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Comparison of cost and return for durian farmers on Magik Growth wrapping bag innovation to increase the quality of durian production in Rayong Province, Thailand

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Abstract The results of the study revealed that farmers who did not use the Magik Growth durian wrapping bag innovation had total costs of 37,647.48 baht per rai, resulting in an average yield of 1,420.41 kilograms per rai and a net profit of 164,999.25 baht per rai. In contrast, farmers who used the Magik Growth durian wrapping innovation had total costs of 48,724.58 baht per rai, leading to an average yield of 1,420.83 kilograms per rai and a net profit of 195,068.58 baht per rai. There was a significant difference of 0.01 in the average yield between those using and not using the Magik Growth durian wrapping innovation. Fixed costs and break-even yield also showed a statistically significant difference at 0.05. However, total costs, variable costs, production factors, product prices, net profit, and prices showed no statistically significant difference.

Keywords: Cost and return, Durian, Magik Growth

Introduction

Durian is Thailand's primary economic fruit crop. In 2024, durian plantations covered 687,140 rai, with 424,724 rai in productive use. However, unstable weather conditions have led to low flower-bearing rates, while water management challenges threaten harvests, as durian requires significant irrigation. These factors have caused decreased fruit weight and quality, with the total yield reaching 782,874 tonnes (Office of Agricultural Economics, 2024). Diseases and pests threaten crop quality and farmers' livelihoods (Nooruang, 2019).

The eastern region of Thailand, particularly Rayong Province, is a leading area for durian cultivation and exports. In 2023, Rayong's durian plantations

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covered 132,071 rai, yielding an average of 2,012 kg/rai and 159,876 tonnes (Rayong Provincial Agricultural Office, 2023). However, durian farmers face significant challenges, with roots, bases, and leaves being affected by pest infestation and diseases. These issues necessitate chemical treatments, increasing production costs. Furthermore, farmers often receive lower prices when selling to intermediaries, potentially reducing their profit margins (Pomsanam, 2012). The introduction of agricultural innovations could address the yield reduction caused by chemical use and pest invasion while also managing production costs in relation to fertilisers, pesticides, and equipment (Agricultural Research Development Agency, 2024; Makthasae and Churin, 2021).

Cost structure significantly impacts agricultural competitiveness, farmers' income levels, and the development of farming systems (Ciaian *et al.,* 2013). Farmers need to thoroughly understand the cost aspects in order to manage unnecessary expenses in the production system to plan future production to ensure an increase in the quantity and quality of outputs (Ohen and Ajah, 2015). Cost-return analysis is a valuable tool for farmers to address and solve problems. The cost of production is an important economic indicator, while production efficiency aids farmers in making informed decisions on risks in agricultural production (Suwanmaneepong *et al*., 2020). Therefore, introducing innovation to help in production is essential for reducing production costs (Toma *et al.*, 2018). Hence, it is necessary to undertake a cost-return comparison when applying innovation to support decision-making.

Researchers from the National Metal and Materials Technology Center (MTEC), in collaboration with King Mongkut's Institute of Technology Ladkrabang (KMITL), have developed the innovative Magik Growth wrapping bag for Thai durian farmers, utilising the methods used by Dr Nattapop Suwunnamek. These bags feature a unique 3D embossed structure with 10–20-micron fibres, providing excellent ventilation while protecting against pests such as mealybugs and black mould during the critical 60–90-day fruit development period, as shown in Figure 1. After three years of testing, the technology demonstrates significant benefits, including improved fruit aesthetics, thinner peel, 10–15% increased flesh weight, reduced chemical usage, and higher selling prices. Furthermore, the bags are reusable for up to three harvest cycles—ultimately enhancing both farmer income and product quality (National Science and Technology Development Agency, 2022; Suwunnamek, 2023).

Figure 1. Magik Growth wrapping bags
Source: https://www.nstda.or.th/home/news_post/pr-nstda-magikgrowth/

This study focused on the general characteristics of farmers who used the Magik Growth durian bag innovation compared to those who did not within the Khao Hin Tan large-scale durian community enterprise to examine the effect of cost and return factors on quality durian production. Additionally, the study compared the impact of cost and return on investment between farmers who used the Magik Growth wrapping bag innovation and those who did not within the Ban Khao Hin Taen large-scale durian community enterprise in Rayong Province.

Materials and methods

Population and sample

The population of the study consisted of 73 farmers from the large-scale durian community enterprise of Ban Khao Hin Taen, Wang Chan Subdistrict, Wang Chan District, Rayong Province. The farmers were split into two groups: those who employed the Magik growth durian bag innovation (24 farmers) and those who did not (49 farmers) (Department of Agricultural Extension, 2023).

Data collection

Data collected using structured questionnaires administered to the participating farmers. It comprised open-ended and closed-ended questions divided into three sections:

Section 1 – General characteristics of durian darmers (demographics, household information, farming experience, cultivation area, and adoption of Magik Growth innovation for durian packaging in the Large Community

Enterprise of durian at Ban Khao Hin Taen, Wang Chan Subdistrict, Wang Chan District, Rayong Province);

Section 2 – Cost and return information for the 2023 growing season (expenses related to soil preparation, Magik Growth durian wrapping bags, durian varieties, production factors, agricultural equipment, yield, and distribution methods);

Section 3 – Problems and obstacles in durian production (challenges faced by farmers and additional suggestions).

Data analysis

Descriptive statistics were used to analyse the general characteristics of durian farmers, including the frequency and percentage of categorical variables between Magik Growth wrapping bag users and non-users, to identify distinguishing characteristics between the two groups.

The research analysis compared the cost and return in durian production between farmers who used the Magik Growth wrapping bag innovation and those who did not. The analysis involved cost and return per rai, considering both cash and non-cash costs and returns for both groups. The following calculation method was used (Pridasak, 2004):

Total Cost (TC)	=	Total Fixed Cost (TFC)	+	Total Variable Cost (TVC)
Total Revenue (TR)	=	Total Output (Q)	x	Selling Price (P)
Net Revenue (NR)	=	Total Revenue (TR)	-	Total Variable Cost (TVC)
Net Profit (NP)	=	Total Revenue (TR)	-	Total Cost (TC)
Break-Even Yield	=	Total Cost (TC)	/	Selling Price (P)
Break-Even Price	=	Total Cost (TC)	/	Total Output (Q)

The independent samples t-test was employed to compare the average cost and return of durian cultivation between farmers who used the Magik Growth durian wrapping bag innovation and those who did not in Rayong Province. This statistical analysis was conducted to determine the existence of significant differences in economic performance between the two groups (Mankeb, 2016).

Results

General characteristics of farmers

The study revealed distinct characteristics between durian farmers who adopted the Magik Growth durian wrapping bag innovation and those who did

not. Among the 33 adopters (45.21%), the majority were aged 61–70 years (12.33%), with nine individuals (12.33%) having completed higher education. The non-adopters comprised 49 farmers (67.12%), predominantly aged 51–60 years (30.51%), with 18 (24.66%) having completed lower secondary education. Both groups primarily cultivated the Monthong durian variety. Adopters typically managed 60 or more trees (27.40%) across 20 rai of land (28.77%). In contrast, non-adopters typically managed 21–40 trees (63.01%) across 20 rai (42.47%). These findings, summarised in Table 1, highlight the characteristics and operational differences between adopters and non-adopters of the Magik Growth durian wrapping bag innovation.

Cost and return of durian farming using the Magik Growth wrapping bag innovation

For farmers using the Magik Growth wrapping bag innovation, the average total cost (TC) was 48,724.58 baht per rai. This TC was divided into variable costs of 38,101.11 baht per rai, accounting for 78.20%, including the labour cost for preparing the planting area of 3,078.90 baht per rai (6.32%), with cash costs of 2,929.18 baht per rai (6.01%), and non-cash costs of 149.72 baht per rai (0.31%). The total labour cost for growing durian averaged 661.98 baht per rai (1.36%), with cash costs of 543.88 baht per rai (1.12%) and non-cash costs of 118.11 baht per rai (0.24%).

The TC for maintaining the durian orchard averaged 8,415.92 baht per rai, with cash costs of 5,198.56 baht per rai (10.67%) and non-cash costs of 3,217.36 baht per rai (6.60%). The TC for harvesting and post-harvesting averaged 7,386.92 baht per rai, accounting for 15.16%, with cash costs of 6,513.41 baht per rai (13.37%) and non-cash costs of 873.52 baht per rai (1.79%). The total production cost was 18,557.39 baht per rai, accounting for 38.09%.

In comparison, the average total fixed cost was 6,414.48 baht per rai, including the opportunity cost of land use averaging 5,000 baht per rai (10.26%), and depreciation of tools at 1,414.48 baht per rai (2.90%). Farmers using the Magik Growth durian wrapping bag innovation exhibited an average net profit of 154,911.68 baht per rai, with a product price of 137.29 baht per kilogram, as shown in Table 2.

Table 1. Characteristics of farmers according to Magik Growth durian wrapping bag innovation usage

Item	Use of Magik Growth (n=24)		Non-Use of Magik Growth (n=49)	
	Frequency	%	Frequency	%
Gender				
Male	11	15.07	33	45.21
Female	13	17.81	16	21.92
Age				
40 years or under	2	2.74	4	5.48
41–50 years	7	9.59	16	21.92
51–60 years	8	10.96	23	31.51
61–70 years	9	12.33	5	6.85
70 years or older	-	-	1	1.37
Education				
Primary	9	12.33	8	10.96
Junior high school	2	2.74	18	24.66
Senior high school	7	9.59	16	21.92
Associate degree	-	-	2	2.74
Bachelor's degree	5	6.85	4	5.48
Higher than a bachelor's degree	1	1.37	1	1.37
Durian variety grown				
Moan Thong	24	32.88	49	67.12
Average number of trees per rai				
21–40 trees	1	1.37	46	63.01
41–60 trees	3	4.11	3	4.11
More than 60 trees	20	27.40	-	-
Durian plantation area (rai)				
Less than 20	21	28.77	31	42.47
20–40	2	2.74	13	17.81
More than 40	1	1.37	5	6.85

Table 2. Cost and returns of durian farming using the Magik Growth wrapping bag innovation (unit: Thai Baht per rai)

Item	Cash Costs		Non-cash Costs		Total Cost	
	Amount	%	Amount	%	Amount	%
1.Variable costs	**33,742.42**	**69.25**	**4,358.70**	**8.95**	**38,101.11**	**78.20**
Labour costs for preparing planting areas	*2,929.18*	*6.01*	*149.72*	*0.31*	*3,078.90*	*6.32*
Preparing soil and adjusting the area	2,392.62	4.91	132.67	0.27	2,525.29	5.18
Digging planting holes	536.56	1.10	17.05	0.03	553.61	1.14
Labour costs for growing durian	*543.88*	*1.12*	*118.11*	*0.24*	*661.98*	*1.36*
Planting	491.55	1.01	68.01	0.14	559.56	1.15
Fertiliser application	52.32	0.11	50.10	0.10	102.42	0.21
Orchard maintenance costs	*5,198.56*	*10.67*	*3,217.36*	*6.60*	*8,415.92*	*17.27*
Weed management	370.13	0.76	117.78	0.24	487.92	1.00
Water management	473.84	0.97	1,351.71	2.77	1,825.56	3.75
Fertiliser management	309.98	0.64	223.17	0.46	533.15	1.09
Pest management	546.06	1.12	158.33	0.32	704.39	1.45
Durian fruit wrapping	3.84	0.01	108.79	0.22	112.63	0.23
Pruning	3,124.58	6.41	783.73	1.61	3,908.31	8.02
Grass cutting	370.13	0.76	473.84	0.97	843.97	1.73
Harvesting + post-harvest	*6,513.41*	*13.37*	*873.52*	*1.79*	*7,386.92*	*15.16*
Source collection cost	5,972.70	12.26	873.52	1.79	6,846.22	14.05
Other costs	540.71	1.11	-	-	540.71	1.11
Production costs	*18,557.39*	*38.09*	-	-	*18,557.39*	*38.09*
Seeds	3,397.92	6.97	-	-	3,397.92	6.97
Chemical fertiliser	2,311.81	4.74	-	-	2,311.81	4.74
Organic fertiliser	347.03	0.71	-	-	347.03	0.71
Chemical and organic fertilisers	1,706.70	3.50	-	-	1,706.70	3.50
Herbicides/ pesticides/hormones	1,884.63	3.87	-	-	1,884.63	3.87
Fuel	426.12	0.87	-	-	426.12	0.87
Electricity for agriculture	2,063.65	4.24	-	-	2,063.65	4.24
Magik growth bags	6,000.00	12.31	-	-	6,000.00	12.31
Other expenses	419.53	0.86	-	-	419.53	0.86
2.Fixed costs	**6,414.48**	**13.16**	**-**	**-**	**6,414.48**	**13.16**
Opportunity cost of land use	5,000.00	10.26	-	-	5,000.00	10.26
Depreciation cost	1,414.48	2.90	-	-	1,414.48	2.90
3.Total cost (Baht per rai)	40,156.90	82.42	8,567.68	17.58	48,724.58	100.00
4.Total revenue (Baht per rai)		195,068.58				
5.Total output (Kg per rai)		1,420.83				
6.Selling price (Baht per kg)		137.29				
7.Net profit (Baht per rai)		154,911.68				
8.Break-even yield (Kg per rai)		354.90				
9.Break-even price (Baht per kg)		34.29				

Cost and returns of durian farming without using the Magik Growth wrapping bag innovation

Farmers who did not use the Magik Growth durian wrapping innovation bag had an average total cost (TC) of 37,647.48 baht per rai, divided into an average total variable cost (TVC) of 31,752.28 baht per rai. This TVC included labour costs for preparing the planting area of 2,754.24 baht per rai (7.32%), cash costs of 2,745.05 baht per rai (7.29%), and non-cash costs of 9.18 baht per rai (0.02%). The total labour cost for durian planting averaged 704.81 baht per rai (1.87%), with cash costs of 556.71 baht per rai (1.48%) and non-cash costs of 148.10 baht per rai (0.39%). The TC of maintaining the durian orchard averaged 9,308.56 baht per rai (24.73%), with cash costs of 6,361.55 baht per rai (16.90%) and non-cash costs of 2,947.02 baht per rai (7.83%). The TC for harvesting and post-harvesting averaged 7,839.25 baht per rai (20.82%), with cash costs of 7,814.76 baht per rai (20.76%) and non-cash costs of 24.49 baht per rai (0.07%).

The total production factor cost averaged 11,145.43 baht per rai (29.60%), and the average total fixed cost was 5,895.20 baht per rai, including the opportunity cost of land use averaging 5,000 baht per rai (13.28%), and depreciation of tools at 895.20 baht per rai (2.38%). Farmers not using the Magik Growth durian wrapping innovation had an average net profit of 127,351.77 baht per rai, with a product price of 116.16 baht per kilogram, as shown in Table 3.

Cost and return comparison of durian farming with and without the Magik Growth wrapping bag innovation

A comparison between the cost and return of durian production for farmers using the Magik Growth wrapping bag innovation and those not using it in the population under study is shown in Table 4. A statistically significant difference was observed in the average yield at the 0.01 level. Fixed costs and break-even yield also exhibited a statistically significant difference of 0.05. However, total cost, variable costs, production costs, total income, product prices, net profit, and break-even prices exhibited no statistically significant difference.

Table 3. Cost and return of durian farming without Magik Growth wrapping bag innovation (unit: Thai baht per rai)

Item	Cash Costs		Non-cash Costs		Total Cost	
	Amount	%	Amount	%	Amount	%
1.Variable costs	**28,623.50**	**76.03**	**3,128.79**	**8.31**	**31,752.28**	**84.34**
Labour costs for preparing planting areas	*2,745.05*	*7.29*	*9.18*	*0.02*	*2,754.24*	*7.32*
Preparing soil and adjusting the area	2,159.83	5.74	9.18	0.02	2,169.02	5.76
Digging planting holes	585.22	1.55	-	-	585.22	1.55
Labour costs for growing durian	*556.71*	*1.48*	*148.10*	*0.39*	*704.81*	*1.87*
Planting	502.48	1.33	92.39	0.25	594.87	1.58
Fertiliser application	54.23	0.14	55.71	0.15	109.94	0.29
Orchard maintenance costs	*6,361.55*	*16.90*	*2,947.02*	*7.83*	*9,308.56*	*24.73*
Weed management	802.01	2.13	147.16	0.39	949.16	2.52
Water management	1,029.26	2.73	769.90	2.05	1,799.16	4.78
Fertiliser management	437.87	1.16	294.90	0.78	732.77	1.95
Pest management	297.43	0.79	294.90	0.78	592.33	1.57
Pruning	2,992.98	7.95	410.89	1.09	3,403.87	9.04
Grass cutting	802.01	2.13	1,029.26	2.73	1,831.27	4.86
Harvesting + post-harvest	*7,814.76*	*20.76*	*24.49*	*0.07*	*7,839.25*	*20.82*
Source collection cost	7,373.70	19.59	24.49	0.07	7,398.19	19.65
Other costs	441.05	1.17	-	-	441.05	1.17
Production costs	*11,145.43*	*29.60*	-	-	*11,145.43*	*29.60*
Seeds	3,177.09	8.44	-	-	3,177.09	8.44
Chemical fertiliser	2,059.62	5.47	-	-	2,059.62	5.47
Organic fertiliser	31.81	0.08	-	-	31.81	0.08
Chemical and organic fertilisers	1,031.87	2.74	-	-	1,031.87	2.74
Herbicides/pesticides/ hormones	2,453.19	6.52	-	-	2,453.19	6.52
Fuel	459.93	1.22	-	-	459.93	1.22
Electricity for agriculture	1,127.83	3.00	-	-	1,127.83	3.00
Other expenses	804.10	2.14	-	-	804.10	2.14
2.Fixed costs	**5,895.20**	**15.66**	**-**	**-**	**5,895.20**	**15.66**
Opportunity cost of land use	5,000.00	13.28	-	-	5,000.00	13.28
Depreciation cost	895.20	2.38	-	-	895.20	2.38
3.Total cost	**34,518.69**	**91.69**	**3,128.79**	**8.31**	**37,647.48**	**100.00**
4.Total revenue (Baht per rai)		**164,999.25**				
5.Total output (Kg per rai)		**1,420.41**				
6.Selling price (Baht per kg)		**116.16**				
7.Net profit (Baht per rai)		**127,351.77**				
8.Break-even yield (Kg per rai)		**324.09**				
9.Break-even price (Baht per kg)		**26.50**				

Table 4. Comparison of the cost and return of durian farming with and without the Magik Growth wrapping bag innovation

Item	Use of Magik Growth	Non-use of Magik Growth	T-Test	Sig
Total cost (Baht per rai)	48,724.58	37,647.48	7.797	.081
Variable costs (Baht per rai)	38,101.11	31,752.28	11.003	.058
Fixed costs (Baht per rai)	6,414.48	5,895.20	23.705	.027*
Production costs (Baht per rai)	18,557.39	11,145.43	4.007	.156
Total revenue (Baht per rai)	195,068.58	164,999.25	11.975	.053
Total output (Kg per rai)	1,420.83	1,420.41	6764.857	.000**
Selling price (Baht per kg)	137.29	116.16	11.995	.053
Net profit (Baht per rai)	154,911.68	127,351.77	10.242	.062
Break-even yield (Kg per rai)	354.90	324.09	22.038	.029*
Break-even price (Baht per kg)	34.29	26.50	7.804	.081

**sig ≤ .01, *sig ≤ .05, ns = no statistical difference

Discussion

Recent cost-cutting innovations have emerged in the large-scale durian farming community of Ban Khao Hin Than, located in Wang Chan Subdistrict, Wang Chan District, Rayong Province. Among them, the Magik Growth durian wrapping bag has caught the attention of local durian farmers. This research compares the costs and returns of farmers who have adopted the Magik Growth durian wrapping bag with those who have not.

The study revealed that farmers who used the Magik Growth innovation experienced lower costs across all categories than those who did not. Significant cost differences were observed in the following categories: 1) weed management: 487.92 vs. 949.16 baht per rai, 2) fertiliser management: 533.15 vs. 732.77 baht per rai, 3) mowing: 843.97 vs. 1,831.27 baht per rai, 4) harvesting: 6,846.22 vs. 7,398.19 baht per rai, and 5) chemicals for weed/pest control/hormones: 1,884.63 vs. 2,453.19 baht per rai. According to the data, the Magik Growth durian wrapping innovation can reduce various farming costs, especially those involving pest control and chemical use. The innovation, developed by the Advanced Polymer Technology Research Group at the National Metal and Materials Technology Center, uses durable, non-woven materials to prevent diseases and pests. This technology aligns with the observed cost reductions,

particularly in terms of chemical use for weed/pest control and hormones (National Metal and Materials Center, 2022).

This study investigated the economic impact of the Magik Growth durian wrapping innovation on farmers. The findings revealed that farmers employing this innovation incurred a total cost of 48,724.58 baht per rai, comprising an average variable cost of 38,101.11 baht per rai and an average production factor cost of 18,557.39 baht per rai. This total cost exceeded that of non-adopters, who averaged 37,647.48 baht per rai. The study found that farmers using the Magik Growth innovation could potentially enjoy increased returns in the long run. This is because they are able to command a higher price per kilogram for their produce, with an average premium of 137.29 baht compared to non-adopters. This price differential suggests that the application of innovation and technology contributes to enhanced product quality and value.

The average yield for farmers using the innovation was 1,420.41 kilograms per rai, generating a total income of 164,999.25 baht per rai. These findings align with the research conducted by Pomsanam (2012), who reported an average cost to farmers of 38,803.14 baht per rai and an average income of 129,965 baht per rai, resulting in a profit of 91,161 baht per rai. Despite the higher initial costs, the study revealed that farmers using the Magik Growth innovation could potentially enjoy increased returns in the long run. This is because they could command a higher price per kilogram for their product, with an average premium of 137.29 baht compared to non-adopters. This price differential suggests that the application of innovation and technology contributes to enhanced product quality and value.

Farmers using the Magik Growth durian wrapping innovation achieved an average yield of 1,420.83 kg/rai, comparable to the 1,420.41 kg/rai for non-users. However, it is evident that innovation has impacted pricing and income. Users of Magik Growth wrapping obtained an average price of 137.29 baht/kg, resulting in an income of 195,068.58 baht/rai. In contrast, non-users received an average price of 116.16 baht/kg like that revealed by Makthasae and Churin, 2021 of 100 baht/kg), earning 164,999.25 baht/rai. This demonstrates that while yield quantities remain similar, the innovation enhances product value and the farmer's income. As noted by Khan *et al*. (2022), such agricultural innovations are crucial for improving economic sustainability and farmer incomes.

The Magik Growth durian wrapping innovation presents a promising opportunity for durian farmers to increase their profitability and sustainability. This technology offers tangible benefits by enhancing product value while reducing chemical costs, as demonstrated in the Ban Khao Hin Than case study. While adoption challenges exist due to knowledge gaps, ongoing support from agencies and continued research efforts are likely to drive more comprehensive

implementation and further improvements. As farmers become more familiar with this innovation and similar technologies, the durian industry can look forward to increased efficiency, higher-quality produce, and more environmentally friendly practices, ultimately contributing to the long-term growth and success of durian farming communities.

Innovations in agriculture can enhance long-term production value for farmers nationwide despite high initial investment costs (Pattison *et al*., 2022). However, limited knowledge and acceptance of these innovations among farmers impede their implementation. External factors and uncontrollable costs further challenge potential profit growth (Fosso and Nanfosso, 2016; Kakinuma, 2022).

In summary, the study revealed that Magik Growth durian wrapping bag adoption in Ban Khao Hin Than, Rayong Province, reduced farming costs across multiple categories while allowing farmers to command higher prices (137.29 vs. 116.16 baht/kg) despite similar yields. This innovation demonstrates significant potential for enhancing both economic returns and environmental sustainability through reduced chemical usage. For wider adoption, agricultural extension agencies should implement targeted training programmes, while agricultural cooperatives could facilitate group purchasing to reduce costs. Furthermore, research institutions should continue refining the technology to address farmers' specific needs and concerns. Pilot project demonstrations and financial incentives would also encourage further adoption of this promising innovation.

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