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Application of Combined A'WOT (AHP and SWOT): A Strategy for Post-Harvest of Duku

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ABSTRACT

Duku is one of the fresh fruits that requires special attention. Duku (*Lansium domesticum* var. *duku*) is a well-known fruit with a pleasant aroma and flavour which has high economic value. The high demand of duku should be balanced with duku quality. The limitation of postharvest management and postharvest handling of duku would determine the marketing area. This study aims to determine the strategic management of postharvest duku. A quantitative AHP-based SWOT analysis has been proposed in this study to systematically evaluate priorities among SWOT components. The proposed technique is derived by pairwise comparisons of recognized SWOT elements and it was carried out using the Focus Group Discussion (FGD) method. The results of the comparison matrix show that the highest scores for strengths, weaknesses, opportunities, and threats are the nutritional value (64%), relatively short shelf life factor (62%), duku brand image in the community is very good (54%), and price fluctuation factor (68%). Therefore, the strategy that can be taken is to take advantage of a good duku brand image in the community due to the high nutritional value of duku fruit, so it requires a good strategy to deal with price fluctuations by maximizing post-harvest technology such as improving harvest storage technology, planting strategies, distribution strategies, and capital lending to reduce the effects of a relatively short shelf life.

Keywords: *A'WOT (AHP and SWOT), Duku, Strategic Management.*

1. INTRODUCTION

Fresh-cut produce including fresh fruit has a different physiology than intact produce, requires a different and more precise handling and storage conditions. Tissue and cell integrity are disrupted during fresh-cut processing, which is accompanied by an increase in enzymatic, respiratory, and microbiological activity which lowering the shelf life of certain products [1]. Duku is a product that requires special attention. Duku (*Lansium domesticum* var. *duku*) is a well-known fruit with a pleasant aroma and flavour. It is also known as langsat or duku. There are, however, a few distinctions between them. *Lansium domesticum Corr.* was commonly referred to as the Latin name of duku, despite the fact that it was not the correct scientific nomenclature. Duku and its relatives were now divided into three categories: duku, langsat or bidjitan, and kokosan. Duku has small ellipsoid and pale yellow fruits, without latex and flowers small in diameter; langsat or bidjitan possesses a ellipsoid large fruit, glabrescent, fruits with pale yellow pericarp, larger flowers and stem contain slight latex; kokosan has the biggest flowers but its fruits is smaller, globose, with orange-yellow tough pericarp, and stem produce latex and most pubescent leaves [2]. The morphological appearance of the varieties was almost similar, so the varieties were not easy to recognize. The high demand of duku must be balanced with duku quality. The limitation of postharvest management and postharvest handling of duku would determine its marketing area. Due to this limitation an innovative way should be created which would improve the area of duku marketing without sacrificing its quality.

All businesses should depend on the strategic management of the product to stay afloat in the face of strong market competition. There are three steps to the strategic management process: formulation, implementation, and strategy evaluation. For strategy formulation and development, a SWOT analysis of external opportunities and threats, as well as internal strengths and weaknesses, is critical [3]. AHP is a multi-criteria decision-making method that entails organizing multiple selection criteria into a hierarchy, evaluating the relative importance of the criteria, comparing alternatives for each criterion, determining the overall ranking of alternatives, and selecting the best option based on relative preference of weighting criteria [4]. A quantitative AHP-based SWOT analysis has been proposed in this study to systematically evaluate priorities among SWOT components. The proposed technique is derived by pairwise comparisons of recognized SWOT elements [5]. The eigenvalue method was then used in the Analytic Hierarchy Process (AHP) to evaluate comparison matrices in order to compute priorities and assign relative significance to each SWOT factor. The findings of this paper demonstrate the utility of the SWOT-AHP technique in analyzing strategic decisions.

1.1. Scientific Hypothesis

A combination of AHP and SWOT analysis could be used to determine the strategic management of duku post-harvest.

2. METHOD

Identification of the combined application of A'WOT (AHP and SWOT) and the development of duku fruit was carried out using the Focus Group Discussion (FGD) method. The FGD participants consisted of 4 selected experts out of 20 participants. Participants were selected from academics such as undergraduate students, master students, fresh graduates, and lecturers as well as from business people. In FGD, participants were asked to discuss the importance of SWOT on a scale of 1-9. The scale on the questionnaire is made by doing pairwise comparisons to determine the relative importance of each pair of SWOT factors. In this study, the AHP structure was generated from the SWOT matrix and divided into three parts: (a) the objectives to be achieved by the decision, (b) the SWOT groups, and (c) the factors included in each SWOT group (sub-criteria). In addition, the data obtained from A'WOT will be applied to the plotting of the relative importance of Duku and the SWOT strategy matrix.

2.1. Statistical Analysis

Statistical analysis was used to determine SWOT attributes, plotting of relative importance and AHP structure. The data collected was analyzed with the help of Microsoft Excel version 2016 (Microsoft).

3. RESULTS AND DISCUSSIONS

Based on the SWOT analysis conducted by the FGD participants on the duku fruit, it was found that the internal and external factors of duku were identified as shown in Table 1. The level of importance of the SWOT factor was analyzed using the AHP method by means of Scale Pairwise Comparison [6]. The results of the comparison of SWOT factors can be seen in Table 2. From the analysis, it was found that the threat factor was identified as the highest SWOT factor ratio, which was recorded 46%, followed by opportunity which was recorded 27%, the weakness factor, and the strength factor were recorded 22% and 5%. The CR obtained of $0.09 \leq 0.1$ is an indication that the decisions of the experts are satisfactory and can be used for decision making. Pairwise comparisons for each SWOT factor and its priority level were calculated. The results of the comparison matrix for strengths, weaknesses, opportunities and threats are shown in Table 3-6.

Among the main strengths, which are cultural heritage, nutrition, acceptance by many people, and unique taste. Duku is one of Indonesia's intangible cultural heritage which is a leading commodity in South Sumatra because it has high economic value. The areas that produce duku in South Sumatra are Ogan Komering Ilir, Ogan Komering Ulu, Musi Banyuasin, Muara Enim, Prabumulih and Lahat. Duku has a good source of nutrients for the human body. Judging from the nutritional content, 100 grams of duku fruit contains 63 kilocalories of energy, 1 gram of protein, 16.1 grams of carbohydrates, 0.2 grams of fat, 18 milligrams of calcium, 9 milligrams of phosphorus, and 1 milligram of iron. In addition, duku fruit also contains 0.05 milligrams of vitamin B1 and 9 milligrams of vitamin C [7]. Duku fruit can be accepted by many people because it has a thinner skin, thicker aril, small seeds, sweeter and fresher taste. Several studies have stated that duku fruit has a unique taste and distinctive aroma [8]. Based on the paired assessment of the experts presented in Table 3. The results show that nutritious is identified as the strength factor that gets the highest weight, which has a percentage of 64%, followed by 17% accepted by many people, 12% cultural heritage, and 7% unique taste. The CR obtained of $0.1 \leq 0.1$ is an indication that the decisions of the experts have acceptable consistency and are used for decision making.

The identified weaknesses are a relatively short shelf life, a traditional post-harvest handling process, and the need for special shipping handling. Duku has a relatively short shelf life. At room temperature, duku has a post-harvest age of 3-7 days. A decrease in quality that occurs in the form of pericarp browning, changes in texture, appearance, and off-flavor after harvest. The post-harvest

Table 1. SWOT Matrix of Duku

Strength (S)	**Weakness (W)**
(S1). Cultural Heritage (S2). Nutritious (S3). Accepted by Many People (S4). Unique Taste	(W1). Relatively Short Shelf Life (W2). Conventional Post-Harvest Handling Process (W3). Needs Special Shipping Handling
Opportunity (O)	**Threat (T)**
(O1). Demand for Duku Fruits Increases (O2). Have Local and Global Opportunities (O3). Excellent Brand Image of Duku in The Community	(T1). Price Fluctuations (T2). Competition between Similar Products (T3). Imported Fruits Increases

Table 2. Pairwise Comparisons of SWOT Factors

SWOT Groups	**S**	**W**	**O**	**T**	**Priority**
Strenght (S)	1.00	0.13	0.20	0.17	0.05
Weakness (W)	8.00	1.00	0.50	0.33	0.22
Opportunity (O)	5.00	2.00	1.00	0.50	0.27
Threat (T)	6.00	3.00	2.00	1.00	0.46
CR = 0.09					

Table 3. Comparisons Matrix of Strengths Group

SWOT Groups	**S1**	**S2**	**S3**	**S4**	**Priority**
(S1). Cultural Heritage	1.00	0.11	0.50	3.00	0.12
(S2). Nutritious	9.00	1.00	5.00	5.00	0.64
(S3). Accepted by Many People	2.00	0.20	1.00	3.00	0.17
(S4). Unique Taste	0.33	0.20	0,33	1.00	0.07
CR = 0.1					

Table 4. Comparisons Matrix of Weaknesses Group

SWOT Groups	**W1**	**W2**	**W3**	**Priority**
(W1). Relatively Short Shelf Life	1.00	5.00	3.00	0.62
(W2). Conventional Post-Harvest Handling Process	0.20	1.00	0.25	0.10
(W3). Needs Special Shipping Handling	0.33	4.00	1.00	0.28
CR = 0.07				

Table 5. Comparisons Matrix of Opportunities Group

SWOT Groups	**O1**	**O2**	**O3**	**Priority**
(O1). Demand for Duku Fruits Increases	1.00	7.00	0.50	0.38
(O2). Have Local and Global Opportunities	0.14	1.00	0.20	0.08
(O3). Excellent Brand Image of Duku in The Community	2.00	5.00	1.00	0.54
CR = 0.1				

Table 6. Comparisons Matrix of Threats Group

SWOT Groups	**T1**	**T2**	**T3**	**Priority**
(T1). Price Fluctuations	1.00	5.00	4.00	0.68
(T2). Competition between Similar Products	0.20	1.00	2.00	0.19
(T3). Imported Fruits Increases	0.25	0.50	1.00	0.13
CR = 008				

handling process is carried out conventionally. Farmers harvest duku by climbing the tree and then holding the fruit to be separated from the race, and for the fruit at the end of the branch, it is done by shaking the branch or fruit twig. Duku fruit requires special shipping handling to maintain its quality, because duku fruit is easily damaged. Damage that occurs in duku will result in increased respiration rate, ethylene production and activity, aging and spoilage. Table 4 shows the pairwise comparison matrix used to see the weight of the weakness. The results obtained show that the weakness factor that most significantly affects the duku fruit is relatively short shelf life, where the percentage of weight is 62%, followed by the need for special shipping handling by 28%, and the conventional post-harvest handling process by 10%. The CR obtained of 0.07 ≤ 0.1 is an indication that the decisions of the experts have acceptable consistency and are used for decision making.

The opportunity factors identified are, demand for duku fruits, increasing local and global opportunities, and the excellent brand image of duku. The consumption demand for fruit tends to increase very rapidly with urbanization, greater awareness and higher income of the population which demand refers to people's desire to buy a particular good or service. So duku is one of the fruits with high demand both local and global opportunies. Have local and global opportunities, because of the nutritious, duku can be a solution of fruit to be market globally. Minerals are essential for human health. The mineral content of duku fruit in mg per 100 g of calcium (Ca), copper (Cu), iron (Fe), potassium (K), magnesium (Mg), manganese (Mn) and sodium (Na). Excellent brand image of duku, cause community both local and global has a high demand of duku which has unique taste and aroma. The lees of imported of duku make it to be high demand of local community. Table 5. shows the pairwise comparison matrix used to see the highest probability weight. The results obtained showed that the most significant opportunity factor affecting duku fruit was the excellent brand image of duku in the community, where the percentage of weight was 54%, followed by demand for duku fruits, which increased by 38%, and having local and global opportunities by 8%. The CR obtained is 0.1 ≤ 0.1, which is an indication that the decisions of the experts have acceptable consistency and are used for decision making.

The threat factors identified are price fluctuations, competition between similar products, and imported fruit increases. The theory of supply and demand in the economy makes it clear that price is determined by both supply and demand [6]. As soon as the supply or demand for a product changes, this leads to fluctuations in the production and price of the product. The climate in the world has a major impact on the production of fruits, especially in Duku, interrupts the stable supply of duku and has a relatively large impact on the market price. For this reason, the planting time schedule should also be analyzed when the high demand for duku increases. Competition between similar products will limit the amount of profit that will be obtained. The more similar products with various prices are offered, the tougher the competition. The quantities of tropical fruits such as bananas, pineapples, green beans and avocados, which are obtained on the basis of social and environmental conditions, have increased significantly. Since imported fruit is cheaper than duku fruit, the Community trend will be towards imported fruit. The pairwise comparison matrix used to see the highest threat weight was shown on Table 6.. The results obtained show that the most significant threat factor affecting duku fruit is price fluctuations, where the percentage of weight is 68%, followed by competition between similar products by 19%, and imported fruit by 13%. AHP for threats produces a CR of 0.08 ≤ 0.1 which is an indication that the decisions of the experts have acceptable consistency and are used for decision making.

Pairwise comparisons for all SWOT factors were shown on Table 7. Based on the SWOT analysis, the percentages of each SWOT factor are strengths (5%), weaknesses (22%), opportunities (27%), and threats (46%). The priority score for all SWOT factors (Table 7) shows that the highest score in a row for strength is the nutritional value factor of duku (64%), the weakness is the relatively short shelf life factor (62%), opportunity is a factor duku brand image in the community is very good (54%), and the threat is the price fluctuation factor (68%). Therefore, the strategy that can be taken is to take advantage of a good duku brand image in the community due to the high nutritional value of duku fruit, so it requires a good strategy to deal with price fluctuations by maximizing post-harvest technology such as improving harvest storage technology, planting strategies, distribution strategies, and capital lending to reduce the effects of a relatively short shelf life.

Finally, the plotting of the relative importance of duku and the SWOT strategy matrix were shown on Figure 1. and Table 8. Based on the analysis related to internal and external factor with the strengths, weakness, opportunities, and threats the strategic analysis that could be used for the solutions of duku's post-harvest was found. The result of strategic based on SWOT matrix provides means to develop strategies based on logical combinations of SWOT factors related to internal strengths (or weaknesses) with factors related to external opportunities (or threats) [8]. SWOT matrix identifies four conceptually distinct strategic groups to create the alternative strategies. The detail analysis of Strengths Opportunities (SO), Weakness Opportunities (WO), Strengths Threats (ST), Weakness Threats (WT) was shown on Table 8.

Table 7. Overall Priority for The SWOT Groups and Factors

SWOT Groups	Group Priority	SWOT Factor	Priority Within Group	Overall Prioority Factor
Strenght	0.05	Cultural Heritage	0.12	0.006
		Nutritious	0.64	0.032
		Accepted by Many People	0.17	0.009
		Unique Taste	0.07	0.004
Weakness	0.22	Relatively Short Shelf Life	0.62	0.136
		Conventional Post-Harvest Handling Process	0.10	0.022
		Needs Special Shipping Handling	0.28	0.062
Opportunity	0.27	Demand for Duku Fruits Increases	0.38	0.103
		Have Local and Global Opportunities	0.08	0.022
		Excellent Brand Image of Duku in The Community	0.54	0.146
Threat	0.46	Price Fluctuations	0.68	0.313
		Competition between Similar Products	0.19	0.087
		Imported Fruits Increases	0.13	0.060

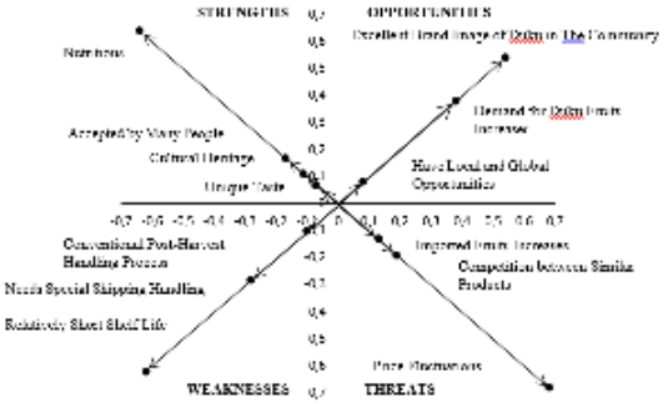

Figure 1. The plotting of the relative importance of duku

Table 8. SWOT Strategy Matrix

Internal Factors and Eksternal Factors	**Strength (S)**	**Weakness (W)**
	(S1). Cultural Heritage (S2). Nutritious (S3). Accepted by Many People (S4). Unique Taste	(W1). Relatively Short Shelf Life (W2). Conventional Post-Harvest Handling Process (W3). Needs Special Shipping Handling
Opportunity (O)	**Strengths Opportunities (SO)**	**Weakness Opportunities (WO)**
(O1). Demand for Duku Fruits Increases (O2). Have Local and Global Opportunities (O3). Excellent Brand Image of Duku in The Community	-Maintain partnerships with actors both farmers and traders (S_1, S_2, O_1, O_2, O_3) -Establish sustainable agriculture in order to create superior seeds (S_1, S_2, S_3, S_4, O_1, O_2, O_3)	-Pay attention to post-harvest management (W_1, W_3, O_1, O_2, O3) -Modify packaging to extend shelf life (W_2, O_1, O_2)
Threat (T)	**Strengths Threats (ST)**	**Weakness Threats (WT)**
(T1). Price Fluctuations (T2). Competition between Similar Products (T3). Imported Fruits Increases	-Maintain 21ket opportunities and marketing strategies (S_1, S_2, S_3, S_4, T_1, T_2, T_3)	-Maintain duku cropping patterns by reading and identifying market opportunities (T_1, T_2, T_3) -Managing appropriate technology and packaging quality to extend shelf life (W_1, W_2, W_3, T_3)

4. CONCLUSION

Based on the AHP structure was generated from the SWOT matrix and divided into three parts: (a) the objectives to be achieved by the decision, (b) the SWOT groups, and (c) the factors included in each SWOT group (sub-criteria). In addition, the data obtained from A'WOT will be applied to the plotting of the relative importance of Duku and the SWOT strategy matrix. Analysis conducted by the FGD participants on the duku fruit, it was found that the internal and external factors by utilizing the high consumer preferences on duku fruit. The results of the comparison matrix show that the highest scores for strengths, weaknesses, opportunities, and threats are the nutritional value (64%), relatively short shelf life factor (62%), duku brand image in the community is very good (54%), and price fluctuation factor (68%). Therefore, the strategy that can be taken is to take advantage of a good duku brand image in the community due to the high nutritional value of duku fruit, so it requires a good strategy to deal with price fluctuations by maximizing post-harvest technology such as improving harvest storage technology, planting strategies, distribution strategies, and capital lending to reduce the effects of a relatively short shelf life.

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