POLICY BRIEF 74

Economic Impacts of Good Agricultural Practices and Implications for their Scaling-up

Ravi S C, Kiran Kumara TM, Shiv Kumar, T Damodaran, M Mishra, A K Gupta, and Akath Singh

With growing consumer awareness and demand for safe food, it is essential for stakeholders in the food supply chain, including producers, traders, manufacturers, and exporters, to ensure compliance with domestic and international food safety standards to safeguard public health and improve market access and the global competitiveness of food exports. Failure to meet these standards results in trade restrictions, financial losses, and damage to brand reputations. In this context, Good Agricultural Practices (GAP) are fundamental, serving as guidelines to promote safe and sustainable farming methods. These practices aim not only to protect human health and conserve natural resources but also to ensure food security and the livelihoods of farmers.

Although GAP provides significant health and environmental benefits, its widespread adoption may encounter several challenges, including farmers lack of access to knowledge and information on technologies and practices, insufficient capital, limited access to institutional credit, and higher costs of implementation. More importantly, the uncertainty surrounding the effects of GAP on crop yields, prices, and profitability makes farmers risk averse in adopting GAP.

This paper assesses the impact of GAP on the yields, costs, prices, and profit from mango orchards. India is the largest producer of mangoes. In 2023-24, the country produced 23.26 million tons of mangoes, accounting for approximately 40% of global production. In 2023-24, global exports of mangoes and mango-based products were valued at US$ 3.34 million, with India accounting for approximately 4.6% of this. One of the primary factors contributing to the poor realization of export potential is the lack of compliance with food safety standards, particularly those related to fruit fly infestations and pesticide residues, which are becoming stringent in the international market.

Good agricultural practices

Uttar Pradesh is one of the leading states in mango production in India, boasting several famous varieties, such as Dashehari, Langra, Chausa, and Safeda. The Dashehari variety has a Geographical Indication status because of its distinct quality and regional uniqueness. Dashehari mango growers encounter numerous agronomic challenges, notably aging orchards, with trees reaching heights of up to 40 feet. The tall canopy complicates intercultural operations, such as pesticide application, often requiring increased pesticide use and more labor for harvesting. Furthermore, the dense canopy restricts sunlight penetration to the lower branches, adversely affecting fruit development and ultimately resulting in reduced yields.

To address these challenges, the ICAR-Central Institute for Subtropical Horticulture (CISH), Lucknow, has developed a package of good agricultural practices (Table 1). The package comprises pruning to improve sunlight and air circulation, fruit bagging, balanced application of manures, fertilizers and micro-nutrient (Awadh Fasal Prabhat) need-based application of pesticides, and integrated eco-friendly pest management practices. Furthermore, this package emphasizes post-harvest activities, including sorting and packaging, and establishing farmers direct market linkages with traders and exporters to ensure premium prices for quality

Ravi S C (Scientist), T Damodaran (Director, ICAR-CISH), M Mishra (Principal Scientist), A K Gupta (Scientist SS) and Akath Singh (Head, Division of PHM) are affiliated with ICAR-Central Institute for Subtropical Horticulture (CISH), Lucknow. Kiran Kumara TM (Scientist), Shiv Kumar (Director, ICAR-NIAP) is affiliated with ICAR-National Institute for Agricultural Economics and Policy Research (NIAP), New Delhi. Authors express their sincere gratitude to Dr. Pratap Singh Birthal, Ex-Director, ICAR-NIAP, for his valuable guidance and support throughout this study.

produce. The implementation of this package started in 2016-17 in 60 orchards in three villages and has since expanded to 2000 orchards in 25 villages in the Lucknow district in the year 2025.

Table 1. Package of good agricultural practices

Component	Traditional practices	GAP
Pruning and canopy management	Trees left unpruned result in overcrowded branches.	Regular pruning and canopy management to maintain optimum tree height.
Application of manures and fertilizers	Reliance mainly on FYM and Phosphate fertilizers, unable to meet the nutrition requirement.	Application of recommended dose of manures, fertilizers and micro-nutrients (Awadh Fasal Prabhat)
Fruit bagging	Not followed	Fruits that are easy to reach are bagged.
Pest and disease management	7-10 times, as advised by pesticide dealers.	Need-based spraying (3-4 times) at the right time and dose in addition to the use of insect traps.
Harvesting	By shaking branches or hitting with sticks.	Harvesting with CISH-designed mango harvester.
De-sapping	No de-sapping and sap injury was common	Systematic de-sapping followed
Grading and sorting	Followed by few	Followed mostly
Packaging	Plastic crates, CFB box	CFB boxes printed with GI-125 (Malihabadi Dashehari).
Marketing	Pre-harvest contractors or local/distant markets.	Local markets, distant markets, export and direct marketing.

Economic impact of GAP

To evaluate the impact of Good Agricultural Practices (GAP), a survey was conducted in 2025, encompassing 200 mango growers who adopted GAP and 200 who did not. The survey aimed to gather data on the cost of implementing the package, crop yields, and price realization. Table 2 presents the mean differences in these parameters between GAP adopters and non-adopters. Although the implementation cost of GAP is significantly higher, the consequent increase in yield and price results in higher profits.

However, this simple comparison of means may lead to biased results because, it does not account for differences in unobserved factors between adopters and non-adopters. These unobserved characteristics could influence both the decision to adopt and the outcomes of interest, thereby confounding the estimated effect. To address this issue, Propensity Score Matching (PSM) is utilized as a robust statistical technique that mitigates selection bias by balancing observable covariates between the two groups. PSM estimates the probability of each unit adopting the practice based on observed characteristics and matches adopters with non-adopters who have similar scores. This process creates a more comparable counterfactual group. This method ensures that differences in outcomes are more likely attributable to the adoption of GAP rather than to pre-existing differences between groups.

Table 2. Comparison of costs, yields, returns and weighted average prices between GAP adopters and non-adopters

Particulars	GAP adopters	Non-adopters	Difference
Yield (ton/ha)	11.65 (0.96)	9.56 (0.79)	2.08***
Net returns (Rs./ha)	1,18,650 (65024.56)	26,452 (31533.38)	92,197***
Total cost (Rs./ha)	2,63,688 (26046.54)	2,17,372 (27044.11)	46,315***
Weighted average price (Rs./ton)	38,445 (16803.12)	23,700 (3154.39)	14,745***

Note: paired t test was used to test the significance of mean differences between adopters and non-adopters

*** indicates significance at the 1% level. Figures in parentheses indicate the standard deviation.

The implementation of the package of good agricultural practices has the potential to increase mango yield by an additional 2.40 tons per hectare (Table 3). However, it also results in a significant increase in production cost by more than Rs. 51,000 per hectare, primarily due to the additional labor required for activities such as pruning, bagging, de-sapping, harvesting, grading, and sorting. Furthermore, the use of fruit bags and corrugated fiberboard (CFB) boxes for packaging further contributes to higher production costs. Despite the increase in production expenses, the adoption

of GAP can lead to an additional profit of more than Rs. 95,000 per hectare. Notably, the implementation of GAP enables farmers to achieve a significant price premium of approximately Rs. 15,000 per ton. Preliminary calculations suggest that approximately 40% of the additional profit is attributable to the price premium, with the rest resulting from increased yield.

Table 3. Change in yields, costs and profits due to implementation of GAP

Particulars	Estimate	Standard Error
Yield (ton/ha)	2.40***	1.5
Cost (Rs./ha)	51,458.1***	4779.0
Net returns (Rs./ha)	95,204.3***	6800.5
Weighted average price (Rs./ton)	14,938.3***	125.7

Note: *** indicates significance at the 1% level.

The premium pricing of mangoes for adopters of GAP is attributable to their superior quality and implementation of post-harvest handling techniques, including grading and sorting, in accordance with market requirements. Additionally, GAP adopters benefit from direct market linkages that facilitate access to high-value buyers, such as exporters, thereby securing better prices. Conversely, more than one-third of the non-adopters of GAP often lease their orchards to pre-harvest contractors to mitigate potential losses due to crop failures and price fluctuations, which results in lower returns. Interestingly, when non-adopters select the same market channel (i.e., traders and commission agents) as adopters, they realize lower prices than adopters.

Policy implications

The evidence leaves no room for doubt that implementing good agricultural practices not only improves product quality but also enhances crop yield. This dual benefit empowers farmers to tap into premium markets, thereby significantly enhancing farm profits. However, it is important to acknowledge that the empirical evidence is drawn from Dashehari mangoes in Uttar Pradesh, the policy insights derived from the study are broadly applicable to other mango-growing regions with comparable farm and market conditions. To effectively scale up these practices, the following issues need to be addressed.

Improving access to institutional credit: A considerable number of farmers opt to lease their orchards to pre-harvest contractors, primarily to secure advance payments for immediate financial requirements and to mitigate production and price risks. However, this arrangement often results in farmers becoming entrenched in a continuous cycle of leasing, thereby restricting their capacity to invest in enhanced orchard-management practices. To disrupt this cycle and enable mango growers to adopt GAP, it is essential to improve their access to institutional credit to meet the additional expenses required for its adoption. Credit-linked crop insurance or price-risk insurance may be introduced to protect farmers against yield loss and market volatility.

Access to premium markets: The adoption of Good Agricultural Practices (GAP) entails additional costs for compliance, necessitating a guaranteed premium price to ensure sustained adoption. To secure premium pricing, mangoes cultivated under GAP should be branded and marketed as "premium spot-free, low residue" mangoes. Furthermore, GAP certification (Bharat GAP/Global GAP), residue testing, quality assurance at the packhouse level, and QR-based traceability systems are crucial for product differentiation and gaining consumer confidence. Financial support under Mission for Integrated Development of Horticulture (MIDH) may be extended for GAP certification, residue testing, and QR-based traceability systems.

Leveraging the Geographical Indication (GI) status of mangoes, provides a strategic advantage in harnessing their export potential. By establishing export facilitation, the supply chain can be optimized to meet stringent international quality and traceability standards. These hubs may serve as centralized points for aggregation, quality control, and certification, which are critical for building brand reputation in competitive global markets.

Mechanization through custom hiring centers (CHCs): The constraints on canopy management are primarily due to a lack of mechanization and a scarcity of skilled labor. To mitigate these challenges, it is proposed that custom hiring centers be equipped with advanced pruning machines and harvesters. Access to such machinery will facilitate rejuvenation efforts, thereby making the adoption of Good Agricultural Practices (GAP) economically viable for resource-poor marginal farmers.

Develop GAP clusters: Establishing model GAP clusters can create a concentrated and manageable area for implementing and showcasing best practices. These clusters facilitate peer learning and collective problem-solving among farmers, thereby enhancing the adoption of improved techniques. Supporting these clusters with farmer field schools (FFS) further strengthens their effectiveness as demonstration platforms. Collective marketing and certification through Farmer Producer Organizations (FPOs) can further reduce transaction costs, facilitate branding and traceability in addition to better price realization.

Strengthening extension systems: Limited awareness and lack of technical understanding of GAP continue to be significant barriers to their widespread adoption. To scale up adoption, a multi-tiered extension strategy is necessary, involving Farmer Producer Organizations (FPOs) or farmer groups. FPOs can act as key facilitators for collective learning, sharing best practices, and providing peer support to motivate farmers to adopt GAP. Furthermore, they have better negotiating power. By leveraging the social capital and organizational capacity of FPOs, extension programs can achieve wider outreach.

Make financial assistance conditional upon adoption and promotion of GAP: Stakeholders receiving financial support from government schemes, such as the Integrated Mission on Horticulture, should be mandated to implement Good Agricultural Practices (GAP) to ensure sustainable and quality agricultural production. Additionally, establishing a robust traceability system is crucial for stakeholders to track the origin and movement of agricultural products throughout the supply chain.

Strengthening input quality regulation: The widespread use of spurious pesticides, low-quality fruit bagging materials, and farmers' reliance on shopkeepers for pest management advice hinder effective pest management and affect product quality. To tackle the problem of counterfeit pesticides, it is crucial to enhance the regulatory system by incorporating market surveillance, routine sampling and testing of pesticides, and imposing severe penalties for breaches, all backed by QR-based traceability.

Moreover, the development of advanced models for predicting pest and disease incidence, in conjunction with a digital advisory framework, can offer real-time guidance on pest alerts, optimal bagging timelines and weather-related risks. This approach will enhance decision-making processes, minimize excessive pesticide application, and contribute to the production of mangoes free of chemical residues.

Invest in research and development (R&D): Fruit bagging is a critical practice for producing spot-free and residue-free mangoes; however, farmers face constraints due to the limited availability of good-quality bagging materials. The use of substandard paper bags often results in moisture accumulation and microbial growth, thereby reducing fruit quality. Furthermore, fruits located in the upper canopy are difficult to access, making manual bagging difficult. To address this gap, there is a need to develop waterproof and UV-resistant paper bags, identify safe and effective coating materials with microbial growth resistant properties, standardize quality parameters (thickness, porosity, strength, biodegradability).

Furthermore, it is essential to develop appropriate mechanization solutions, such as handheld or pole-mounted devices and robotic arms, to facilitate the efficient bagging of fruits in high canopies.

February 2026

ICAR – NATIONAL INSTITUTE OF AGRICULTURAL ECONOMICS AND POLICY RESEARCH
(Indian Council of Agricultural Research)
P.B. No. 11305, Dev Prakash Shastri Marg, Pusa, New Delhi-110 012, INDIA
Phone : 91-11-25847628, 25848731, Fax : 91-11-25842684 E-mail : director-niap@icar.org.in
https://www.niap.res.in