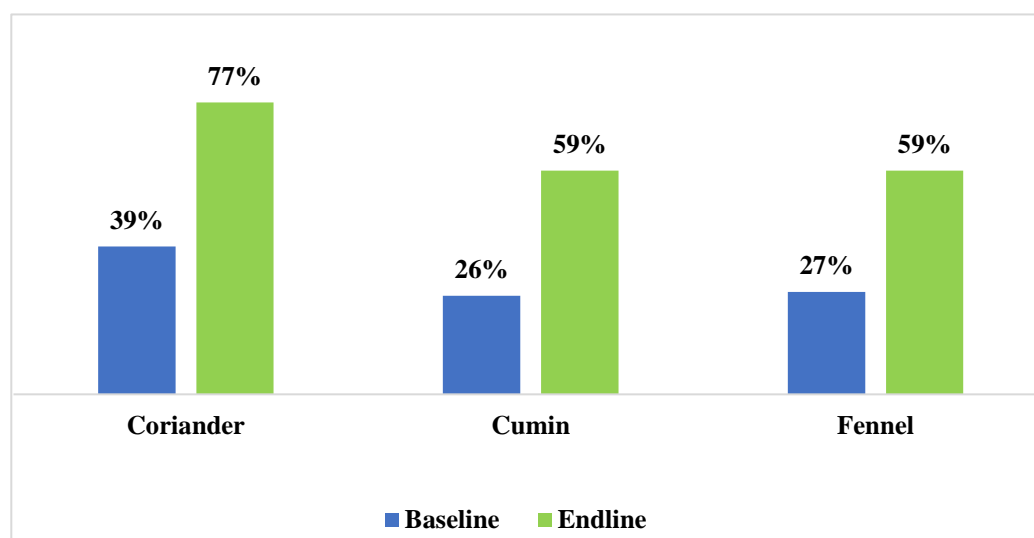
Type of input	% of surveyed farmers who received inputs
Certified seeds or saplings	26
Bio-fertilizers	7
Organic fertilizers	3
Tarpaulin sheets (post-harvest)	43
Aluminium ladders (post-harvest – black pepper farmers)	22

Inter-cultural operation disaggregated by spices

- **Adoption of IPM techniques**

Figure 15 highlights a significant rise in the adoption of IPM for coriander, cumin and fennel. This reflects the success of interventions promoting sustainable pest control, showing farmers' increasing awareness of eco-friendly pest management practices.

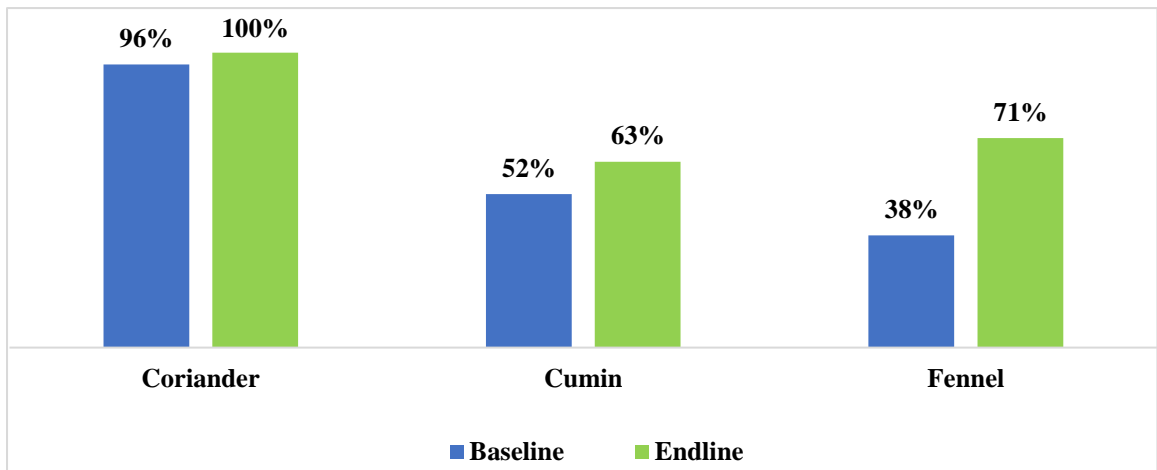
Figure 15: Adoption of IPM techniques disaggregated by spices



- **Schedule for fertilizer application**

Figure 16 shows increased adherence to scheduled fertilizer and pesticide applications, reflecting improved crop management and planning.

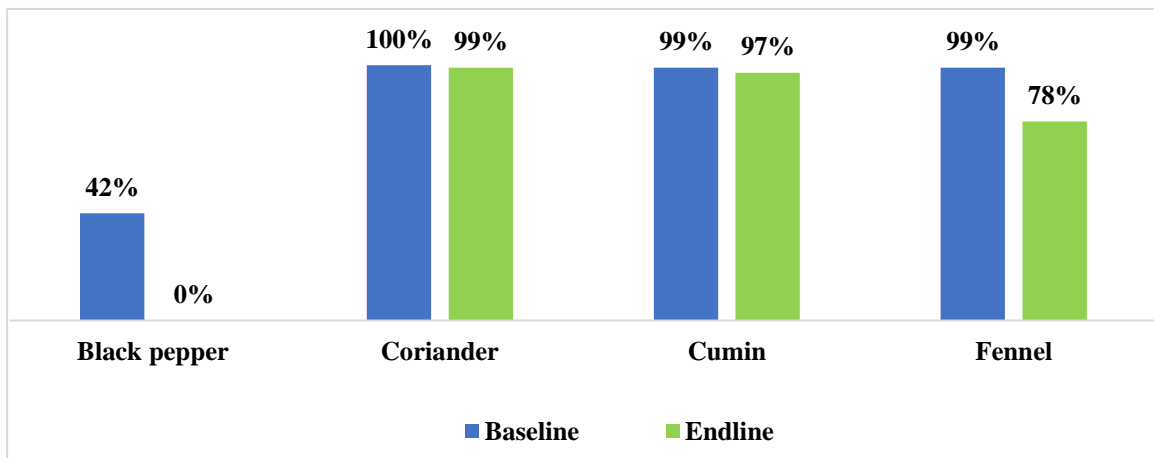
Figure 16: Follow schedule for fertilizer application (disaggregated by spices)



- Usage of fertilizer**

Figure 17 shows changes in fertilizer usage among farmers for the four spices, highlighting a significant decline for black pepper and varied trends for the others.

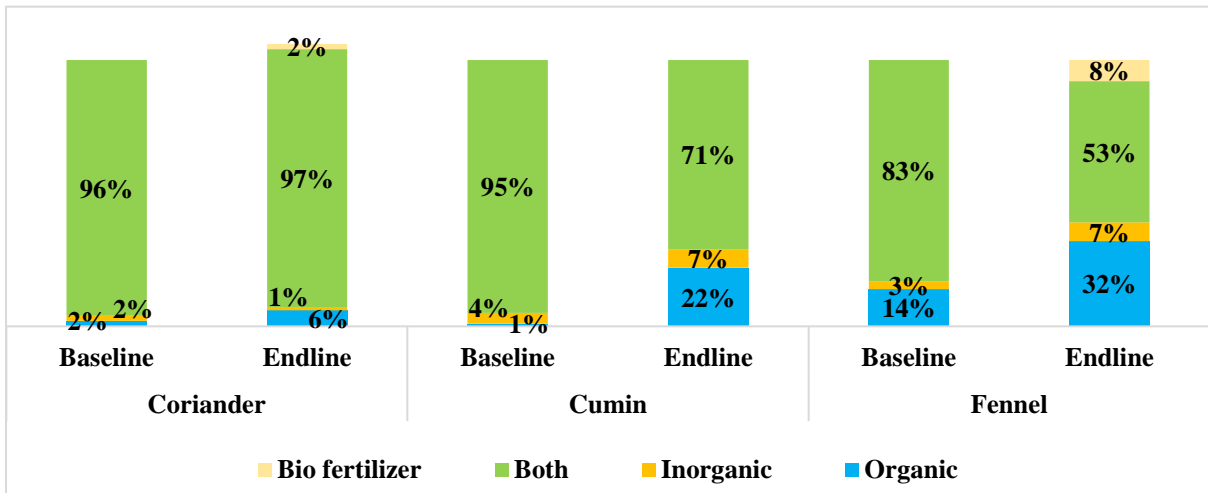
Figure 17: Use of fertilizer disaggregated by spices



- Type of fertilizer uses**

Figure 18 presents the changes in fertilizer usage in coriander, cumin and fennel crops, indicating a trend towards increased adoption of organic and bio-fertilizers for enhanced soil health and reduced reliance on inorganic inputs.

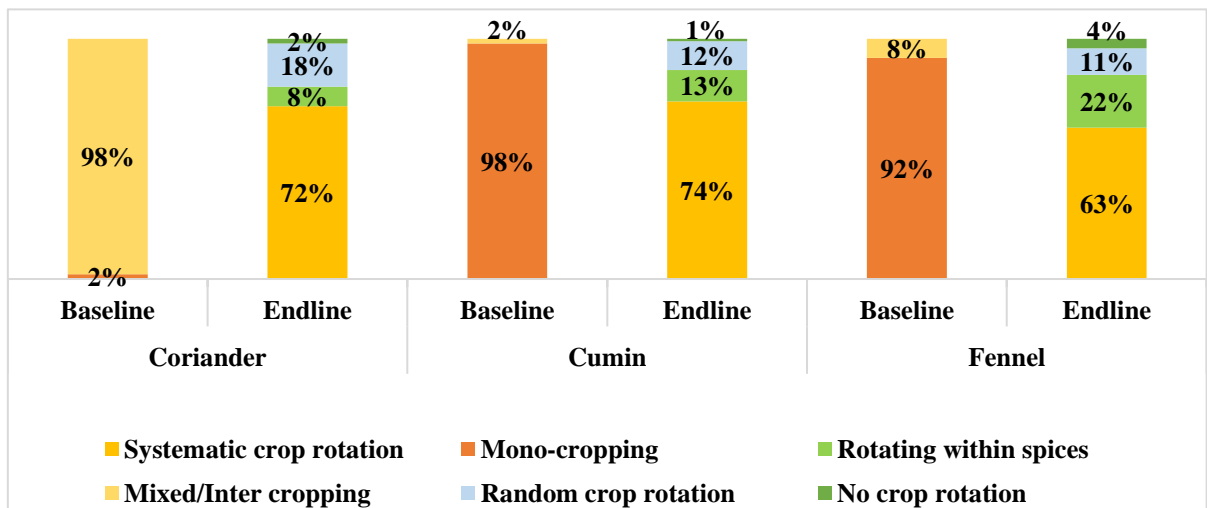
Figure 18: Type of fertilizer uses disaggregated by spices



- Crop rotation**

Figure 19 highlights a significant transition to systematic crop rotation for cumin and fennel, with coriander also showing a notable increase. This shift indicates a move away from mono-cropping toward more sustainable agricultural practices, driven by training and support from ongoing projects that promote crop diversity.

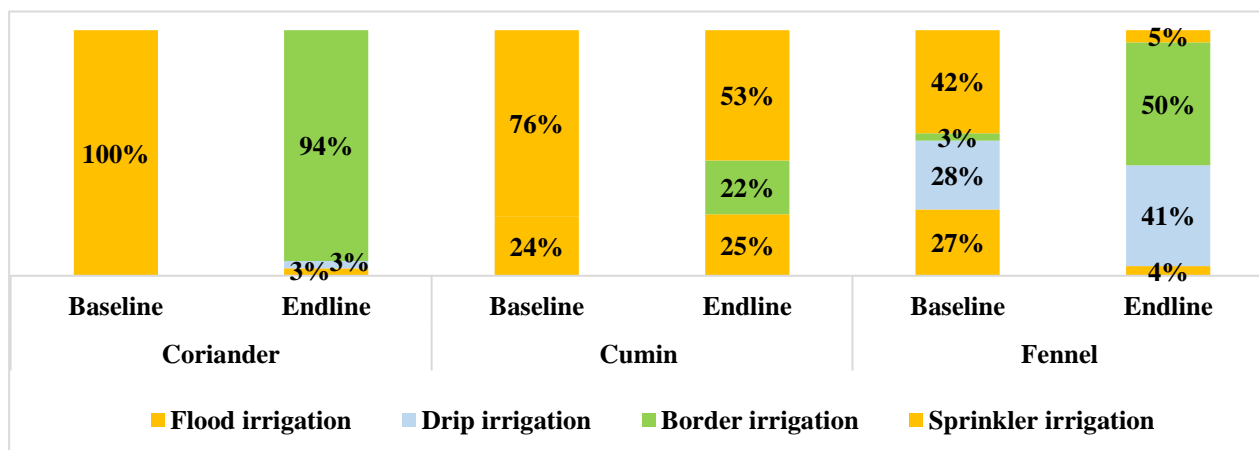
Figure 19: Practising crop rotation to improve soil fertility and pest management (disaggregated by spices)



- Water efficient irrigation practices**

The project successfully encouraged the adoption of more efficient irrigation methods, as illustrated in Figure 20. There was a significant shift away from flood irrigation towards drip and border irrigation for coriander, while fennel saw increased use of drip irrigation. This change highlights the project's effectiveness in promoting water conservation and minimizing excessive water usage.

Figure 20: Methods of irrigation disaggregated by spices



- **Usage of pesticides to avoid contamination**

Table 13 shows the project effectively promoted safer pesticide practices. Although the use of protective clothing declined slightly for coriander, improvements were observed in practices like avoiding chemical spraying in non-target areas for cumin and fennel. These changes highlight the project's success in encouraging safer pesticide application, crucial for reducing environmental contamination and protecting human health.

Table 13: Use of pesticides to avoid contamination disaggregated by spices

Practices	Coriander		Cumin		Fennel	
	BL	EL	BL	EL	BL	EL
Use protective clothing, face mask and gloves while preparing and applying chemicals	100%	82%	83%	88%	69%	78%
Avoid eating, drinking, smoking and chewing while preparing solutions	96%	78%	65%	79%	30%	42%
Take precautions to avoid spraying chemicals beyond the application area	90%	72%	67%	75%	62%	75%
Spray liquids are prepared in designated areas away from water bodies, drinking water sources, human dwellings, etc.	88%	73%	58%	64%	58%	67%
Avoid carrying bulk pesticides on the head and shoulders	73%	77%	79%	84%	34%	54%
Do not dispose left over empty containers and spray solutions in ponds, water bodies, etc.	65%	71%	20%	36%	13%	22%
Avoid mixing pesticides	51%	73%	72%	79%	49%	66%
Spray chemicals in the afternoon to avoid strong windy conditions and rain	41%	64%	44%	57%	42%	56%
Store plant protection chemicals in a dry and well-ventilated area	39%	48%	43%	56%	33%	44%
Use the right kind of sprayer with the appropriate nozzle	25%	33%	30%	38%	29%	34%
Follow waiting period to for repeated application of pesticides	20%	32%	36%	54%	34%	45%
Display information on hazardous chemicals inaccessible to children and unauthorized people in the storage area	18%	24%	60%	73%	43%	49%
Do not spray during the peak period of bee activity	4%	9%	32%	53%	14%	18%

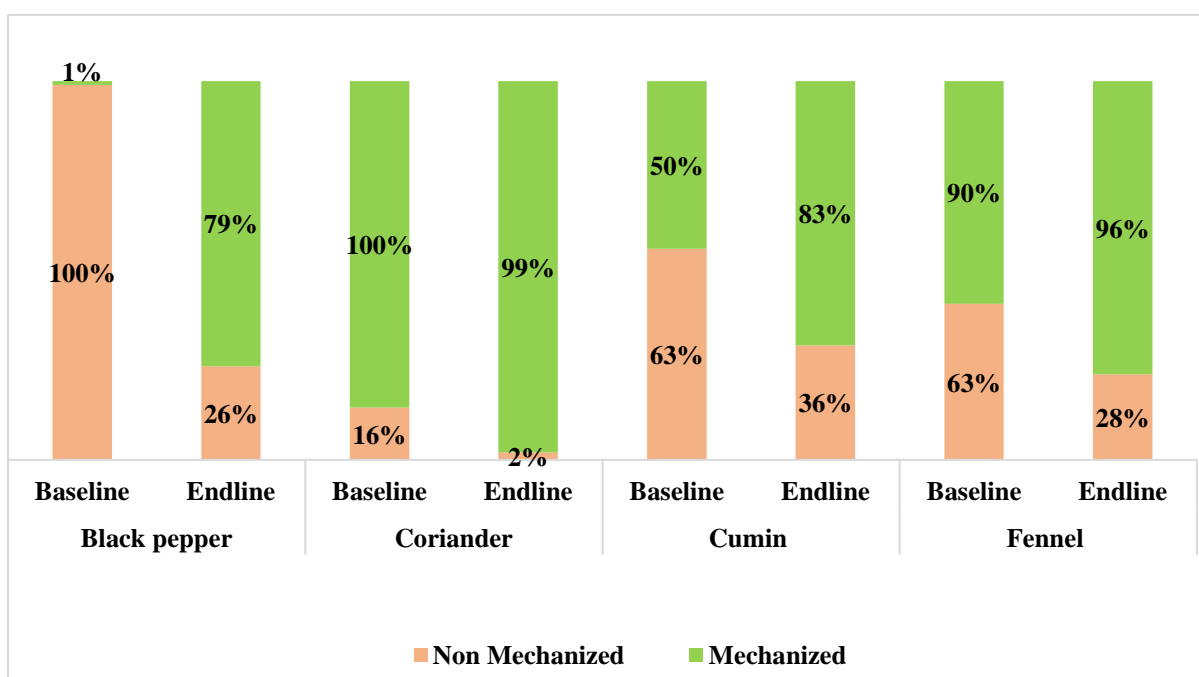
Ensure containers, buckets used for mixing chemicals are not used for domestic purposes	2%	21%	25%	29%	16%	23%
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Post harvest practices adopted - disaggregated by spices

- Method of threshing**

Figure 21 indicates a significant shift towards mechanized threshing, particularly in cumin, where the use of non-mechanized methods decreased substantially. This change underscores the project's success in enhancing labour efficiency and improving the quality of post-harvest processing.

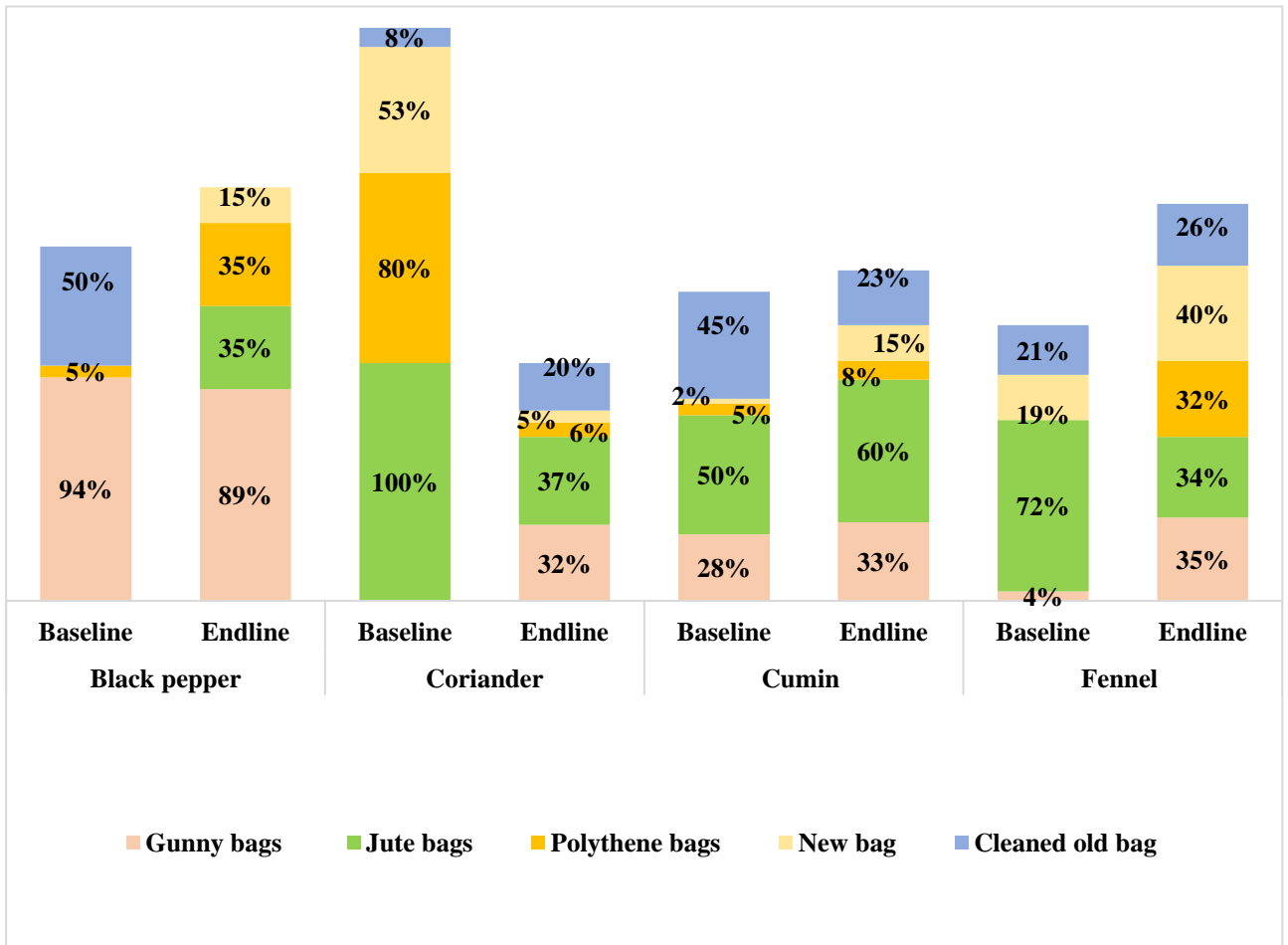
Figure 21: Methods of threshing disaggregated by spices



- Method of storing**

The project improved storage practices by reducing usage of jute bags in favour of gunny bags, enhancing storage quality and minimizing post-harvest losses while increasing the use of cleaned and new bags for better hygiene (Figure 22).

Figure 22: Method of storing disaggregated by spices



- **Practices adopted to maintain the quality and hygiene of produce**

Improvements in the quality of post-harvest operations were observed across all spices, highlighting better soil removal, increased use of proper cutting equipment and cleaner storage areas (Table 14). This emphasis on hygiene and cleanliness underscores the project's goal of enhancing market readiness, ensuring export compliance, and maintaining product integrity.

Table 14: Practices to maintain the quality and hygiene of produce disaggregated by spices

Type of Practices	Black pepper		Coriander		Cumin		Fennel	
	BL	EL	BL	EL	BL	EL	BL	EL
Ensure removal of soil material from the harvested crop	62%	77%	98%	79%	36%	59%	65%	73%
Use proper cutting equipment	95%	100%	37%	68%	58%	71%	63%	78%
Avoid harvest of unwanted plants	96%	98%	98%	76%	56%	68%	62%	73%
Storage area is kept clean and free from insects and pests	78%	85%	90%	98%	44%	62%	47%	79%
Keep the processing area clean and shaded	63%	76%	33%	65%	51%	65%	43%	53%
Established process for cleaning containers and avoiding mix up and contamination of produce	64%	87%	27%	49%	31%	34%	41%	52%
At all stages from planting to post-harvest, proper hygiene is maintained	87%	96%	0%	54%	46%	54%	40%	78%
Machinery used for fertilizer and pesticide application is properly calibrated	2%	27%	2%	26%	29%	42%	39%	54%
Proper training of staff in hygiene maintenance, the quality requirement of end products and food safety	0%	26%	8%	22%	37%	45%	38%	41%

- **Safe practices adopted to avoid contamination while drying, sorting and grading**

Improvements in prevention of post-harvest contamination were evident (Table 15), with better practices for maintaining clean storage and drying areas, significantly reduced contamination risks and enhanced training of workers. These advancements reflect a wider adoption of hygienic practices, ultimately enhancing the quality and safety of spices for local and export markets.

Table 15: Practices followed to avoid contamination while drying, sorting and grading

Practices	Baseline	Endline
Storage, drying and packaging areas are free from objectionable odor, smoke, dust, etc	6%	27%
Ensuring the conveyance for transportation in clean, well-ventilated to avoid entry of moisture	5%	46%
All equipment and utensils should prevent hygienic hazards and be easy to use and clean	4%	31%
Storage, drying and packaging areas have floors, walls and ceilings which are water-proof, free of insects and easy to clean	4%	30%
Adequate, suitable and convenient changing, toilet hand-washing facilities should be available in storage, drying and packaging areas	4%	13%
Take proper precautions during the drying process like preventing contamination of raw material; avoiding growth of microorganisms by reaching a safe moisture level; ensuring plants do not come in contact with the soil	4%	62%
Application of chemical, physical or biological agents is undertaken under the supervision of personnel who have thorough knowledge of potential health hazards	3%	14%
Storage, drying and packaging areas are properly constructed, clean and designed to prevent entrance and harboring of pests as well as designed to provide separation between different operations to avoid cross-contamination	3%	13%
Proper training of workers to maintain hygiene and food safety	3%	79%
Proper cleaning, maintenance and disposal of equipment, input and waste material post-harvest	6%	53%
Animals that are uncontrolled or that could be a hazard to health should be excluded from food handling areas	2%	13%
Not accepting spices which are known to be contaminated with parasites, microorganisms, etc.	2%	6%
Proper inspection and sorting of raw materials	0%	50%