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Production Improvement in Siam Orange Farming: A Farmer Group Case in Kendari, Indonesia

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Abstract

Improving horticultural production requires both higher output and stronger farmer capacity to manage harvesting and fruit quality. This study analyzed production improvements in Siam orange farming by linking changes in production capability to physical production outcomes. The study was conducted in the Makmur Sejahtera Farmer Group, Mokoau, Kambu District, Kendari City, Indonesia, using a descriptive longitudinal case-study approach. The study assessed production capability using seven indicators scored on a five-point scale and evaluated production performance through production per tree, premium-fruit proportion, damaged-fruit proportion, and sorting practices. The production-capability score increased from 19 to 33 out of a maximum of 35, a 73.68% increase. Representative production increased from 30.0 to 37.5 kg/tree, a 25.00% increase. Premium fruit increased from approximately 50% to 65%, while damaged fruit decreased from 9% to 5%. Premium output per tree consequently increased from approximately 15.00 to 24.38 kg. The largest improvements in production capability occurred in quality-oriented harvesting and fruit sorting. The findings indicate that production improvement was characterized not only by increased yield but also by greater farmer capability, higher premium output, and lower fruit damage. These results highlight the importance of integrating production quantity and quality-related capability in evaluating smallholder horticultural performance.

Keywords: Siam orange, production improvement, farmer group, production capacity, fruit quality

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INTRODUCTION

Farmer capacity is an important determinant of agricultural performance because production depends not only on land and inputs but also on farmers' ability to apply appropriate production practices. Farmer groups can support this capacity by facilitating learning, technology adoption, information exchange, and collective problem-solving. Studies in Indonesia have shown that farmer-group functions and group dynamics are associated with farmers' capacity to manage agricultural activities (Jaya et al., 2017; Nuryanti & Swastika, 2011; Safei et al., 2021; Wahyuni et al., 2017).

International evidence also indicates that participation in farmer organizations may improve technology adoption, technical efficiency, and agricultural productivity. Farmer groups can facilitate access to production knowledge, inputs, technology, and mechanization (Ainembabazi et al., 2017; Bairagi & Mottaleb, 2021; Wossen et al., 2017). Abdul-Rahaman and Abdulai (2018) reported higher yields and technical efficiency among farmer-group participants, while Lin et al. (2022) found positive effects of cooperative membership on rice productivity through mechanisms including mechanization, quality inputs, and technical training.

Indonesian evidence similarly demonstrates a positive relationship between farmer-group membership, farming practices, and agricultural productivity (Baga et al., 2023). However, organizational effects may vary with farming conditions and organizational characteristics, meaning group membership alone does not necessarily reflect farmers' actual production capability (Verhofstadt & Maertens, 2014).

Production improvement in horticultural farming also requires attention to product quality. An increase in harvested quantity may have limited value if a substantial proportion of fruit is damaged or classified as low quality. This issue is particularly relevant for citrus because inappropriate harvesting, rough handling, physical injury, and postharvest diseases can reduce the proportion of marketable fruit. Dwiastuti et al. (2021) reported that inadequate postharvest handling contributes to physical damage and deterioration of fresh fruit in Indonesia. Strano et al. (2022) similarly emphasized that appropriate harvesting and postharvest management are essential to reduce citrus losses and preserve fruit quality.

Siam orange production should therefore be evaluated using more than total yield. Farmers' ability to identify harvestable fruit, harvest appropriately, handle fruit properly, separate damaged fruit, sort products, use equipment, and record production represents an important operational dimension of production performance.

Previous studies have mainly examined the relationship between farmer-group membership and productivity or technical efficiency. Less attention has been given to the

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specific production capabilities that change within a farmer group and how these changes correspond with physical production and fruit-quality composition.

This study is novel in assessing production improvement through both physical output and task-level production capability. Production improvement is therefore interpreted not only as an increase in kilograms per tree but also as an increase in premium output and a reduction in damaged fruit. This study aimed to analyze production improvement in Siam orange farming based on changes in farmer-group production capability, production per tree, premium-fruit proportion, fruit damage, and sorting performance.

METHOD

The study used a descriptive longitudinal case-study design comparing two observation periods within the same farmer group. The research was conducted in the Makmur Sejahtera Farmer Group, Mokoau, Kambu District, Kendari City, Southeast Sulawesi, Indonesia. The group managed approximately 3 ha of Siam orange cultivation containing around 1,000 trees, of which approximately 700 trees were productive.

Production capability was measured using seven indicators: determining fruit suitable for harvesting, implementing quality-oriented harvesting techniques, conducting initial fruit handling, separating healthy and damaged fruit, sorting premium and non-premium fruit, using harvesting and sorting equipment, and weighing and recording harvested products.

Each indicator was evaluated using a five-point ordinal scale. A score of 1 represented very low capability, 2 represented initial knowledge without adequate application, 3 represented implementation with assistance, 4 represented independent implementation, and 5 represented independent and consistent implementation. Ordinal rating scales can summarize progressive levels of capability, but interpretation should remain consistent with the properties of ordinal data (Norman, 2010; Sullivan & Artino, 2013).

The maximum production-capability score was 35. Production-capability attainment was calculated as:

Production capability attainment (%) = Observed score / Maximum score × 100

Relative change was calculated as:

Change (%) = (Follow-up value − Initial value) / Initial value × 100

Physical production indicators consisted of representative production per productive tree, premium-fruit proportion, non-premium-fruit proportion, damaged-fruit proportion, and systematic sorting. The analysis was descriptive because the available data represented aggregate observations of one farmer group at two measurement periods. We did not perform

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inferential statistical tests because we lacked individual-level repeated observations and a comparison group.

RESULTS AND DISCUSSION

The production-capability score increased from 19 to 33 out of a maximum possible score of 35. Standardized capability attainment therefore increased from 54.29% to 94.29%, while the total score increased by 73.68%. Table 1 presents the seven original production indicators and their changes.

Table 1. Changes in Production Capability

No	Production capability	Initial	Follow-up	Change
1	Determining fruit suitable for harvesting	3	5	+2
2	Quality-oriented harvesting techniques	2	5	+3
3	Initial fruit handling	3	5	+2
4	Separating healthy and damaged fruit	3	5	+2
5	Sorting premium and non-premium fruit	2	5	+3
6	Using harvesting and sorting equipment	3	4	+1
7	Weighing and recording harvested products	3	4	+1
Total		**19**	**33**	**+14**

The largest improvements occurred in quality-oriented harvesting and fruit sorting, which each increased by three points. Together, these two indicators contributed 6 of the total 14 additional capability points, or 42.86% of the total production-capability gain. The results indicate that production-capacity development was strongest at the harvest and quality-control stages. At the initial observation, harvesting remained conventional, maturity assessment relied largely on experience, handling was not systematic, and fruit sorting was inconsistent. At follow-up, farmers increasingly considered fruit maturity and condition, separated damaged fruit earlier, and systematically classified products.

These changes are consistent with the role of farmer groups as learning and technology-adoption institutions described by Nuryanti and Swastika (2011) and Safei et al. (2021). Farmer organizations may also improve production efficiency by facilitating technology, information, and production management (Ainembabazi et al., 2017; Bairagi & Mottaleb, 2021).

Physical production showed a similar positive pattern. Representative production increased from 30.0 to 37.5 kg/tree, equivalent to a 25% increase. At the same time, the proportion of premium fruit increased from approximately 50% to 65%, while damaged fruit decreased from approximately 9% to 5%. At follow-up, approximately 80% of harvested fruit

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was systematically sorted.

Table 2. Improvement in Siam Orange Production

Indicator	Initial	Follow-up	Change
Representative production	30.0 kg/tree	37.5 kg/tree	+25.00%
Premium fruit	≈50%	≈65%	+15 percentage points
Non-premium fruit	≈41%	≈30%	−11 percentage points
Damaged fruit	≈9%	≈5%	−44.44% relative
Systematically sorted harvest	Not systematic	≈80%	Improved

The increase in production was accompanied by improved fruit-quality composition. At the initial production level, premium output was approximately:

30.0 kg × 50% = 15.00 kg/tree

At follow-up, premium output was approximately:

37.5 kg × 65% = 24.38 kg/tree

Premium output therefore increased by approximately 9.38 kg/tree or **62.5%**. The original production records also report approximately 15.00 kg of premium fruit initially and 24.38 kg at follow-up. This finding provides a more specific interpretation of production improvement. Total production increased by 25%, but premium-quality production increased by approximately 62.5%. Thus, the improvement occurred not only in the quantity of fruit produced but also in the quality composition of production.

The proportion of damaged fruit decreased from 9% to 5%, corresponding to a relative reduction of 44.44%. In physical terms, damaged production decreased from approximately 2.70 kg/tree to 1.88 kg/tree despite the increase in total production. The decline in damaged fruit is consistent with improvements in harvesting and handling capacity. The group used harvesting tools, harvest baskets, branch supports, gloves, sorting tables, perforated containers, digital scales, and fruit-diameter measuring equipment.

Appropriate handling is particularly important for citrus because physical injuries can facilitate deterioration and infection. Dwiastuti et al. (2021) identified rough handling, inappropriate harvesting time, and physical damage as important postharvest problems in Indonesian fruit systems. Strano et al. (2022) also emphasized that harvesting, handling, storage, and transport practices strongly influence citrus losses and quality preservation. The results

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therefore suggest a production-upgrading pattern:

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mproved production capability → better harvesting and handling → lower fruit damage → higher premium output

Interpret this sequence descriptively rather than causally. The available data do not control for weather, fertilizer application, tree age, irrigation, pests, diseases, or other agronomic factors that may also influence production. Nevertheless, the simultaneous increases in production capacity, yield, premium-fruit proportion, and systematic sorting provide consistent evidence of production improvement. Similar studies have found positive relationships between farmer-group participation and productive performance in Indonesia and other countries (Abdul-Rahaman & Abdulai, 2018; Baga et al., 2023; Lin et al., 2022; Wossen et al., 2017).

This study's principal contribution is its **production-capability and production-quality perspective**. Yield alone shows a 25% improvement, whereas the integrated analysis shows that premium output increased by approximately 62.5% and fruit damage declined by 44.44%. Two indicators had not yet reached the maximum capability score: equipment use and production recording. Both reached score 4, indicating independent implementation but not yet full consistency. These areas should be priorities for further improvement because systematic production records are necessary to monitor productivity, losses, and variation among trees or farmers.

CONCLUSION

Siam orange production improved substantially in the Makmur Sejahtera Farmer Group. The production-capability score increased from 19 to 33, corresponding to an increase from 54.29% to 94.29% of the maximum attainable score. Representative production increased by 25%, from 30.0 to 37.5 kg/tree. Premium fruit increased from approximately 50% to 65%, while damaged fruit decreased from approximately 9% to 5%. Premium output per productive tree consequently increased from approximately 15.00 to 24.38 kg, equivalent to an increase of about 62.5%.

The largest capability improvements occurred in quality-oriented harvesting and fruit sorting. These findings indicate that production improvement should not be evaluated solely by changes in total yield. Production capability, premium-quality output, fruit damage, and systematic sorting provide complementary indicators of effective horticultural production performance. The study is limited to one farmer group and two aggregate observation periods. Further research using farmer-level longitudinal data and detailed agronomic variables is

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required to statistically examine the relationship between production capability and Siam orange productivity.

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