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Financial Feasibility of Sweet Orange (Citrus sinensis) Farming in Dau District, Indonesia

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Abstract

Sweet oranges are a horticultural commodity that offers health benefits and is affordable for consumers. However, the agribusiness faces many challenges in various countries, including Indonesia. This study aims to analyze financial feasibility of sweet orange farming and its sensitivity to changes in price and production. Data were collected from 77 farmers selected using a simple random sampling method. Feasibility analysis was based on Benefit Cost Ratio (B/C), Break Even Point (BEP) of production and price, Payback Period (PP), Net Present Value (NPV), and Internal Rate of Return (IRR). Sensitivity analysis was based on price and production fluctuations. The results showed that existing sweet orange farming is feasible because B/C > 0, BEP production < actual production, BEP price < actual price. Payback period of 6.12 years, NPV of 135.9493 million IDR and IRR of 48.3% strengthen feasibility of this farming. Even though orange prices and production have decreased by 10-15%, sweet orange farming remains feasible. If orange prices and production drop by 20%, the farming business is not feasible because IRR is ≤ 6%. Sustainability of sweet orange farming can be achieved if farmers can increase their yields and income by 1) implementing intercropping and rejuvenation, 2) obtaining facilitation from extension workers and the government to establish an integrated sweet orange tourism area, and assistance in rejuvenation.

Keywords: Sweet orange, cashflow, financial, feasibility, sensitivity

INTRODUCTION

Sweet oranges are a popular horticultural commodity. Indonesia has a low ranking in the global sweet orange market and must improve its competitiveness. They are relatively

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inexpensive and offer significant nutritional and vitamin benefits. Consuming oranges can boost the immune system and aid in detoxification (Saini et al., 2022; Etebu & Nwauzoma, 2014) due to their potent antioxidant (Dongre et al., 2023; Priyanka et al., 2021) and antibacterial (Andrade et al., 2023; Mogole et al., 2021).

In Nepal, sweet oranges are a source of income for farmers and are financially feasible (Dhakal et al., 2023). This agribusiness faces numerous challenges, such as declining prices in Egypt (Mohamed et al., 2024), land conversion to coffee (Juliana et al., 2023), and the production of environmentally damaging waste (Pineda-lozano et al., 2022). However, this agribusiness remains a source of economic growth in its production centers (Irawan & Yuristia, 2021). Orange farming is a long-term investment. New trees become productive after 3-4 years and have a productive lifespan of up to 15-20 years. Therefore, the analysis must be dynamic, taking into account all costs (initial investment, annual maintenance) and revenues (fruit sales) throughout the plant's life cycle.

Sweet orange (Citrus sinensis) farming is a source of income for farmers in Dau District, Malang Regency. Located at an altitude of 500-1,200 meters above sea level, this area has sufficient rainfall and stable air temperatures, making it ideal for sweet orange cultivation. 2023 BPS data shows that Dau District has an agricultural land area of 2,400 hectares. Most (75%) of this land is used for horticultural crops, including oranges (1,450 hectares). (Hidayat et al., 2022) found that siamese and tangerine farming in this area is feasible to develop based on R/C, B/C, payback period, NPV, and IRR criteria, and its marketing is not hampered (Kusmawan et al., 2022). We conducted a study on the feasibility of sweet orange farming in Dau District, selecting farmers from five villages: Karangwidoro, Sumbersekar, Petungsewu, Selorejo, and Gadingkulon. Meanwhile, (Hidayat et al., 2022) only focused on Gadingkulon Village. This research project spanned 20 years, eight years longer than previous study. Another difference was sensitivity analysis, which involved scenarios of price and production declines of 10%, 15%, and 20%, respectively. This scenario was expected to indicate the percentage of price and production declines that sweet orange farmers could tolerate. The scenario also differs from the study on sweet oranges in Nepal (Dhakal et al., 2023) which focused on 10% increase in costs, 10% decrease in prices, and 1-year delay in production.

Challenges facing sweet orange farming in Dau District, Malang Regency emerged between 2022 and 2024, when the price of sweet oranges declined from IDR 8,000 per kg to IDR 4,000 per kg. Fluctuating prices often hinder investment in improved agricultural practices and technological improvements, which are essential for increasing productivity and product quality (Barasa et al., 2021). Low prices will impact farmer income, the

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sustainability, and the long-term profitability of sweet orange farming (Mukaminah et al., 2020).

Issues such as soil degradation due to excessive pesticide use and climate variability require attention regarding sustainable agricultural productivity (Hidayat et al., 2021; Kusumastuti et al., 2022). As an integrated system of activities, agribusiness should maximize profits while maintaining environmental sustainability (Jiang et al., 2022). Furthermore, limited market access and inefficient supply chain networks will hinder farmers from achieving optimal returns on investment (Sujarwo & Laili, 2023). This study aims to analyze the current financial feasibility of sweet oranges in Dau District, Indonesia and its sensitivity to fluctuations in sweet orange prices and production.

THEORETICAL REVIEW

Concepts of Farming and Cost Efficiency

Farming is a series of human activities in managing natural resources and the environment to produce agricultural products with the aim of meeting food needs, improving farmer welfare, and obtaining economic benefits (Sinaga et al., 2024). In sweet orange farming, the cost structure is divided into fixed costs such as taxes or land rent and equipment depreciation, and variable costs such as procurement of seeds, fertilizers, pesticides, and labor. Farming efficiency is often measured by the ratio between revenue and costs (Anindita et al., 2015; Pudjiastuti et al., 2024), but for perennial crops such as oranges, this analysis is considered inadequate because it does not consider the time value of money.

Financial Feasibility of Perennial Crops

The financial feasibility analysis of perennial horticultural commodities differs from that of annual food crops. According to (Gittinger, 1982), investment in perennial crops requires a large initial outlay during the vegetative phase with no income for the first few years. Therefore, the use of discounted investment criteria is essential to determine the payback period, assess the efficiency of each unit cost incurred over the crop's economic life (Net B/C), determine the net present value (NPV), and measure the internal rate of return on invested capital (IRR).

Characteristics of Sweet Orange Farming in Indonesia

Sweet oranges (Citrus sinensis) are a leading national commodity. The Citrus and Subtropical Fruit Research Institute (Balitjestro) emphasizes that the success of citrus farming is largely determined by the selection of disease-free seedlings (blue label) and maintenance management, particularly the control of Citrus Vein Phloem Degeneration (CVPD). The fluctuating characteristics of citrus production (main harvest vs. inter-harvest

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harvest) create unique cash flow dynamics for farmers, requiring careful financial planning (Hidayat et al., 2022).

Dau District has a comparative agroclimatological advantage for sweet orange development in Malang Regency. In addition to being a production center, Dau is undergoing economic transformation through the integration of farming with the tourism sector (orange picking agrotourism). Research by (Kusmawan et al., 2022) in Gadingkulon Village, Dau District, shows that farmer involvement in the agrotourism supply chain tends to increase profit margins compared to conventional sales to middlemen. This provides a new dimension in the analysis of farm income which must be taken into account in the aspect of financial feasibility.

Risk and Sensitivity Analysis in Agriculture

Farming has become increasingly risky as farmers become more commercial. Farmers need to understand risk and have risk management skills to better anticipate problems and reduce consequences (Kahan, 2008). The main types of risk in agriculture include personal, production, economic, political, and credit risks. These agricultural risks have different sources, but they are nevertheless related to each other (Girdžiūtė, 2012). Sensitivity analysis is an important tool for testing the resilience of a project or farm to changes in key variables. In the context of sweet oranges in Dau District, the main sensitivity variables include fluctuations in farm-level selling prices, increases in non-subsidized fertilizer prices, and decreased productivity due to extreme climate factors.

Although numerous studies on the feasibility of citrus have been conducted at the national level, financial analysis that integrates local price dynamics and the agro-tourism context in Dau District is still limited. This research aims to fill this gap.

METHOD

The research was conducted in the sweet orange production center in Dau District, Malang Regency, which consists of five villages: Selorejo, Gading Kulon, Petung Sewu, Karang Widoro, and Sumbersekar. The population consisted of 346 sweet orange farmers. The sample size was determined using the Slovin formula and consisted of 77 farmers. Simple random sampling was used to select farmer respondents to represent the population.

Data were collected through interviews with respondents using a questionnaire and direct observation. Questionnaire was developed based on a literature review of agribusiness feasibility studies and modified to suit the local context. Questions were designed in a mixed format (closed and open-ended) to obtain precise quantitative data and in-depth qualitative insights. The instrument was piloted on 10 farmers outside the research sample to identify

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ambiguous questions, estimate interview time, and ensure a logical flow of questions for respondents. Interviews were conducted face-to-face with farmers in their fields or at their homes, depending on their availability. Primary data collected included initial investment costs, production costs, income, profitability, and data needed to measure B/C, BEP, Payback Period, NPV, and IRR, as well as information for sensitivity analysis.

1. Benefit Cost Ratio (B/C): shows the amount of profit obtained from each rupiah of costs incurred for sweet orange farming. This farming is feasible if B/C > 0. Mathematically, the formula is:

$$B/C = \sum_{t=1}^{n} \frac{(B_t - C_t)}{(1+r)^2} \quad (1)$$

Bt = benefit of t-year

2. Break Even Point (BEP): the minimum amount of production that must be produced in order to cover the costs incurred. There are two types of these parameters, namely the price BEP and the production BEP, which are calculated by the formula:

$$BEP_{unit} = \frac{FC}{P-VC} \quad (2)$$

$$BEP_{price} = \frac{FC}{P} \quad (3)$$

FC = fixed cost

P = selling price per unit

VC = variable cost per unit

3. Payback Period (PP): an estimate of the length of time to return investment in sweet orange farming. This parameter is calculated using the formula:

$$PP = \frac{Initial\ Investment}{Revenue}\ x\ time\ period\ (years) \quad (4)$$

Sweet orange farming is feasible if PP is less than or equal to the economic life of the project.

4. Net Present Value (NPV): the difference between the present value of benefits and the present value of costs. Mathematically, NPV is formulated as:

$$NPV = \sum_{t=1}^{n} \frac{B_t - C_t}{(1+i)^t} \quad (5)$$

i : rate of interest (6 %)

Criteria: if NPV > 0, sweet orange farming is feasible; if NPV = 0, sweet orange farming is in a break-even condition; if NPV < 0, sweet orange farming is not feasible.

5. Internal Rate of Return (IRR): the discount rate that equates the present value (NPV) of cash flows with the total investment of the project. Formula for calculating IRR:

$$IRR = i_1 + (i_2 - i_1)\frac{NPV_1}{(NPV_1 - NPV_2)} x100\% \quad (6)$$

i1 = interest rate that produces NPV > 0; i2 = interest rate that produces NPV < 0; NPV1 = NPV at interest rate i1; NPV2 = NPV at interest rate i2

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6. Sensitivity analysis of financial feasibility was based on a decline in production and price of sweet oranges at farmer gate. Prices and production are assumed to fall by 10%, 15%, and 20% to identify which scenario was most suitable for sustainability of sweet orange farming. It is based on the price and production fluctuations frequently experienced by sweet orange farmers, although farmers have experienced declines of more than 20%. Price drops typically occur during peak harvests and an abundance of local and imported oranges, both from other regions in Indonesia and abroad. Percentage figures are estimated based on price and production fluctuations over 20 years.

RESULT AND DISCUSSION

Characteristics of Sweet Orange Farming and Farmers in Dau District

Sweet oranges in Dau District are cultivated by farmers in Selorejo Village, Gading Kulon Village, Petung Sewu Village, Karang Widoro Village, and Sumber Sekar Village. These villages are located at an altitude of 500-1200 meters above sea level. Sweet orange farming is carried out on relatively small plots of dry land, measuring 0.17-0.29 hectares. Before planting sweet orange seedlings, farmers cultivate the soil. They add lime to reduce soil acidity. Next, they dig planting holes at a distance of 3 meters x 3.75 meters and 3 meters x 4 meters, resulting in a total of 150-300 trees. Initial fertilizer applied by farmers at planting is ZA, NPK, and SP in a 1:1:1 ratio. The plants currently in the field are approximately 5-20 years old. The characteristics of sweet orange farming can be seen in Table 1 (No. 1-3).
Farmers maintain sweet orange plants by watering them regularly, especially during the dry season, fertilizing them, pruning them, and controlling pests and diseases. This farming practice involves an all-male workforce, as the work is considered difficult by the local community. Farmers water the plants together with fertilizing them to save on labor, water, and fertilizer costs. Finding labor is difficult because farm laborers perceive wages as relatively low and agricultural work as seasonal. To reduce land degradation, farmers reduce the amount of ZA, NPK, and SP fertilizers and use more organic fertilizers. Pruning is done if the plants become too leafy to prevent them from blocking sunlight. Farmers control pests and diseases with the insecticides abamectin, profenos, imidacloprid, and lambda-cyhalothrin, and the fungicides mancozeb, carbendazim, and propineb. The amount of insecticide and fungicide applied depends on the condition of the plant and the frequency and intensity of pest and disease attacks.

Sweet oranges in Dau District begin to bear fruit when they are three years old. Sweet oranges can be harvested twice a year. Farmers carry out the first harvest in February-May, and the second in June-September. First harvest was smaller in quantity than the second,

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while prices is vice versa. It is relevant to theory that the greater quantity of a good offered, the lower its market price, ceteris paribus.

Table 1: Characteristics of Sweet Orange Farming and Farmers

No	Description	Category	Frequency (person)	Percentage (%)
1	Number of trees (trunk)	150-200	35	45.45
		>200-250	27	35.06
		>250-300	15	19.48
2	Land area (ha)	0.17-0.23	35	45.45
		>0.23-0.29	27	35.06
		>0.29	15	19.48
3	Tree age (years)	5-10	23	29.87
		>10-15	26	33.77
		>15	28	36.36
4	Farmer age (years)	15-25	1	1.30
		>25-35	4	5.19
		>35-45	17	22.08
		>45-55	35	45.45
		>55-65	16	20.78
		>65	4	5.19
5	Education	Elementary school	53	68.83
		Junior high school	12	15.58
		High school	11	14.29
		Diploma	1	1.30
6	Farming experience (years)	≤10	33	42.86
		>10-15	21	27.27
		>15-20	17	22.08
		>20-25	3	3.90
		>25	3	3.90
7	Number of family members (persons)	2	4	5.19
		3	24	31.17
		4	40	51.95
		5	8	10.39
		7	1	1.30

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Table 1 also shows information on farmer characteristics (Nos. 4-7). Majority (94.81%) of farmers are in productive age category, and 84.41% of them have formal education below high school. At this age, farmers tend to have more energy, physical endurance, and skills to manage agricultural activities. With the characteristics, they can improve agricultural yields, product quality, and efficiency in resource management. Low formal education is not a problem for farmers because 57.14% of farmers have more than 10 years of farming experience. Farmers' knowledge and skills are generally improved through informal education obtained through extension activities, interactions with fellow farmers, and farming experience. Almost all (94.81%) farmers have more than two family members. The large burden of responsibilities will motivate farmers to innovate in their farming to increase production and profits so they can meet their family's needs.

Costs and Income of Sweet Orange Farming

Cash inflows (revenues) and cash outflows (costs) over 20 years for a farm with 300 sweet orange trees are presented in Table 2. Initial investment includes expenses for purchasing 300 seedlings, labor for land preparation (tilling, digging planting holes), planting and applying basic fertilizer (including watering the seedlings), purchasing fertilizer, and land rental. Implementing a sweet orange farm on this scale requires an initial investment of IDR 27.870 million.

Farmers also calculated fixed costs, including land rental and depreciation of agricultural equipment (sprayer pumps, spray hoses, spray sticks, hoes, pruning shears, electric sprayers, pruning saws, and lawn mowers). Each piece of equipment has a useful life of five years and is assumed to have no salvage value. Variable costs included labor, chemical fertilizers, organic fertilizers, insecticides, fungicides, water, lime, and fuel. These costs vary depending on the age of the trees, the intensity of pest and disease attacks, and the weather (dry season).

Sweet oranges begin producing fruit when they are three years old. Yields tend to increase from 3 to 14 years old, after which the quantity of harvestable sweet oranges decreases. Farmers rejuvenate the trees after the plants reach 20 years of age and remove the trees. Market prices for sweet oranges tend to fluctuate, as with most agricultural commodities. According to (Kusmawan et al., 2022), price of sweet oranges in Dau District is generally determined by collectors in each village and is highly dependent on harvest volume. Oranges are harvested twice a year. Price of sweet oranges is higher during first harvest season than the second, because quantity of the first harvest is smaller.

Farmers' income from sweet orange farming is largely determined by farm gate price and production volume. Table 2 shows that income tends to increase year after year, reaching a

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maximum in the 14th year, after which it declines, even resulting in losses. This trend aligns with annual production volume, despite price fluctuations.

Table 2: Cashflow of Sweet Orange Farming for 300 Trees along 20 Years

Year	Production (ton)	Price (million IDR/ton)	Revenue (million IDR)	Fixed Cost (million IDR)	Variable Cost (million IDR)	Total Cost (million IDR)	Profit (million IDR)
0	-	-	-	-	-	27.870	-27.870
1	-	-	-	4.544	39.270	43.814	-43.814
2	-	-	-	4.544	39.270	43.814	-43.814
3	2.400	5.058	12.140	4.544	39.270	43.814	-31.675
4	3.000	5.106	15.319	4.544	35.561	40.105	-24.786
5	6.000	5.106	30.638	4.544	35.561	40.105	-9.467
6	9.900	5.144	50.922	4.544	36.287	40.831	10.091
7	10.500	5.292	55.563	4.544	33.810	38.354	17.209
8	14.400	5.260	75.744	4.544	36.145	40.690	35.054
9	13.500	5.293	71.455	4.544	35.674	40.218	31.237
10	17.400	5.417	94.250	4.544	36.097	40.641	53.609
11	17.700	5.424	96.000	4.544	37.895	42.439	53.561
12	20.700	5.638	116.705	4.544	34.820	39.364	77.341
13	21.900	5.567	121.914	4.544	34.820	39.364	82.550
14	22.500	5.621	126.483	4.544	36.957	41.501	84.982
15	21.600	5.594	120.840	4.544	39.176	43.720	77.121
16	16.800	5.637	94.706	4.544	39.449	43.993	50.713
17	15.300	5.361	82.030	4.544	48.697	53.241	28.790
18	13.200	5.541	73.144	4.544	41.550	46.094	27.050
19	8.100	5.381	43.583	4.544	48.231	52.775	-9.192
20	6.600	5.494	36.258	4.544	43.714	48.258	-12.000

Total costs tend to vary depending on the magnitude of variable costs. With fixed costs of IDR 4.544 million over the life of the project, the total cost is the sum of fixed and variable costs. It's important to understand that variable costs, in this case, don't follow a concept that higher production volumes mean higher variable costs. Variable costs in sweet

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orange farming depend on technology used by farmers, intensity of pest and disease attacks, the season (dry/rainy), age of the plants, and other factors.

Farming begins to generate profits when the plants are 6 years old. Table 2 clearly shows that sweet orange farming continues to incur losses from first to the fifth year. Even when the plants begin to produce, farmers still experience losses due to the investment and costs incurred in the first to fifth years. Interestingly, farmers achieve greatest profits when the plants are 14 years old. The amount of profit earned each year varies depending on production volume, orange prices, intensity of pest and disease attacks, and the weather (dry season). Highest production obtained when the plants are 14 years old actually generates greatest profits at the market price level at that time. Toward the end of the project (the plants were 19 years old), farmers experience losses primarily due to declining production and a value lower than total costs.

Feasibility of Sweet Orange Farming and Sensitivity Analysis

Based on cash flow in Table 2, we can calculate B/C and BEP parameters for both production (units) and price. Figure 1 shows the magnitude of these parameters in a sweet orange farm over a 20-year period. Based on B/C parameters, there are two critical periods that pose crucial problems: when the plants were 3-5 years old and 19-20 years old. A negative B/C ratio at certain stages indicates that costs are greater than revenues. To address this and ensure the sustainability of the farm, an integrated strategy is needed from farmers, extension workers, and the government.

Critical period 1: 3-5 years of age (investment phase/plants not yet producing optimally). In this phase, plants have begun to bear fruit but have not yet reached peak production, while maintenance costs (fertilizer, pesticides, labor) are already complete, resulting in a negative B/C ratio. The main goal of farmers is to increase short-term income and reduce maintenance costs. During this period, farmers can: 1) implement an intercropping pattern with high-value annual crops between rows of sweet orange trees such as chilies, tomatoes, sweet corn, beans, or leafy vegetables (mustard greens, spinach). Farmers will earn cash income from intercropping while waiting for the oranges to be productive. It directly covers operational costs and makes B/C ratio positive. Legume crops (beans) can also help improve soil fertility. 2) Input cost efficiency by: a) farmers making their own organic fertilizer to reduce dependence on expensive chemical fertilizers, b) farmers implementing integrated pest control by utilizing natural enemies or botanical pesticides to reduce the cost of chemical pesticides, c) farmers carrying out mechanical or manual weeding regularly so as not to need to use expensive and risky herbicides. 3) Efficient water management: making rorak or biopore holes to collect rainwater, reducing

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irrigation needs, and maintaining soil moisture, using drip irrigation for water and fertilizer efficiency.

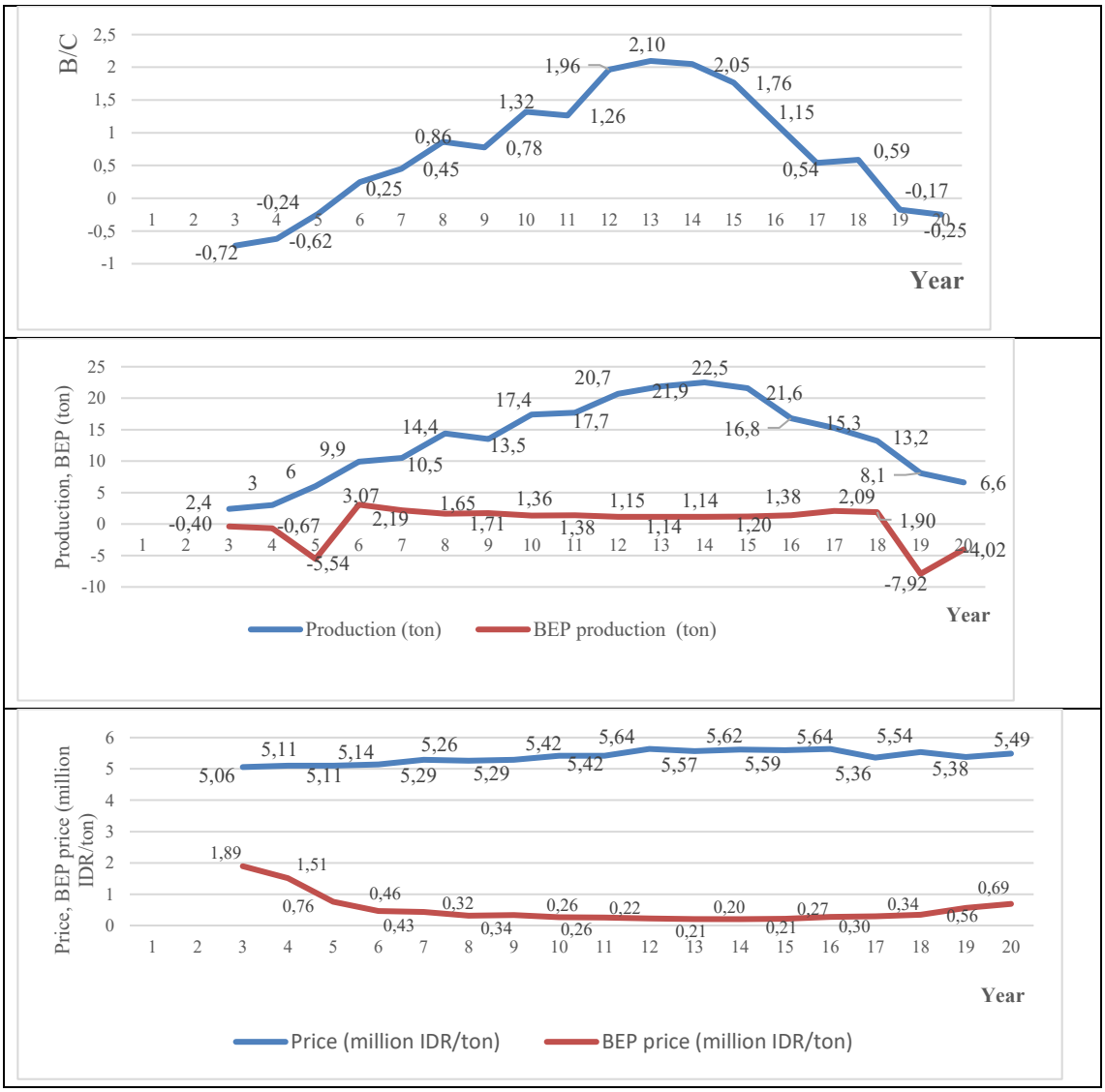


Figure 1: B/C, BEP Price and Production, Sweet Orange Farming along 20 Years

Agricultural extension workers, acting as technical mentors and facilitators, can provide education and training on proper intercropping techniques, teach farmers how to produce high-quality organic fertilizers and botanical pesticides, and assist farmers in implementing good agricultural practices to ensure healthy and productive crop growth in the future. Furthermore, extension workers can provide access to information and networks to sources of quality intercrop seeds, market information on intercrops with high demand

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and good prices, and facilitate the formation of farmer groups so farmers can share experiences and solutions.

Government can provide capital support, production input assistance, and infrastructure development. Capital support: providing access to low-interest credit for smallholder agricultural businesses that farmers can use as working capital during the pre-yielding phase. Production input assistance: providing certified, disease-free, high-quality citrus seedlings (especially CVPD) to ensure farmers' investments are not wasted. Targeted fertilizer subsidies can help reduce initial costs. Infrastructure development: building irrigation infrastructure to ensure water availability, improving farm roads to facilitate the transportation of harvested crops (both citrus and intercrops).

Critical period 2: 19-20 years of age (phase of declining productivity/old plants). In this phase, plant productivity declines drastically, fruit quality also declines, but maintenance costs remain. This causes income to plummet and the B/C ratio to return to negative. Farmers can create a transition plan for business sustainability. First, plan a gradual rejuvenation: 1) Farmers do not cut down the entire plantation simultaneously, but only in a portion of the land (for example, 25% of the total area) a year or two before. The hope is that farmers will still have a source of income from the remaining old trees while waiting for the new plants to start producing, so that cash flow continues. Second, business diversification: 1) On rejuvenated land, farmers implement an intercropping system. 2) Plant other annual crops with economic value on part of the land to diversify risks. 3) Optimize old trees: Carry out heavy pruning to stimulate new shoots (rejuvenation), although the results may not be optimal. Third, selling the harvest from old trees to processing industries (fruit juice, concentrate) which may not be as concerned with the appearance of the fruit, but still provide income.

Agricultural extension workers during this period played a role in encouraging long-term planning and the transfer of new technologies. First, they socialized the importance of rejuvenation: 1) Providing farmers with an understanding that declining productivity in old plants is natural and that rejuvenation is an investment for the future. 2) Presenting an analysis of rejuvenation farming efforts that demonstrate the potential for long-term profits. Second, introducing new technologies and varieties: 1) Introducing new, superior citrus varieties (more productive, disease-resistant, and with a more market-preferred flavor). 2) Providing technical guidance on how to carry out rejuvenation effectively, from felling and land preparation to planting new seedlings. Third, group facilitation: Encouraging farmers to rejuvenate in groups to be more efficient in terms of costs and labor, and to have a stronger bargaining position in obtaining superior seedlings.

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Government plays a role in creating programs that support transition and sustainability. First, the orchard rejuvenation program: Creating a special assistance or subsidy scheme for rejuvenating citrus orchards, such as providing free or low-cost certified superior seedlings and fertilizer for new plantings. Second, Research and Development (R&D): Through research institutions (such as the Citrus and Subtropical Fruit Research Institute), sustainably producing new superior varieties and more efficient cultivation technologies. Third, ensuring the availability of disease-free superior seedlings with guaranteed quality at the breeder level. Fourth, downstream industry development: Encouraging investment in the citrus processing industry. This industry will create a market for fruit from old trees whose quality may not meet fresh market standards, thereby still providing economic value for farmers.

Sustainable sweet orange farming cannot be achieved alone. With a well-planned and collaborative strategy from all three parties, the farming can maintain a positive B/C ratio, even during the most critical periods, ensuring its viability and continuity from generation to generation. Therefore, the following synergy is required: 1) Government establishes a rejuvenation program. 2) Extension workers educate and assist farmers in following the program using correct techniques. 3) Farmers proactively implement the rejuvenation program and implement efficient cultivation practices in their gardens.

Production break-even point (BEP) is lower than actual production, meaning the minimum production volume required to break even has been exceeded by the actual harvest. Business implications are: 1) Sweet orange farming is profitable, with every kilogram of oranges produced above the BEP representing a profit for farmers. 2) Production efficiency is achieved: farmers are able to produce a harvest high enough to cover all expenses. 3) A safety margin exists, indicating a significant difference between BEP and actual yield. If at some point there is a slight decrease in production (for example due to bad weather), the business will most likely still make a profit.

BEP price is lower than the actual price, meaning the minimum selling price required to break even is lower than the price actually received by farmers in the market. Business implications are: 1) the farm is able to generate profits where the difference between actual selling price and BEP price is profit margin per kilogram of oranges sold. 2) Good cost management: farmers are able to reduce production costs per kilogram of oranges below the prevailing market price. 3) Strong bargaining position: farmers have price flexibility. If the market price drops slightly (but remains above BEP price), their business will still remain profitable. If both BEPs are met simultaneously, it is the strongest signal that sweet orange farm is in a very healthy, efficient, and profitable condition.

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Based on the PP, NPV, and IRR, it was also found that sweet orange farming in Dau District is financially feasible (see Table 3). The return on investment can currently be achieved within 6.12 years with a positive NPV. IRR is 48.30%, significantly higher than prevailing small business credit interest rate of 6% per year. These research results align with findings (Dhakal et al., 2023) on sweet orange farming in Nepal.

Table 3: Feasibility of Sweet Orange Farming based on PP, NPV, IRR and Sensitivity

Condition	Payback Period (year)	NPV (million IDR)	IRR (%)
Normal	6.12	135.949	48.30
Scenario 1			
Sweet orange prices fell by 10%	6.35	70.780	37.41
Sweet orange prices fell by 15 %	6.48	38.195	26.23
Sweet orange prices fell by 20 %	6.64	5.611	5.54
Scenario 2			
Sweet orange production fell by 10%	6.35	70.780	39.19
Sweet orange production fell by 15 %	6.48	38.195	27.92
Sweet orange production fell by 20 %	6.64	5.611	6.07

Sensitivity of the farming to price and production fluctuations was assessed using scenarios 1 (price decline) and 2 (yield decline) of 10%, 15%, and 20%, respectively (see Table 3). Payback period for 10-20% price and production decline shows not significant difference (less than 7 years). It is crucial for cash flow management. If PP is insensitive to price and production declines, it indicates that the business does not face high liquidity risk. Investors or farmers will know that they do not need to set aside reserve funds for capital repayment. Positive NPV for both scenarios indicates that farming is not vulnerable to price and production fluctuations. IRR shows interesting dynamics; this parameter is sensitive to price and production declines of 20%. Farmers must ensure that prices and production do not decline by 20% because IRR was less than prevailing loan interest rate (6%). These results support the findings by (Hidayat et al., 2022; Irawan & Yuristia, 2021) despite the differences in orange varieties. Dau District has a potential to develop sweet orange-based agrotourism, providing farmers with an opportunity to increase their income. Integrating sweet orange agritourism has been proposed as a strategy to diversify income sources and increase economic resilience (Wilson, 2023).

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CONCLUSION

Sweet orange cultivation in Dau District, Malang Regency, has proven financially feasible, with B/C > 0, BEP production significantly lower than current production, and BEP price significantly lower than farm gate price. Other investment criteria, such as a payback period shorter than the age of the plant, NPV > 0, and IRR > prevailing loan interest rate (6%), indicate that this farming is also feasible. Sensitivity analysis of first scenarios (price decline) and second scenario (production decline) of 10% and 15%, respectively, indicates that sweet orange farming is still financially feasible based on PP, NPV, and IRR. However, when prices and production decline by 20%, the sweet orange business is not financially feasible because IRR ≤ interest rate (6%).

Recommendations

Farmers do not need to switch commodities to other citrus fruits because the market is different. Furthermore, sweet oranges dominate global citrus market, both in fresh fruit and processed products (food and beverage industry, cosmetics and aromatherapy, pectin and fiber). Some activities that can guarantee the financial feasibility and sustainability are: 1) farmers integrate their businesses into existing agro-tourism areas. 2) farmers improve land degradation due to the intensity of chemical use (fertilizers, insecticides, and fungicides) by reducing their use and increasing in use of organic materials (organic fertilizers and biochar). 3) farmers increase their income by planting annual crops as intercrops when sweet orange plants are 1-5 years old and gradually rejuvenating plants when oranges are 15 years old. 4) agricultural extension workers and government facilitate agro-tourism that is integrated with farmers' gardens, create rejuvenation programs and assist farmers in their implementation.

Limitations and suggestions for further study

Villages in Dau District have diverse topography, which can lead to differences in sweet orange production between villages. Further research could examine the feasibility of sweet orange cultivation based on topography. Furthermore, the relatively long lifespan of sweet orange cultivation and the infrequent recording of costs, income, and activities undertaken by farmers in sweet orange farming require a simple yet comprehensive digital application. Future research could explore farmers' perceptions and expectations regarding digitalization in sweet orange farming.

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