

Constraints in the Implementation of Post-Harvest Management Practices among Organic Rice Farmers in Karanganyar Regency, Central Java

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Abstract

Post-harvest management is critical to maintaining the quantity, quality, and market value of organic rice. However, organic rice farmers may face technical, economic, infrastructural, and environmental constraints that limit the effectiveness of post-harvest handling. This study aimed to identify and analyze the constraints organic rice farmers encounter when implementing post-harvest management practices in Karanganyar Regency, Central Java, Indonesia. A quantitative field survey was conducted from June to July 2026, involving 101 organic rice farmers from six farmer groups in Mojogedang and Kerjo Districts. Respondents were selected using a snowball sampling technique. Data were collected through structured questionnaires with 12 dichotomous indicators representing constraints related to post-harvest information, equipment, pest occurrence, extension support, financial assistance, weather conditions, storage facilities, transportation, milling quality, pest-control practices, packaging technology, and product quality and marketability. Responses were recoded so that a score of 1 consistently represented the presence of a constraint and 0 its absence. The results showed that pest attacks were the most frequently reported constraint, experienced by 81% of respondents. Other major constraints included limited development and improvement of post-harvest equipment (77%), limited availability of vacuum packaging technology (73%), insufficient financial support (72%), and unfavorable weather conditions (51%). In contrast, constraints related to milling quality (2%), access to post-harvest information (8%), extension and mentoring support (8%), and storage facilities (10%) were reported by relatively fewer farmers. These findings indicate that the major challenges in organic rice post-harvest management are predominantly related to pest management, technological availability, financial capacity, and environmental conditions. Strengthening access to appropriate post-harvest technologies, financial support, and organic-compatible pest management strategies is therefore important to improve the efficiency and sustainability of organic rice post-harvest management.

Keywords Food loss, Post-harvest management, Organic rice, Sustainable agriculture, Socio-economic characteristics

INTRODUCTION

Food loss is a major challenge to global food security and sustainable agri-food systems because it reduces food availability and wastes land, water, energy, and labor invested in production. Losses at the production and post-harvest stages also have economic and environmental impacts, making food loss reduction an important strategy for improving food system efficiency and supporting sustainable development (Cattaneo et al., 2021; Xue et al., 2017).

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Rice (*Oryza sativa* L.) is a staple for more than half of the world's population and is particularly important for food security and rural livelihoods in Asia. In Indonesia, post-harvest losses remain a persistent problem despite improvements in rice production. Losses during harvesting, threshing, drying, transportation, storage, and milling can reduce rice quantity and quality, decrease farmers' income, and weaken value-chain efficiency (Stathers et al., 2020). Therefore, improving post-harvest management offers an important opportunity to enhance food availability without requiring additional land or production inputs.

Effective post-harvest management is especially important in organic rice systems. Organic farming supports environmental conservation, biodiversity protection, and sustainable agriculture by reducing reliance on synthetic fertilizers and pesticides (Reganold & Wachter, 2016). However, organic rice requires careful post-harvest handling to preserve grain quality, prevent contamination, maintain organic integrity, and meet certification requirements. Inadequate handling can accelerate deterioration, increase food loss, and reduce product competitiveness. Previous studies have primarily focused on estimating post-harvest losses, evaluating technologies, and improving storage or supply-chain efficiency (Delgado et al., 2021; Stathers et al., 2020), while less attention has been given to the practical constraints organic rice farmers face in implementing recommended post-harvest practices.

In Indonesia, research on organic rice has largely focused on cultivation, productivity, certification, and marketing, whereas evidence on constraints in post-harvest management remains limited. Understanding these constraints is important for developing appropriate interventions to improve post-harvest efficiency and support sustainable organic rice production. Therefore, this study aims to identify and analyze the constraints faced by organic rice farmers in implementing post-harvest management practices in Karanganyar Regency, Central Java, Indonesia. The findings are expected to provide a basis for improving post-harvest strategies and supporting the efficiency and sustainability of organic rice farming.

LITERATURE REVIEW

Post-Harvest Management

Post-harvest management encompasses a series of activities conducted after harvest to preserve the physical, chemical, nutritional, and economic quality of agricultural products until they reach consumers. These activities include harvesting, threshing, drying, cleaning, milling, packaging, storage, transportation, and distribution. Proper post-harvest handling is essential because inappropriate practices can accelerate physical damage, quality deterioration, and biological contamination. Tong et al. (2019) emphasized that postharvest operations, particularly drying, storage, and milling, play an important role in maintaining rice grain quality by influencing its physical characteristics, nutritional composition, and sensory properties. Similarly, Müller et al. (2022) highlighted drying and storage as critical stages because they directly affect grain moisture, milling quality, and storage stability.

Advances in post-harvest technology have introduced innovations such as mechanical harvesting equipment, improved drying systems, environmental monitoring, hermetic storage, and modern packaging technologies to improve handling efficiency and reduce product deterioration. However, adoption of these technologies remains limited among smallholder farmers because of inadequate infrastructure, limited technical knowledge, and financial constraints. Zhang et al. (2021) demonstrated that integrated post-harvest management using the Five Time (5T) management approach significantly reduced post-harvest losses by improving the efficiency of harvesting, field handling, drying, warehousing, and storage operations.

Food Loss

Food loss is a reduction in the quantity or quality of food intended for human consumption that occurs during production, harvesting, post-harvest handling, storage, processing, and distribution before reaching retail markets. It differs from food waste because it primarily occurs in the upstream stages of the food supply chain and is generally associated with technical, environmental, and managerial constraints rather than consumer behavior. [Bellemare et al. \(2017\)](#) emphasized that food loss involves not only a reduction in food quantity but also a decline in economic value and resource-use efficiency. In addition, food loss undermines food security, reduces farmers' income, and increases environmental burdens through the inefficient use of land, water, labor, and energy. [Chauhan et al. \(2021\)](#) further highlighted that food loss is influenced by technical, managerial, institutional, and logistical factors across multiple stages of the supply chain.

Reducing food loss requires improvements in harvesting techniques, post-harvest handling, storage, transportation, packaging, and supply chain coordination. [Moraes et al. \(2021\)](#) classified food loss prevention strategies into technological, managerial, educational, and policy-based approaches, emphasizing the importance of stakeholder collaboration. In cereal commodities such as rice, losses commonly occur during harvesting, drying, storage, and transportation, where improper handling can cause mechanical damage, pest infestation, microbial contamination, and quality deterioration. [Nicastro and Carillo \(2021\)](#) emphasized that integrated preventive strategies from farm to fork, supported by improved post-harvest management, technological innovation, and stakeholder collaboration, are essential for reducing food loss and supporting food security and sustainable agricultural systems.

Organic Rice

Organic rice is produced using an agricultural system that prioritizes ecological sustainability by avoiding synthetic fertilizers, pesticides, genetically modified organisms (GMOs), and chemical growth regulators, while promoting biodiversity, soil fertility, and environmental conservation. Organic farming relies on practices such as organic fertilization, biological pest control, and crop rotation to maintain soil health and productivity. [Willer et al. \(2024\)](#) noted that the expansion of organic agriculture reflects growing global awareness of environmental sustainability and food safety, as well as demand for environmentally responsible products. Similarly, [Mie et al. \(2017\)](#) reported that organic farming provides environmental benefits, including enhanced biodiversity, improved soil quality, reduced pollution, and lower dependence on synthetic agricultural inputs.

Despite these advantages, organic rice production faces several challenges, including lower yields during the conversion period, higher labor requirements, vulnerability to pests and diseases, stricter certification standards, and limitations in post-harvest handling. [Seufert and Ramankutty \(2017\)](#) emphasized the importance of improved management practices and technological innovation to maintain the environmental benefits of organic farming while improving productivity. Post-harvest management is particularly important for preserving the quality and market value of organic rice through appropriate drying, sanitation during storage, moisture control, and environmentally friendly packaging. Effective post-harvest handling helps prevent pest infestation, microbial contamination, and quality deterioration while maintaining organic integrity, reducing food loss, and supporting sustainable organic rice value chains ([Eyhorn et al., 2019](#)).

RESEARCH METHOD

Study Location

This study was conducted in Mojogedang and Kerjo Districts, Karanganyar Regency,

Central Java, Indonesia. These locations were purposively selected because they are part of an organic rice production area on the slopes of Mount Lawu and have been developed to support sustainable organic agriculture (Prajatino et al., 2021). Six organic rice farmer groups were selected as research units based on their consistent implementation of organic rice farming and involvement in post-harvest activities. The geographical distribution of the study area is shown in Figure 1.

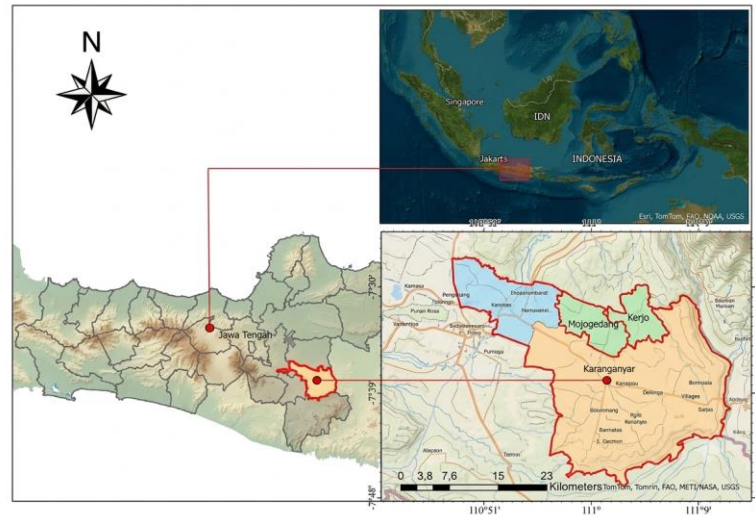


Figure 1. Research location

Research Design and Data Collection

This study used a quantitative research approach and a field survey to identify and examine the constraints organic rice farmers face in implementing postharvest management practices. A quantitative survey enables the systematic collection of standardized information from a defined group of respondents and is appropriate for describing farmers' perceptions and experiences regarding specific constraints encountered in farming activities (Creswell & Creswell, 2018; Taherdoost, 2022). Primary data were collected through structured questionnaires administered directly to farmers. Respondents were selected using snowball sampling, with eligibility criteria requiring active involvement in organic rice farming and participation in harvesting or postharvest activities. A total of 101 farmers from six farmer groups—Tani Mulyo I, Tani Mulyo V, Pandan Sari, Sri Rejeki 1, Sri Rejeki 2, and Konco Tani—participated in the study. Data collection was conducted from June to July 2026.

Determining Constraints in Post-Harvest Management Practices

Post-harvest constraints were assessed using 12 dichotomous “Yes” or “No” questions covering access to information, equipment, pest occurrence, extension support, financial assistance, weather conditions, storage facilities, transportation losses, milling quality, pest control, packaging technology, and declining selling prices of unsold organic rice. Responses were recoded so that a score of 1 consistently indicated the presence of a constraint and 0 its absence. For positively worded indicators, “No” was coded as 1 and “Yes” as 0.

FINDINGS AND DISCUSSION

Constraints in Post-Harvest Management Practices among Organic Rice Farmers

Figure 2 shows the various constraints faced by farmers in implementing organic rice post-harvest management practices. Based on the survey results, there is variation in the level of

constraints perceived by respondents, with some constraints reported by more than 70% of the farmers.

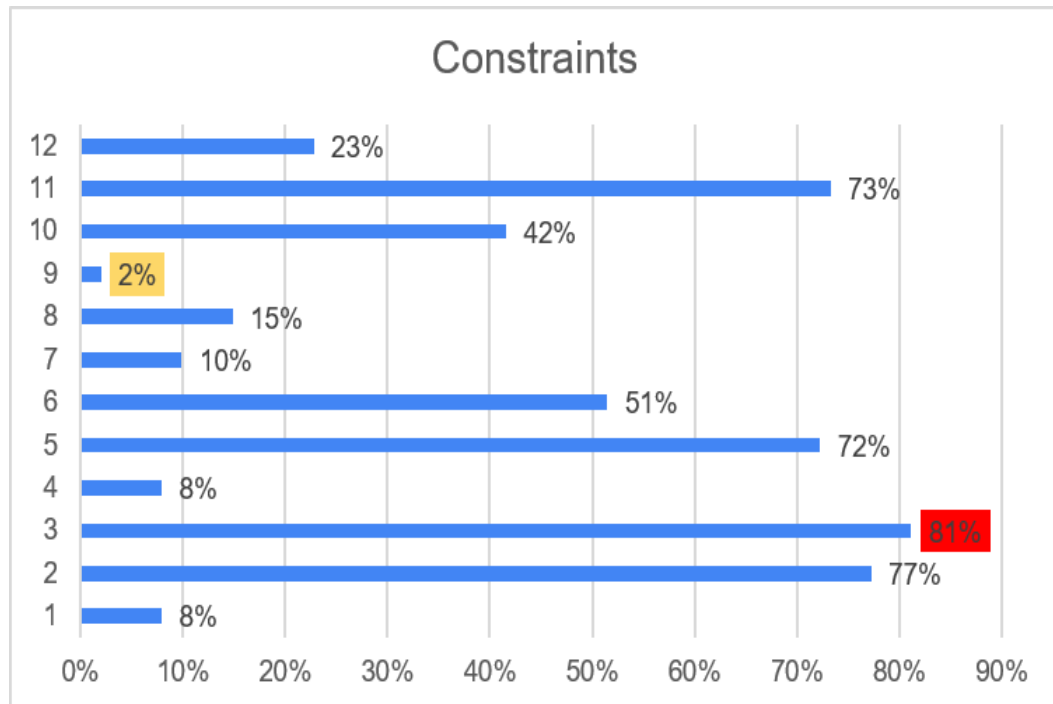


Figure 2. Constraints

Figure 2 shows that organic rice farmers in Karanganyar Regency face post-harvest constraints of varying intensity. The most frequently reported constraints were pest attacks (81%), limited development or improvement of post-harvest tools (77%), limited availability of vacuum technology (73%), limited financial support (72%), and weather conditions (51%). Other constraints included pesticide use for pest control (42%), shelf life and quality of organic rice (23%), paddy spillage during transportation (15%), storage facilities (10%), access to post-harvest technology information (8%), extension and mentoring support (8%), and rice milling quality (2%).

Pest attacks are the most prominent challenge, underscoring the difficulty of maintaining effective crop and grain protection in organic farming systems where the use of synthetic pesticides is restricted. Inadequate pest control during harvesting, drying, and storage can increase grain damage, reduce production quantity and quality, and lower the market value of organic rice. Technological constraints are also substantial, particularly limited access to improved post-harvest equipment and vacuum packaging technology. Dependence on manual or simple equipment may increase the risk of yield loss and quality deterioration, while limited use of vacuum packaging restricts opportunities to extend shelf life by reducing exposure to oxygen, moisture, and storage pests.

Financial and environmental constraints further affect post-harvest management. Investment in equipment, storage facilities, and packaging technology requires considerable capital, making access to financing and government support essential for technology adoption. Weather conditions, particularly heavy rainfall during harvest, may delay drying, increase grain moisture, and accelerate quality deterioration. Transportation-related spillage also contributes to losses when paddy is moved from fields to drying or milling locations, underscoring that post-harvest constraints are influenced by both environmental conditions and supporting infrastructure.

In contrast, relatively few farmers reported constraints related to milling quality, extension

and mentoring support, and access to post-harvest information. This suggests that access to information and assistance may be better than access to technology, financing, and infrastructure, although the low percentages do not necessarily indicate that these aspects are fully optimal. Overall, improving organic rice post-harvest management requires an integrated approach that combines appropriate technology, improved access to financing, adequate infrastructure, and pest-management strategies consistent with organic farming principles to enhance post-harvest efficiency, production sustainability, and product competitiveness.

Discussion

Pest infestation was a major constraint on postharvest management among organic rice farmers, indicating that food loss may persist beyond cultivation, particularly during storage. Because synthetic pesticides are prohibited in organic systems, proper drying, moisture control, sanitation, and pest prevention are essential to reduce insect infestation, microbial contamination, grain deterioration, and both quantitative and qualitative losses. [Stathers et al. \(2020\)](#) identified inadequate storage practices as a major cause of postharvest losses among smallholder cereal producers, while [Cattaneo et al. \(2021\)](#) emphasized that improved postharvest management is an effective strategy for reducing food loss and enhancing agri-food system efficiency and sustainability.

Limited availability of postharvest equipment and its improvement were also major constraints, indicating continued dependence on manual operations and simple tools that may increase mechanical damage, processing delays, and quality deterioration. Inadequate access to postharvest technology has been associated with greater food losses, whereas investment in appropriate technologies can improve product quality and reduce losses ([Affognon et al., 2015](#)). Similarly, [Stathers et al. \(2020\)](#) highlighted the importance of improved technologies for increasing storage efficiency, reducing losses, and strengthening food security among smallholders. Limited adoption of vacuum packaging was another important constraint, likely related to high investment costs, limited equipment access, and small-scale farming. Vacuum packaging can reduce oxygen exposure, oxidative deterioration, and microbial growth. [Klaykruayat et al. \(2020\)](#) found that vacuum packaging, combined with appropriate storage conditions, maintained rice physicochemical quality and extended storage life, while [Stathers et al. \(2020\)](#) emphasized the effectiveness of improved storage and packaging technologies in minimizing food losses and preserving grain quality.

Financial constraints further limit the adoption of improved postharvest practices because harvesting equipment, drying facilities, storage warehouses, and packaging technologies require substantial investment. This constraint is especially significant for small-scale organic farmers, who also incur additional production and certification costs. [Wossen et al. \(2017\)](#) found that access to financing positively influences agricultural technology adoption and farm productivity. Weather conditions also pose a significant challenge, as heavy rainfall can delay drying, increase grain moisture, and raise the risk of mold growth, quality deterioration, and storage losses. Climate variability and increasingly frequent extreme weather events further complicate natural drying processes. The [IPCC \(2023\)](#) reported that climate variability has increased the vulnerability of food production systems, including postharvest activities, underscoring the need for more adaptive drying and storage technologies.

Overall, the findings indicate that constraints in organic rice postharvest management are interconnected across technical, technological, economic, and environmental dimensions. Therefore, reducing postharvest food loss requires an integrated approach that improves access to appropriate technologies, strengthens financial support, develops storage infrastructure, and promotes pest-control strategies aligned with organic farming principles. These measures can

improve postharvest efficiency while supporting the sustainability and competitiveness of organic rice production.

CONCLUSIONS

This study identified the primary constraints organic rice farmers in Karanganyar Regency, Central Java, face in implementing post-harvest management practices. The most frequently reported constraints were pest attacks, limited development and improvement of post-harvest equipment, limited availability of vacuum packaging technology, insufficient financial support, and unfavorable weather conditions. These findings indicate that post-harvest management among organic rice farmers is primarily constrained by technical, technological, economic, and environmental factors. Improving access to appropriate post-harvest technologies, financial support, infrastructure, and pest management strategies compatible with organic farming principles is therefore important to enhance the efficiency and sustainability of organic rice post-harvest management.

LIMITATIONS & FURTHER RESEARCH

This study was limited to 101 farmers from six farmer groups in Mojogedang and Kerjo Districts and used a cross-sectional design focused on constraints at the farmer level. Therefore, the findings should be interpreted within the study area. Future research should include broader organic rice production areas and larger samples, as well as other actors in the post-harvest supply chain. Further studies may also examine the relationship between specific post-harvest constraints and the magnitude of food loss to provide stronger evidence for developing targeted interventions and policies.

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