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Strategies for Developing Hydroponic Lettuce *(Lactuca sativa* L.*)* Agribusiness in Samarinda City, Indonesia

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This research aims to determine the internal and external factors that can influence hydroponic lettuce agribusiness and to find strategies for developing hydroponic lettuce agribusiness in Samarinda City. This research was carried out in several hydroponic lettuce agribusiness locations in Samarinda City from December 2023 to February 2024. The data collection method was carried out by observation, direct interviews with respondents, and a literature study. The sampling method in this research was carried out by purposive sampling, namely, as many as 10 market-oriented business actors. Data analysis uses the SWOT analysis method and internal and external environmental analysis (IFAS and EFAS). Based on the SWOT analysis, it shows that the matrix calculation results are located in quadrant I, namely the S-O strategy or supporting aggressive strategies, namely business actors can explore various potentials, maintain vegetable quality, optimize cultivation experience, create loyalty programs, and complete facilities.

Keywords: Development strategy; SWOT; lettuce; hydroponics.

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1. INTRODUCTION

Vegetables and fruit are important foods that must always be consumed in daily life because they function as regulatory substances, contain nutrients such as vitamins and minerals, have high water content, are a source of dietary fiber, and antioxidants, and can balance the body's acid-base levels. These various benefits can prevent various diseases [1]. Awareness of the importance of consuming vegetables encourages farmers to cultivate them [2]. As times progress and public knowledge of the importance of health increases, vegetables produced using an organic system are starting to be chosen for daily consumption. The increase in population accompanied by high awareness of safe, clean, and hygienic products has become a huge market opportunity. Currently, residents of big cities, especially those in the upper classes, tend to improve their quality of life. To overcome these challenges, hydroponics has emerged as a promising solution. Hydroponics allows vegetable production without relying on land by providing proper nutrition through water supply, not through soil, hydroponics is a very relevant alternative for urban communities who want healthy vegetables and are free from excessive pesticides. It was stated by [3] that the hydroponic system does not recognize seasons and does not require large areas of land compared to soil culture to produce the same unit of productivity. The hydroponic system can provide a more controlled growth environment, able to utilize water and nutrients significantly and more efficiently compared to soil culture.

The dense population in urban areas means limited agricultural land, which is a serious challenge in meeting vegetable food needs. Similar challenges are also felt in Samarinda City, one of the urban centers in East Kalimantan. The increase in population in this city, which will reach 825,490 people in 2022 and is estimated to reach 878,405 people in 2025 [4] , has caused the demand for fresh vegetables to increase Average vegetable consumer spending in East Kalimantan in 2019-2021 increased by 16.26%. Consecutive expenditure from 2019-2021 is IDR 46,497.00, IDR 59,874.00, and IDR 62,117.00 capita^{-1} year^{-1} [5].

In Samarinda City, hydroponic farming businesses are starting to develop, with the main commodity being lettuce. Hydroponic lettuce offers an attractive solution to meet market demand for fresh vegetables. Its fast growth and high quality make it an attractive option for development in this region. Apart from that, the trend of Korean and Asian food which relies on lettuce as one of its main ingredients, and public awareness of the benefits of healthy vegetables continues to increase, making demand for this commodity continue to grow. On average, hydroponic lettuce farmers usually sell their harvest for IDR 35,000.00 -40,000 kg^{-1}.

Even though the market potential for hydroponic lettuce in Samarinda City is very promising, there are still several obstacles faced by business actors. Some farmers still lack the knowledge and skills needed to manage hydroponic cultivation efficiently, such as understanding plant nutrition, water management, and controlling pests and diseases. Capital requirements to start or expand a hydroponics business tend to be high, especially when it involves investment in more sophisticated hydroponic infrastructure. So limited capital can hinder the development of hydroponic businesses. Inefficient business management, such as inappropriate production planning or supply management, can also hamper the productivity and profitability of hydroponic farming businesses [6].

Another problem is that market demand for fresh vegetables can fluctuate, especially related to changes in consumer trends or seasonality. Raw materials used in hydroponics, such as nutrients and substrate, are sometimes scarce. This can create an increased risk of price fluctuations and supply disruptions. Although hydroponics is more efficient in water use compared to conventional farming, water availability remains a key factor. In areas with limited water resources, careful water management and sustainable water sources are important issues [7].

This research aims to determine the internal and external factors that can influence hydroponic lettuce agribusiness and to find strategies for developing hydroponic lettuce agribusiness in Samarinda City.

2. METHODOLOGY

2.1 Time and Location

This research was carried out from December 2023 to February 2024 on the hydroponic lettuce vegetable agribusiness in Samarinda City.

2.2 Research Stages

This research is quantitative and qualitative descriptive, stages of research activities, namely: preparation, observation, collection of primary and secondary data, data processing and analysis, and reporting.

2.3 Determination of Respondents (Sample)

The sampling method is carried out using purposive sampling, namely a data source sampling technique based on certain characteristics or properties (characteristics) that are related to the research to ensure that the data obtained is logical and considered representative of the population. Sampling was carried out among 10 market-oriented respondents in the hydroponic lettuce vegetable business, namely those operating commercially.

2.4 Data Collection Technique

Primary data collection was carried out by observation and direct interviews with respondents with a list of questions that had been compiled and prepared for research purposes (questionnaire). Meanwhile, secondary data was obtained from reading books, journals, articles, literature studies, and related agencies, namely the Central Statistics Agency of East Kalimantan Province, and the Agricultural Service of East Kalimantan Province.

2.5 Data Analysis

Data were analyzed using descriptive statistical methods and using the Internal Factor Analysis Summary (IFAS) and External Factor Analysis Summary (EFAS) matrices, the EI matrix, and the Strengths-Weaknesses-Opportunities-Threats or SWOT matrix [8]. Data processing was carried out with the help of the Microsoft Excel program.

2.5.1 Internal Factor Analysis Summary (IFAS) analysis

IFAS analysis is used to identify internal environmental factors and measure the extent of farmers' strengths and weaknesses. The steps that must be taken in using the IFAS matrix are as follows: (a) determine the factors that are strengths and weaknesses for the company in column 1; (b) determine the weight for each of these factors using a scale of 1 (very poor) to 5 (very good). The weight value of each factor is normalized so that the overall weight value is 1.00; (c) determine a rating or ranking of 1 to 4 for each factor to indicate the level of urgency, whether the factor is not urgent (rank 1), less urgent (rank 2), urgent (rank 3) or very urgent (rank 4); (d) multiplying the weight of each factor by its rating to determine the weight score for each variable; and (e) adding up the weight scores for each variable to obtain a total weight score for the company or organization concerned.

2.5.2 External Factor Analysis Summary (EFAS) analysis

The EFAS table is prepared to formulate external strategic factors in the framework of opportunities and threats for the company. The steps for using EFAS are as follows: (a) determine the factors that constitute opportunities and threats for the company; (b) determine the weight for each opportunity and threat factor using a value of 1 (very poor) to 5 (very good). The weight value of each factor is normalized so that the overall weight value is 1.00; (c) determine a rating of 1 to 4 on each factor to respond to the level of urgency on that factor, with a rating of 4 (very good), rating 3 (above average), 2 (average) and rating 1 (below average), (d) multiplying the weight of each factor by its ranking to determine the weight score for each variable, and (e) adding up the weight scores for each variable to get the total weight score for the company or agency concerned. This total value will show how the company reacts to its external strategic factors.

2.5.3 SWOT analysis

SWOT analysis is used to compare external factors and internal factors. Internal factors consist of strengths and weaknesses while external factors consist of opportunities and threats. This matrix produces 4 (four) sets of strategies which are summarized into S-O strategy (Strengths-Opportunities), S-T strategy (Strengths-Threats), W-O strategy (Weaknesses-Opportunities), and W-T strategy (Weaknesses-Threats).

3. RESULTS AND DISCUSSION

3.1 Hydroponic Lettuce Cultivation Carried Out by Respondents

Based on the results of interviews with respondents, information was obtained regarding

the stages of hydroponic lettuce cultivation, namely as follows:

(1) Nursery: Seeding is done every morning and evening in the greenhouse nursery. Each seed is placed into a wet rockwool measuring 2 cm x 2 cm and filled with water, then a hole is made in the Rockwool to a depth of 0.15 cm and the selected seeds are ready for seeding. One rockwool itself is filled with 1-2 seeds. After that, put the seedling tray containing the seeds into a special seed storage box for 1 x 24 hours. Then the seeds and rockwool are placed in the seedling tray for the seeding process. The seeds that have been broken are then moved and placed in a seed rack to receive treatment and sunlight. After 7 days, the seeds begin to be watered with nutrient solution three times a day. After the seeds have been sown for 15 days, they become seedlings that are ready to be transferred to the greenhouse.
(2) Enlargement: The seeds are put into the netpot which is on the hydroponic pipe rack. The distance between the planting holes is 20 cm x 20 cm. The process of seeding plant growth varies so that there are large plants and small plants, therefore it is necessary to place the plants appropriately. Large plants are placed on the bottom shelf and small plants are placed on the top shelf, this is done so that sunlight can enter the plants evenly.
(3) Maintenance: Routine maintenance activities carried out are: (a) filling water in each hydroponic tank, providing nutrition 3 times a week using AB Mix fertilizer; (b) providing the nutrients used, namely 5lA and 5lB, equal to 1 liter of water producing 1,100 ppm or approximately 150 ml each tub-1. [and (c) cleaning yellowing and browning vegetable leaves, then cleaning the greenhouse area namely cleaning weeds.
(4) Harvesting: Harvesting activities are carried out in the morning, namely 06.00 – 08.00 Central Indonesian Time, the harvesting method is done manually, namely by separating the plant and the netpot, then the plant roots are cleaned, and make sure the Rockwool does not come off from the main roots of the plant. Vegetables that have been separated from the netpot and cleaned of the fibrous roots are placed in plastic baskets carefully so that the vegetable stems are not broken and the leaves are not torn, then transported to the packaging room. A mandatory activity after the harvesting process is carried out is cleaning the hydroponic rack and water reservoir from harvest residue and moss. If the rack and tub are clean then fill them with water again and provide nutrition. Next, the shelves are refilled with seeds that are ready to be transferred from the seedling media into the hydroponic shelves, so that there are no empty shelves and vegetable production continues.
(5) Post-harvest: Post-harvest activities carried out on hydroponic vegetables are (a) sorting, namely the activity of selecting and separating good quality vegetable plants from vegetables that are not good or damaged, after which they are packaged using a plastic press and labeled.

3.2 Analysis of Internal and External Factors of Lettuce Hydroponic Business in Samarinda City

Lettuce is a commodity that is widely developed by hydroponic farmers in Samarinda City. Hydroponics is not only developed for home business purposes but there are also small-scale or commercial farms. The choice of lettuce as the main commodity is considered appropriate, because lettuce has a relatively short growth cycle, allowing farmers to maintain production sustainably, lettuce also has fairly good temperature tolerance, post-harvest handling is quite simple, and the existence of a local market that also requires a supply of lettuce increasing the attractiveness of this crop for farmers.

Hydroponic farming is widely practiced in Samarinda City because it has the advantage that it can be cultivated on limited land. The success of plants to grow and produce is more guaranteed, crop production is higher, the harvest is continuous, pest and disease attacks can be controlled, and free from flooding.

The average planting hole used ranges from 1,500-4,000. Many hydroponic lettuce vegetable farmers use family labor to run their business, which is usually managed by husband and wife and children, but some use hired labor. The most important production facility for hydroponic vegetable cultivation is the greenhouse (GH). Some farmers have simple facilities, semi-greenhouses, and greenhouses. GH is a building used to protect plants from extreme weather such as rain, and hot sunlight and

prevent pests and disease. This GH is used because it does not have air ventilation so the air and humidity inside are stable. The GH building frame is made of iron and has a lifespan of approximately thirty years. The roof is made of ultraviolet (UV) plastic to prevent solar radiation and keep the inside temperature stable. The GH walls are surrounded using insect net/paranet wire mesh. The wire mesh functions to prevent insects and plant pests from entering the GH. Meanwhile, semi-greenhouse buildings are made using a wooden frame which is built to provide shade for hydroponic vegetable plants. The roof of this building uses transparent spandex tiles and is surrounded by thick paranet. Apart from greenhouse facilities, hydroponic vegetable cultivation also requires irrigation facilities. Irrigation facilities are needed to channel nutrients and water to the roots of vegetable plants. Irrigation facilities consist of a pump machine, nutrient tank, nutrient drum, and paralon pipe. A pump machine is used to drain water and nutrients from the nutrient drum, then the nutrient solution is channeled to the plants via a paralon pipe connected to the bed. Water and nutrients flow in circulation so that the nutrient solution will flow back into the nutrient tank.

The planting medium used for hydroponic vegetable plants is rockwool. Rockwool was chosen because the roots of vegetable plants can grow well and are carried over when the seedlings are transferred to enlargement. Rockwool is also able to hold water well and support plants quite strongly. The rockwool is then inserted into the holes in the styrofoam and cup container. Other inputs used are seeds and nutrients.

The types of lettuce cultivated by hydroponic farmers are Caipira, Rz, Grand Rapid, and Bohemia lettuce. Caipira lettuce has characteristics such as thick and wide leaves, a round shape, and a deep green color. The Rz type has blooming leaves that are slightly less green in color than Caipira lettuce. Bohemian lettuce has a light green color, less thick, curlier leaves, and taller stems than other types of lettuce. On the other hand, Grand Rapid has coarser roots, taller stems, curly, wide, and thin leaves, and a distinctive light green color.

The nutrients used are AB Mix fertilizer whose nutritional composition is formulated by ourselves. The harvest is usually sold to regular customers, traditional markets, supermarkets, and restaurants.

Based on the results of interviews and data processing obtained from the hydroponic lettuce agribusiness in the research area, it can be identified that the internal and external factors are as follows:

3.2.1 Internal factors

Internal factors are factors that come from within the hydroponic lettuce vegetable agribusiness which consist of strengths, namely everything that influences and is needed to develop the activities that run within the business optimally, which are internal and weaknesses are all deficiencies that exist in the business, which are internal. Which hinders and hydroponics affects business development so that business activities do not run well as presented in Table 1.

3.2.2 External factors

External factors are factors that come from outside the hydroponic lettuce agribusiness which influences the business and consists of opportunities and threats. Based on identification in the field, several opportunities can be exploited, and several threats that can influence hydroponic lettuce agribusiness activities in Samarinda City are presented in Table 2.

3.2.3 Internal Factor Analysis Summary (IFAS) Matrix

The internal factors of the hydroponic lettuce business consist of strengths and weaknesses, then weighting and rating are carried out for each factor using the pairwise comparison method

Table 1. Strengths and weaknesses of hydroponic lettuce vegetable agribusiness in Samarinda City

No.	Strength	No.	Weakness
1	The quality of vegetables is maintained	1	The initial capital is quite large
2	The selling price is stable	2	Maintenance of tools is more difficult
3	Hydroponic cultivation experience	3	The use of online media is not yet optimal
4	Adequate facilities	4	Production volume is not yet optimal
5	High sales rate		

Source: Primary data processed (2023)

Table 2. Opportunities and threats for hydroponic lettuce vegetable agribusiness in Samarinda City

No.	Opportunity	No.	Threat
1	Market opportunities are available	1	Scarcity of raw materials
2	High market demand	2	Hydroponic vegetables compete with conventional vegetables
3	Customer loyalty	3	Plant pests and diseases
4	The existence of a hydroponic community	4	Unpredictable weather

Source: Primary data processed (2023)

Table 3. IFAS matrix

Internal Factors		Value	Ratings	Score
	Strength (S)			
1	Quality of vegetables maintained	**0,2**	**4,0**	**0,8**
2	Selling price stable	**0,1**	**3,1**	**0,3**
3	Experience in hydroponic cultivation	**0,1**	**2,8**	**0,3**
4	Adequate facilities	**0,1**	**3,3**	**0,3**
5	High sales level	**0,1**	**3,5**	**0,4**
Amount		**0,6**		**2,1**

Internal Factors		Value	Ratings	Score
	Weakness (W)			
1	The initial capital is quite large	**0,1**	**2,2**	**0,2**
2	Maintenance of tools is more difficult	**0,1**	**2,5**	**0,3**
3	The use of online media is not yet optimal	**0,1**	**1,9**	**0,2**
4	Production volume is not yet optimal	**0,1**	**2,3**	**0,2**
Amount		**0,4**		**0,9**
Total				**3,0**

Source: Primary data processed (2023)

for the strengths and weaknesses. The rating was determined to determine the factors that influence the hydroponic lettuce business (Table 3).

Based on Table 3, it is known that among the internal strategy factors, the strength factor that has the greatest influence is the quality of vegetables which is maintained with a score of 0.8. This shows that the quality of vegetables that is maintained provides a positive image in the eyes of consumers and becomes capital to retain customers and even attract new customers, thereby having a positive influence on the development of the hydroponic lettuce agribusiness in Samarinda City. Meanwhile, the most influential weakness factors are that the initial capital is quite large, the use of online media is not optimal and the production volume is not optimal with a score of 0.2 which is the lowest score.

3.2.4 External Factor Analysis Summary (EFAS) matrix

External factors for the development of hydroponic lettuce agribusiness in Samarinda City consist of opportunities and threats, and each of these factors is assigned a weight and rating. This weighting and rating serves

Table 4. EFAS matrix

External Factors		Value	Ratings	Score
	Opportunity (O)			
1	Market opportunities are available	**0,2**	**3,7**	**0,7**
2	High market demand	**0,2**	**3,4**	**0,7**
3	Customer loyalty	**0,2**	**3,7**	**0,7**
4	The existence of a hydroponic community	**0,1**	**1,8**	**0,2**
Amount		**0,7**		**2,3**

External Factors		Value	Ratings	Score
	Threat (T)			
1	Scarcity of raw materials	**0,1**	**2,3**	**0,2**
2	Hydroponic vegetables compete with conventional vegetables	**0,1**	**2,2**	**0,2**
3	Plant pests and diseases	**0,1**	**1,6**	**0,2**
4	Unpredictable weather	**0,1**	**1,4**	**0,1**
Amount		**0,4**		**0,7**
Total				**3,0**

Source: Primary data processed (2023)

to compile a matrix of external factors that influence the development of hydroponic lettuce agribusiness (Table 4).

Based on Table 4, it is known that among the external strategy factors, the greatest opportunity factors are available to market opportunities, high market demand, and customer loyalty with a score of 0.7. Meanwhile, the threat factor that has the most influence on hydroponic lettuce agribusiness is uncertain weather with a score of 0.1.

3.2.5 SWOT analysis diagram

The SWOT analysis diagram is presented in Fig. 1.

Fig. 1 shows the value of X > 0, namely 1.2, and Y > 0, namely 1.6. This shows that the position of the hydroponic lettuce agribusiness development strategy is in Quadrant I, which supports an aggressive strategy or SO (Strength-Opportunities) strategy, namely using the company's internal strengths to seize opportunities that exist outside the company.

3.3 Hydroponic Lettuce Vegetable Agribusiness Development Strategy

3.3.1 Strengths Opportunities (SO) strategy

The SO strategy is a strategy that uses internal strength factors maximally to take advantage of existing external opportunity factors, namely:

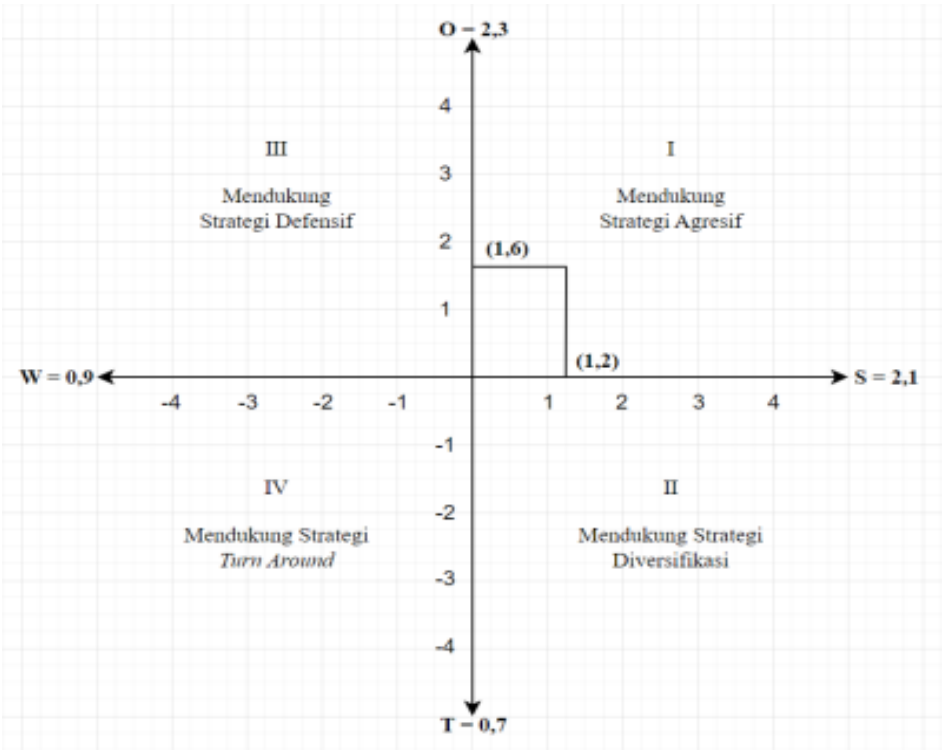

Fig. 1. Position Map of hydroponic lettuce vegetable agribusiness development strategy in Samarinda City

Description: Quadrant I: supports aggressive strategies; Quadrant II: supports diversification strategies; Quadrant III: supports defensive strategies; and Quadrant IV: supports the turnaround strategy

1) Maintaining the quality of vegetables by optimizing the hydroponic cultivation experience to attract new customers and maintain customer loyalty as well as take advantage of available market opportunities.
2) Create customer loyalty programs such as delivery services, membership, and special discounts.
3) Equip facilities to increase production efficiency and meet high market demand.
4) Cultivation experience can be used as material in hydroponic community forums so that they can share experiences and also collaborate as partners to face high market demand.

3.3.2 Weaknesses-Opportunities (WO) strategy

The WO strategy is a strategy that aims to fix or correct weak factors in the hydroponic lettuce business so that it can take advantage of the opportunities available, including:

1) Large enough capital can be overcome by seeking alternative funding assistance so that the business can develop and be able to face high market demand.
2) Increase production volume by adapting efficient methods and technology to meet high market demand.

3.3.3 Strengths-Threats (ST) strategy

The ST strategy is a strategy that utilizes the internal strength factors of the hydroponic lettuce plant business to reduce or minimize threats that affect the hydroponic plant business, namely:

1) Utilize cultivation experience and apply plant protection technology such as greenhouses or shelters to protect plants from pest attacks and unpredictable weather.
2) Taking advantage of stable selling prices with superior quality as the main attraction and a way to face competition with conventional vegetables.

3.3.4 Weaknesses-Threats (WT) strategy

The WT strategy is a strategy used to improve internal weaknesses in the hydroponic lettuce business to minimize external threat factors. This strategy is useful for defending your business from competitors. Utilize online media for online marketing activities so that more and more people know about hydroponic products.

3.4 Decision-Making Stage for Hydroponic Lettuce Agribusiness Development Strategy

Based on the results of data analysis, it can be stated that the development strategy that is suitable to be applied to the hydroponic lettuce vegetable agribusiness in Samarinda City is aggressive. An aggressive strategy in a hydroponic business is an effort to use internal strength factors optimally to take advantage of existing external opportunity factors. From the results of the SWOT matrix obtained from the SWOT diagram, the position of the development of hydroponic lettuce vegetable agribusiness in Samarinda City is quadrant I using the SO (Strength-Opportunities) strategy. This shows that the hydroponic vegetable business can use and utilize internal strengths to achieve opportunities that exist outside the business. The strategy that can be implemented is to maintain the quality of vegetables by optimizing the hydroponic cultivation experience to attract new customers maintain customer loyalty and take advantage of available market opportunities. In line with the research results of [9], the SO Strategy that can be implemented is to manage it effectively and efficiently by creating customer loyalty programs such as delivery services, memberships, and special discounts, complementing facilities to increase production efficiency and meet high market demand. Cultivation experience can be used as material in hydroponic community forums so that they can share experiences and also collaborate to face high market demand. Then [10] reports that the hydroponic vegetable development strategy uses the SO strategy, namely by improving production management, recruiting skilled workers, carrying out good maintenance and equipping equipment, as well as increasing direct promotion efforts and social media.

SO's strategy is to maintain trust in partners, carry out management effectively and efficiently, and conduct training; WO's strategy is to stabilize the room temperature in the greenhouse, use more modern technology, and develop the packaging process using more sophisticated technology. ST's strategy is to provide mother trees with seeds and nutrition, optimize product quality, and utilize collaboration with partners. WT's strategy is to increase business experience to be able to be competitive. Another research

result reported by [11] is that an alternative that can be applied in developing lettuce farming on a hydroponic horizon is the SO strategy, namely increasing production yields through collaboration with business partners to meet high market demand.

In this research, the hydroponic lettuce vegetable business to carry out a development strategy needs to pay attention to influencing factors, especially in terms of exploring its development potential both from internal factors and external factors from outside the hydroponic vegetable business. This is because a business will not be able to develop well if evaluation and consideration are not carried out. As reported by Trifani et al. [12], the hydroponic vegetable business development strategy, so that the business can run well, requires an appropriate development strategy to get maximum results so that the business is profitable.

4. CONCLUSION

Based on the results of the identification and discussion that have been described, it can be concluded that:

1. The IFAS factor in the development of hydroponic lettuce agribusiness which is the main strength factor is the maintained quality of the vegetables. Meanwhile, the main weakness factors are that the initial capital is quite large, the use of online media is not optimal and the production volume is not optimal. The EFAS factors are available to market opportunities, high market demand, and customer loyalty. Meanwhile, the main threat factor is erratic weather.
2. Alternative strategies in developing hydroponic lettuce agribusiness in Samarinda City are in quadrant I (S-O), namely by maintaining vegetable quality by optimizing hydroponic cultivation experience, maintaining customer loyalty, and taking advantage of available market opportunities, creating customer loyalty programs, equipping facilities for increase production efficiency and meet high market demand.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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