Indonesian Journal Of Small Scale Farming
Volume 2(1), 83 - 96, 2026
https://doi.org/10.24843/ijoss.2026.v02.i01.p08
ISSN : 3109-6484 (Online - Elektronik)

Income and Risks of Melon Farming with a Hydroponics System

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Submitted October 9, 2025; Approved December 20, 2025

ABSTRACT

BACKGROUND AND OBJECTIVES

The development of hydroponic cultivation has become an efficient solution to the constraints imposed by limited agricultural land and declining soil quality. Melon farming using this system still faces various production and business risks that can affect income levels. This study aims to analyse income levels and identify the risks associated with hydroponic melon farming at the Experimental Farm of the Faculty of Agriculture, Udayana University (KPFP), Pegok, South Denpasar, Bali.

METHODS

This study uses a qualitative descriptive approach combined with quantitative income analysis. Primary data were obtained through interviews and documentation of key informants, namely the Head of KPFP and the greenhouse manager. Income analysis was conducted by calculating total costs and total receipts, while risk identification employed Failure Mode and Effects Analysis (FMEA) to assess the severity, occurrence, and detectability of each risk source.

FINDINGS

The total production cost of hydroponic melon farming was IDR 40,579,625, with total revenue of IDR 32,280,000, resulting in a net loss of IDR 8,299,625 during the planting period. The main risks identified include pest and disease attacks, nutrient concentration errors, and climate instability in the greenhouse. Based on the FMEA results, production risk has the highest Risk Priority Number (RPN), followed by human resources and market risks.

CONCLUSION

Hydroponic melon farming at the Experimental Garden of the Faculty of Agriculture, Udayana University, has not yet achieved financial viability due to high investment and operational costs. Effective risk management strategies, such as improved pest control, routine nutrient monitoring, and worker training, are needed to minimise the risk of production failure. This study contributes to the development of a sustainable hydroponic agribusiness model in an educational and research environment.

Keywords: Income; Risk; Melon; Hydroponics; FMEA

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INTRODUCTION

Plant cultivation technology is advancing, with hydroponic systems emerging as an innovation in modern agriculture. Hydroponic farming is now not only a hobby but also an educational tool for creating a green environment around the home (1). Generally, hydroponic systems utilise greenhouses to regulate temperature and humidity and reduce the risk of pest and disease attacks. These controlled environmental conditions can increase productivity and produce products with low pesticide levels (2). In addition, hydroponic systems are considered efficient because they can be applied in limited spaces, do not require soil, and produce high-quality products without the use of harmful pesticides (3). This efficient, controlled hydroponic system is a fundamental foundation for melon cultivation, enabling the optimisation of quality and productivity.

One horticultural commodity with promise for hydroponic cultivation is the melon (*Cucumis melo L.*). Melons belong to the family *Cucurbitaceae*, which has high economic value and is cultivated in warm climates across Asia, Europe, the Americas, and Africa (4). In Indonesia, melons are popular for their sweet taste, crisp texture, and nutritional content, including vitamins C and A, potassium, and fibre (5). However, the plant is sensitive to climate change and susceptible to disease (6). As a high-value crop, melons have significant market potential both domestically and for export (7). Melons are a high-value commodity with widespread demand, but their environmental sensitivity requires more precise and controlled cultivation practices.

National melon production declined from 129,147 tonnes in 2021 to 117,794 tonnes in 2023, and in Bali Province, it fell from 218 tonnes to 153 tonnes over the same period (8). Meanwhile, national melon consumption is estimated to reach 332,698 tonnes per year (9). This decline in production indicates challenges in agricultural activities, both technical and economic. Hydroponic systems can be a solution because they allow optimal control of the growing environment, protect plants from extreme weather and pests, and produce healthier products (10). Hydroponic products also command a higher selling price because they are considered high-quality and environmentally friendly (11). The decline in melon production amid high demand underscores the importance of implementing more efficient cultivation systems, such as hydroponics.

Income is the primary indicator of the feasibility of a farming business, encompassing production value, revenue, and profit (12). Hydroponic farming has the potential to generate high profits (13). According to the Indonesia Hydroponics Market – Growth, Trends, and Forecast (2020–2025) report, the Indonesian hydroponics market is projected to grow at an annual rate of 15% through 2025 (14). However, every business faces risks arising from internal and external factors (15). In agriculture, these risks can include crop uncertainty, operational errors, price fluctuations, and unpredictable climate change.

Melon cultivation entails significant production risks, including unpredictable weather, pest attacks, and inadequate labour skills (16,17). Marketing risks also stem from limited distribution channels and declining product freshness (18). These risks can reduce income and threaten business sustainability if not managed appropriately. Therefore, risk analysis is an essential component of managing hydroponic melon farming.

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The Faculty of Agriculture Experimental Garden (KPFP) of Udayana University in Pegok, South Denpasar, is one of the locations where hydroponic melon cultivation is implemented for educational and research purposes. However, field practices are challenged by pest attacks and nutritional imbalances, which reduce production by approximately 20%. This indicates that although hydroponics offers potential benefits, production and financial risks remain significant.

This research is essential for analysing income and identifying the risks associated with hydroponic melon cultivation at the KPFP of Udayana University. Income analysis determines the income generated by calculating production costs, receipts, and income. Meanwhile, risk identification is conducted using Failure Mode and Effects Analysis (FMEA) to assess the severity, occurrence, and detection of each risk source, and to calculate the Risk Priority Number (RPN) to identify the risks that most affect the success of farming. The objectives of this study are (1) to analyse the income from melon farming using the hydroponic system, and (2) to identify and analyse the risks of melon farming using the hydroponic system.

RESEARCH METHOD

This research was conducted at the Experimental Garden of the Faculty of Agriculture (KPFP) of Udayana University, located in the South Denpasar District, Denpasar City, Bali Province. The site was purposively selected because KPFP Udayana University has implemented a hydroponic melon cultivation system in a greenhouse. In this study, the key informants were Prof. Dr Ir. Ketut Budi Susrusa, MS, the Head of the Experimental Farm of the Faculty of Agriculture (KPFP) of Udayana University, and I Kadek Agus Indrawan, the greenhouse manager. These two informants played an essential role in providing detailed, factual information on the technical, economic, and risk aspects encountered during hydroponic melon cultivation.

Data were collected using two main approaches: library research and field research. Library research was conducted by reviewing a range of sources, including books, scientific journals, articles, and other relevant documents, to strengthen the theoretical basis and broaden understanding of the research issues. Field research was conducted using two techniques, namely interviews and documentation. Interviews were conducted directly with parties involved in hydroponic melon farming to obtain in-depth information on the cultivation system, production costs, risks, and business management strategies. Meanwhile, the documentation method was used to collect written data, including financial reports, production records, activity archives, and sales documents, for hydroponic melon crops at the Udayana University KPFP. Through this documentation, researchers were able to verify income and cost data more accurately.

Data analysis in this study was divided into two parts, namely income analysis and risk analysis of hydroponic melon farming at the Udayana University Faculty of Agriculture Experimental Garden. The first objective, analysed using the income analysis method, was to calculate Total Costs (TC), Revenue (TR), and Income (I). This analysis aims to determine the net income generated from hydroponic melon farming. Income is calculated using the cost and revenue analysis approach with the following formula:

Total cost (TC) is obtained by adding fixed cost (FC) and variable cost (VC), using the formula:

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$$TC = FC + VC$$

Revenue (TR) is calculated as total production (Q) multiplied by the selling price per kilogram (P), using the following formula:

$$TR = Q \times P$$

Net income (I) is obtained as the difference between total revenue and total production costs:

$$I = TR - TC$$

Objective two is analysed using risk analysis. This analysis employs Failure Mode and Effects Analysis (FMEA) to identify, assess, and prioritise sources of risk in farming activities. The assessment is based on three parameters, namely severity, occurrence, and detection, each rated on a scale of 1–5. The Risk Priority Number (RPN) is calculated by multiplying the three parameters, yielding a value on a scale of 1–125, using the formula:

$$RPN = \textit{Severity} \times \textit{Occurrence} \times \textit{Detection}$$

The RPN calculation results are used to determine risk priority. A high value indicates a risk that warrants greater urgency. Risk level mapping is carried out using an FMEA risk level map.

RESULTS AND DISCUSSION

Income from Hydroponic Melon Farming at the Faculty of Agriculture Experimental Farm (KPFP)

a) Production costs

Production costs in this study cover the production process over 95 days. In hydroponic melon farming, costs include all expenses incurred by farmers to operate the farm, including goods and services used in production (19). See Table 1 Total Overall Production Costs.

Table 1. Total Production Costs

Description	Component	Total (IDR)
A.	**Fixed Costs**	
	a) Equipment Depreciation	3,913,625
	b) Labour wages	1,302,000
Subtotal		5,215,625
B.	**Variable costs**	

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	a)	Seeds	2,730,000
	b)	Nutrition	19,920,000
	c)	Fertiliser	654,000
	d)	Pesticides	675,000
	e)	Planting media	8,025,000
	f)	Electricity	3,360,000
Subtotal			35,364,000
C.		**Total Cost (A+B)**	**IDR 40,579,625**

Source: Processed data (2025)

According to Table 1, the total production cost is IDR 40,579,625. This figure indicates that hydroponic melon farming requires substantial capital, both for equipment investment and routine operating costs. Research by (20) suggests that hydroponic systems have higher initial installation costs than conventional systems, which may explain the substantial investment required. Findings from (21) indicate that fixed costs are higher due to the use of technological equipment and nutrients that are always in operation.

b) Revenue

Revenue from hydroponic melon farming at KPFP is calculated by multiplying the quantity of hydroponic melon production (kg) by the selling price of hydroponic melon (Rp). The total revenue from hydroponic melon farming at KPFP is shown in Table 2.

Table 2. Total Revenue from Hydroponic Melon Farming at KPFP

No	Variety	Production (kg)	Selling Price (Rp/kg)	Total (IDR)
1	Golden	380	30,000	11,400,000
2	Fujisawa	60	35,000	2,100,000
3	Inthanon	108	35,000	3,780,000
4	Golden	80	30,000	2,400,000
5	Sweethami	280	45,000	12,600,000
	Total Revenue			**32,280,000**

Source: Processed data (2025)

According to Table 2, total revenue across the three harvest seasons amounts to IDR 32,280,000. The revenue data indicate that the success of hydroponic melon farming depends not only on the size of the planting area but also on the variety selected, productivity, and market price. The low revenue, attributable to suboptimal productivity, is consistent with research by (22), which reports that fluctuations in crop yields in

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hydroponic systems significantly affect total income because these systems are sensitive to nutrient management quality and environmental conditions.

c) Income

Farm income is the difference between revenue and production costs incurred during production. The total income generated by hydroponic melon farms at the Faculty of Agriculture Experimental Garden (KPFP) is presented in Table 3.

Table 3. Total Income from Hydroponic Melon Farming at KPFP

No	Description	Total (IDR)
1	Receipts	32,280,000
2	Production Costs	40,579,625
3	Income	(8,299,625)

Source: Processed data (2025)

The calculation results show that the income is negative, amounting to IDR (8,299,625). This negative value indicates that revenue from the sale of hydroponic melons was insufficient to cover total production costs, resulting in a loss for the business during the research period. (23) 's findings state that fluctuations in crop yields in hydroponic systems occur due to differences in nutrient management and environmental conditions. When production is not yet stable, the income received is lower. (20) 's findings state that, due to high initial costs, income in the early stages of farming is usually unable to cover total costs, especially on a small or experimental scale, so cost efficiency is key to sustainable profits.

Risks of Hydroponic Melon Farming at the Faculty of Agriculture Experimental Garden (KPFP)

a) Activities at the Faculty of Agriculture Experimental Farm (KPFP)

This identification process covers stages from planning and planting through to maintenance, harvesting, and distribution of the results. As shown in Table 4, the activities in hydroponic melon farming at KPFP are listed.

Table 4. Activities in Hydroponic Melon Farming at KPFP

No.	Activity Stage	Type of Activity
1	Planning	Land preparation Seed procurement Procurement of fertilizer Procurement of pesticides Procurement of equipment Procurement of growing media

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2	Planting	Determining the right time Seed sowing Planting seedlings Transferring sprout seedlings to potted growing media
3	Maintenance	Nutrient and fertilizer watering Checking irrigation channels Pest and disease prevention Pollination process Pruning/fruit selection
4	Harvest	Determining harvest time Fruit cutting Sorting/grading
5	Distribution	Product shipping and distribution Collaboration with partners

Source: Faculty of Agriculture Experimental Farm (KPFP), 2025

b) Risk Agent and Risk Event Identification Stage

Risk identification is the first step in analysing potential risks, based on interviews with key informants. The identification of risk events is based on information from parties directly involved in hydroponic melon farming at the Faculty of Agriculture Experimental Farm (KPFP). The framework for the activity process is presented in Table 5.

Table 5. Risk Event Identification and Risk Event

No	**Activity**	***Risk Event***	**Code (Ei)**	***Risk Agent***	**Code (Ai)**
1	Planning	Inaccuracy in determining planting time	E1	Unstable weather fluctuations	A1
				Delays in seed supply	A2
				Non-sterile growing medium	A3
2	Sowing	Seedling rot/failure to grow	E2	Seed quality does not meet standards	A4
				Seeding errors (excessive moisture)	A5

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				Sowing medium (rockwool/cocopeat) is not sterile	A6
3	Planting	Seedlings stressed after transplanting	E4	Inappropriate seedling transplanting time	A7
				Roots damaged during transplanting	A8
4	Maintenance	Disruption in nutrient and water supply	E5	Water pump failure/power outage	A9
				Irrigation channel blocked	A10
				Incorrect dosage of AB Mix nutrients	A11
		Pest and disease infestation	E6	Pests (thrips, aphids, caterpillars)	A12
				Fungal/bacterial/viral diseases	A13
		Low yield & poor quality	E7	Failed pollination	A14
				Late fruit pruning	A15
				Insufficient sunlight intensity	A16
5	Harvest	Harvest not timely	E8	Shortage of harvest labor	A17
		Fruit is easily damaged.	E9	Harvesting is done during rain	A18
		Fruit damage during sorting	E10	Improper post-harvest handling	A19
		Decline in fruit quality during storage	E11	Storage space does not meet standards	A20
6	Distribution	The selling price has decreased	E12	Market price fluctuations	A21
				Competition with imported products	A22

Source: Faculty of Agriculture Experimental Farm (KPFP), 2025

The table above shows that 22 risk agents have been successfully identified in hydroponic melon farming activities at KPFP. The identification of risks in the series of

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hydroponic melon farming activities indicates that the primary risks arise in the early stages of production, from planning through sowing.

c) Risk Priority Number (RPN) Assessment

In hydroponic melon farming at KPFP, each risk agent yields a different RPN value based on its level of influence on the production process. A summary of the overall RPN calculation and its grouping by risk agents is presented in Table 6.

Table 6. Total RPN Score Risk Agent

Code (Ei)	Risk Event	S	Code (Ei)	Risk Agent	O	D	RPN
E1	Inaccuracy in determining planting time	3	A1	Unstable weather fluctuations	4	4	48
			A2	Delays in seed supply	1	1	3
			A3	Non-sterile growing medium	1	3	9
E2	Rotten/failed seedlings	4	A4	Seed quality does not meet standards	1	1	4
			A5	Sowing error (excessive moisture)	2	2	16
			A6	Sowing medium (rockwool/cocopeat) is not sterile	2	2	16
E4	Seedlings stressed after transplanting	3	A7	Inappropriate timing for seedling transplanting	2	2	12
			A8	Roots damaged during transplanting	1	1	3
E5	Disruption to the nutrient and water supply	3	A9	Water pump failure/power outage	3	4	36
			A10	Clogged irrigation channels	2	2	12
			A11	Incorrect dosage of AB Mix nutrients	3	3	9
E6	Pest and disease attacks	4	A12	Pests (thrips, aphids, caterpillars)	4	5	80
			A13	Fungal/bacterial/viral diseases	5	5	100

			A14	Pollination failure	5	4	60
E7	Low yield & poor quality	3	A15	Late fruit pruning	2	2	12
			A16	Insufficient sunlight intensity	5	5	75
E8	Harvest not timely	2	A17	Shortage of harvest labor	2	2	8
E9	Fruit is easily damaged	2	A18	Harvesting is done during rain	3	3	18
E10	Fruit damage during sorting	2	A19	Improper post-harvest handling	1	2	4
E11	Decline in fruit quality during storage	3	A20	Storage space does not meet standards	4	4	48
			A21	Market price fluctuations	2	3	18
E12	The selling price decreased	1	A22	Competition with imported products	3	3	9

Source: Processed Data Results, 2025

Based on the Risk Priority Number (RPN) calculation results, the highest-priority risk for handling is A13 (Fungal/bacterial/viral diseases), with an RPN of 100, followed by A12 (Thrips/aphids/caterpillars) with an RPN of 80, and A16 (Insufficient sunlight intensity) with an RPN of 75. These high RPN values indicate significant impact, a high frequency of occurrence, and difficulty in early detection. Hydroponics is a sensitive system that is easily affected by changes in pH, EC, and water quality, making these factors the primary sources of risk in hydroponic melon cultivation (24). After identifying risks and calculating RPN values for hydroponic melon farming activities at the Faculty of Agriculture Experimental Garden (KPFP), the risk level can be determined from the assessment results for severity, occurrence, and detection. The following ranking scale was then applied.

RISK LEVEL	100 - 125				A13	
	75 - <100			A16	A12	
	50 - <75			A14		

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	25 - <50			A1, A9, A20		
	1 - <25	A22	A17, A18, A19	A2, A3, A7, A8, A10, A11, A15, A21	A4, A5, A6	
	Severity	1	2	3	4	5

Image1. RPN Value Ranking Scale in KPFP
Source: Processed Data Results, 2025

Explanation:

BA (Broadly Acceptable), where risks in the green area indicate that the risks are still acceptable and require control by the existing system

ALARP (As Low As Is Reasonably Practicable), where risks in the yellow area indicate that immediate action is required.

INT (Intolerable), where risks in the red zone indicate that risks require swift action from management.

As shown in Figure 1, risks in hydroponic melon farming are categorised into several priority levels. Risk A13 is at the highest level (RPN 100–125), making it highly critical and a top priority for control, as it has the potential to affect production success significantly. Risks A16 and A12 are at a high level (INT), indicating the need for severe and continuous mitigation measures. Risk A14 is in the moderate category (ALARP) and can still be controlled through routine monitoring and the consistent application of technical procedures. Meanwhile, risks with low to very low levels (ALARP), such as A1, A9, A20, and most other risks, are considered acceptable and can be managed through daily operational management and standard monitoring. Therefore, in general, risk control should focus on risks with high RPN values.

CONCLUSION

Hydroponic melon cultivation at the Experimental Garden of the Faculty of Agriculture, Udayana University, has not yet yielded profitable results because total production costs exceed income. The main risks faced stem from production factors such as pest attacks, nutritional errors, and climate instability in the greenhouse. Improved risk management and cost efficiency are needed to enable hydroponic melon farming to operate sustainably and generate future profits.

RECOMMENDATIONS

Improvements are needed in pest and disease control systems, in regular monitoring of plant nutrition, and in worker training to enhance cultivation skills. In addition, operational cost

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ISSN : 3109-6484 (Online - Elektronik)

efficiency and innovation in *greenhouse* management need to be strengthened to enable hydroponic melon farming to achieve optimal profitability and competitiveness in the future.

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ACKNOWLEDGEMENTS AND FUNDING

The authors express their sincere gratitude to all parties who participated in and supported this research, especially the Head of KPFP and the Greenhouse Manager, for their support and the opportunities provided during the study. We would also like to thank our supervisors for their guidance, advice, and valuable input in the preparation of this journal. In addition, the authors appreciate all other parties who have provided suggestions, criticism, and contributions that enabled the completion of this journal.

AUTHOR CONTRIBUTIONS

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Indonesian Journal Of Small Scale Farming
Volume 2(1), 83 - 96, 2026
https://doi.org/10.24843/ijoss.2026.v02.i01.p08
ISSN : 3109-6484 (Online - Elektronik)

	Contributions	The researcher's contribution includes collecting and analysing data on income, production costs, and business feasibility. Researchers also provide recommendations to improve the efficiency and sustainability of farming businesses, as well as identify factors that influence outcomes and the risks faced by farmers.
	Homepage	https://pddikti.kemdiktisaintek.go.id/detail-mahasiswa/UC37x2ZPXC4pq7RNzODac0lRFu3KAp3khpo6IimMet2qnIlbbccKMPwNRpzYQU_P-zJeVQ==