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Sustainability analysis of fish crackers agroindustry in Palembang City

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Abstract

Agroindustry is an activity of utilizing agricultural products into processed products that have economic value, including being an effort to develop sustainable agriculture. The influence of agroindustry on national economic development shows a significant contribution every year, especially in developing countries. The processing agroindustry really needs attention because it is the biggest support for the national economy, namely reaching Rp. 866.26 trillion. This study aims to assess the status of the sustainability of Fish Crackers Agroindustry in Palembang City using the RAPFISH (Rapid Appraisal for Fisheries) modification method and develop strategy for developing a development system to increase the productivity of the Fish Crackers Agroindustry in Palembang City. The method used to analyze sustainability status uses RAPFISH, while a prospective analysis is used to develop scenarios for increasing sustainability status. The results showed that the sustainability status index of the Fish Crackers Agroindustry in Palembang City was 48,54 and was considered less sustainable. Considering that fish crackers are traditional foods from South Sumatera, the Fish Crackers Agroindustry in Palembang City needs to be developed. The total fish cracker industries in Palembang City have reached 1,183 industries. Efforts that can be made to be sustainable, the priority strategies for developing the Fish Crackers Agroindustry in Palembang City are formulated, namely the price of raw materials, the level of fisheries exploitation, post-harvest, the role of business actors, and the quality of governance.

Keywords: Palembang; Sustainability; Fish Crackers; RAPFISH

1. Introduction

The potential of Indonesia's fisheries sector is the largest in the world with a total of 67 million tonnes/year consisting of 9.3 million tonnes/year from the capture fisheries sector and 57.7 tonnes from the aquaculture sector [1]. Palembang is one of the oldest cities in Indonesia which is geographically located at coordinates 2°59'27.99" S and 104°45'24.24" E with an area of 400.61 km². The value and production of aquaculture in South Sumatra Province in 2018 reached 6.2 million tonnes/year [2]. This is supported by the presence of large rivers, namely the Banyuasin River, the Keruh River, the Musi River, the Belida River, the Komering River, the Lematang River, the Ogan River, the Rawas River, and the Simpangkanan River as well as a wide expanse of lowlands.

One of the many regional specialties of South Sumatra which is quite famous is fish crackers. This food is a dry food product made from fish which is mixed with complementary spices such as tapioca flour, water, and salt from starch gelatinization. Fish crackers are used as complementary foods when eating or as a snack because they have a delicious, savory, and light taste. Not only do they have a delicious taste, but fish crackers also contain substances needed by the human body [3]. The types of crackers are very diverse, but there are two types that are quite popular, namely crackers made from vegetable raw materials, such as fish crackers and shrimp crackers [4].

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Fish crackers are products that have a very high crispiness, causing a slightly rough texture. The coarse texture is caused by the ability of fish crackers to form larger air cells during frying [5]. The nature of cracker products is that they easily absorb water (hygroscopic), so these products are very easy to sluggish if they are not packaged in a good way and with the right type of packaging [6]. For this reason, crispness is an important requirement in consumer acceptance of fish cracker products.

Fish crackers agroindustry in Palembang City is still on a semi-modern scale so product uniformity will be difficult to obtain. The problem that often occurs in this agroindustry is the production of fish crackers which have greater variability in drought because they use sun dryers which have weak controls and affect the hygiene of fish crackers a [7]. Fish crackers are foods that have a fairly high protein content. It is well known that protein can reduce the swelling capacity of a product, causing air pockets in the resulting fish crackers to become smaller because they are filled with a lot of protein [8]. Fish crackers agroindustry in Palembang City has the potential to be developed because it can absorb labor thereby reducing unemployment.

Fish crackers agroindustry in Palembang City requires planned management so that it can be said to be sustainable while still paying attention to various aspects of sustainability, namely dimensions, attributes, criteria, categories, and the sustainability index scale. This is because these various aspects of sustainability can be the starting point for an assessment to see the sustainability status of fish cracker agroindustry in Palembang City which is then conical to see the most dominant aspect using the modified RAPFISH (Rapid Appraisal for Fisheries) method. Therefore, it is necessary to conduct a research study of fish crackers agroindustry in Palembang City in 5 (five) Districts, namely Kertapati, Seberang Ulu I, Sukarami, Seberang Ulu II, and Plaju to assess the status of the sustainability of fish crackers agroindustry in Palembang city. The formulation of the problem studied in this study is the status of the sustainability of fish crackers agroindustry in Palembang City.

The aims of this study were to analyze the status of the sustainability of fish crackers agroindustry in Palembang City using the RAPFISH (Rapid Appraisal for Fisheries) modification method. The benefits of this research to improving the status of the sustainability of fish crackers agroindustry in Palembang City using the modified RAPFISH (Rapid Appraisal for Fisheries) method.

2. Materials and Methods

This research was conducted in 5 (five) Districts of fish crackers agroindustry in Palembang City. This location determination was made purposively with the consideration that the city of Palembang is a center for fish crackers agroindustry. The sample locations chosen were Kertapati, Seberang Ulu I, Sukarami, Seberang Ulu II, and Plaju. The consideration of determining the location of the sample is because the 5 (five) sub-districts are the most ordered list of fish crackers agroindustry in Palembang City [9]. The number of samples in this study were 50 (fifty) fish crackers agroindustry in Palembang City. The time of the research was carried out from March 2023 to June 2023.

The method used in this research is a survey method that is used to reach facts that occur in the field through visits and direct interviews by filling out the questions that have been provided in the questionnaire. The sample surveyed is part of the agroindustrial population that processes fish crackers. This study also used a modified method from the Rapid Appraisal for Fisheries (RAPFISH). RAPFISH is a fisheries sustainability assessment method based on the Multi Dimensional Scaling (MDS) approach. This study tries to apply the RAPFISH method in evaluating the sustainability of fish crackers processing in Palembang City.

Determination of the sample in this study was carried out using Non-Probability Sampling which was chosen by using the purposive sampling method, where the researcher determined the sampling deliberately by setting specific criteria according to the research objectives so that it was expected to be able to answer research problems. The sustainability status of fish crackers agroindustry in Palembang City is based on the awarding of a sustainability index score for each attribute in each dimension of the assessment of the sustainability of fish crackers agroindustry in Palembang City with 5 (five) Districts namely Kertapati, Seberang Ulu I, Sukarami, Seberang Ulu II, and Plaju where each sub-district has 10 agroindustries.

The data collected in this study consists of 5 (five) dimensions of sustainability, namely Economic, Social, Marketing Technology, Institutional, and Management. Types of data in the form of primary data and secondary data, both quantitative data and qualitative data. Primary data collection was carried out using observation methods and direct field measurements, as well as structured interviews with the help of questionnaires. Secondary data collection was carried out through literature study by collecting all information related to research objectives, both from journals and

from various related agencies. Data collection methods and types of attributes, scoring criteria and scoring criteria in full in Table 1 below:

Table 1 Data collection methods

Dimension	Attribute	Data Collection Method
Social	Age of workers	Direct observation and interviews
	Worker experience	Interviews
	Systems and work patterns	Direct observation and interviews
	Get raw materials	Interviews
	Raw material specifications	Interviews
	Availability of raw materials	Interviews
Economic	Raw material quantity	Direct observation and interviews
	Many types of fish	Interviews
	Production timeframe	Interviews
	Raw material prices	Interviews
	Marketing price trends	Interviews
	Labor salary	Interviews
Marketing Technology	Raw material handling	Direct observation and interviews
	Post-harvest	Direct observation and interviews
	Packer type	Direct observation and interviews
	Sales chain process	Direct observation and interviews
	Various types of crackers sold	Direct observation and interviews
	Marketing reach	Interviews
Institutional	Participatory Institutions	Interviews
	The role of the entrepreneur	Interviews
	Implementation of policies	Interviews
	Access to resources	Direct observation and interviews
	Externalities (waste)	Interviews
	Habitat destruction mitigation	Direct observation and interviews
Management	Business license legality	Direct observation and interviews
	Governance quality	Direct observation and interviews
	Ownership of environmental permits	Direct observation and interviews
	Halal certification	Direct observation and interviews
	SNI certification	Direct observation and interviews
	HACCP certification	Direct observation and interviews

This study applies the RAPFISH fisheries sustainability assessment method based on a multidimensional scaling approach to the management of fish crackers agroindustry in Palembang City. The data collected consists of data relevant to the 5 (five) dimensions of sustainability, namely Social, Economic, Marketing Technology, Institutional, and

Management. If an assessment of the 5 (five) dimensions has been carried out, then the sustainability index value is determined based on the scale shown in Table 2 below [10].

Table 2 RAPFISH sustainability index scale in this study

Sustainability Status	Index Sustainability
Not Sustainable	0,00 – 25,00
Less Sustainable	25,01 – 50,00
Sufficiently Sustainable	50,01 – 75,00
Very Sustainable	75,01 – 100,00

The data obtained will be calculated mathematically, then presented in the form of tabulations and graphs, then analyzed and explained descriptively. Assessment of the sustainability status of fish crackers agroindustry in Palembang City was carried out using the modified RAPFISH method. RAPFISH results are presented graphically using the Spider Chart. In summary, the RAPFISH method is described in several stages as follows determination of sustainability attributes, determination of the value of each attribute, ordination of RAPFISH with the MDS (Multidimensional Scaling) method, and determination of sustainability status.

3. Results and Discussion

3.1. General Conditions of Research Locations

This research was conducted in the city of Palembang. Palembang City is the sixth most populous city in Indonesia after Jakarta, Surabaya, Bandung, Medan and Semarang, as well as the nineteenth largest city in Southeast Asia. Palembang City, which is geographically located at coordinates 2°59'27.99" S and 104°45'24.24" E, is a tropical area with relatively humid winds, moderately hot temperatures between 23.4°C-31.7°C with the most rainfall in April as much as 338 mm and in September with a minimum rainfall of 10 mm. The administrative map of Palembang City can be seen in Figure 1.



Figure 1 Administrative map of Palembang City

The history of the city of Palembang, which was once the capital of the largest Buddhist maritime empire in Southeast Asia at the time, the Sriwijaya Empire, which dominated the archipelago and the Malay Peninsula in the 9th century, also made this city known as the "Bumi Sriwijaya". Based on the Kedukan Bukit inscription found on Siguntang Hill to the west of Palembang City which states the formation of a wanua which is interpreted as a city on June 16, 683 AD, making Palembang the oldest city in Indonesia. In the Western world, the city of Palembang is also nicknamed the Venice

of the East ("Venice of the East") and Serambi Hadramaut, this city has earned the nickname Serambi Hadramaut because of several Habaib titles that are not found in other areas in Indonesia.

The city of Palembang is divided by the Musi River into two regions, namely Seberang Ilir and Seberang Ulu. The Musi River empties into the Bangka Strait with a distance of ± 105 km. Therefore, this area is highly affected by tides between 3-5 m. The soil structure is generally layered with alluvial clay and sand, located in a layer that is still young, contains a lot of petroleum, and is also known as the Palembang-Jambi valley.

Palembang City is the capital of South Sumatra Province which consists of 18 (eighteen) Districts, namely Ilir Timur I, Ilir Timur II, Ilir Timur III, Ilir Barat I, Ilir Barat II, Seberang Ulu I, Seberang Ulu II, Sukarami, Sako, Bukit Kecil, Gandus, Kemuning, Kalidoni, Plaju, Kertapati, Alang-Alang Lebar, and Sematang Borang and 107 Villages (out of a total of 236 Districts, 386 Villages and 2,764 Villages throughout South Sumatra). In 2023, the population will reach 1,570,409 people with an area of 369.22 km² and a population distribution of 4,250,889 people/km².

The people of Palembang are a heterogeneous society, since the Sriwijaya era, this city has been established as the center of the native tribes of the archipelago and also the presence of foreign nationals who live there. The people of Palembang are Malays. Apart from the native population, Palembang also has migrants and descendants, such as Javanese, Minangkabau, Malay (outside Palembang Malay), Madurese, Bugis, Sundanese, Batak and Banjar. The descendants of many who live in Palembang are Chinese, Arab and Indian.

3.2. Identification of Attributes Influencing the Dimensions of Sustainability of Cracker and Kemplang Fish Agroindustry in Palembang City

In order to determine the status of the sustainability of fish crackers agroindustry in Palembang City, an analysis of 5 (five) dimensions of sustainability is carried out, namely Social, Economic, Marketing Technology, Institutional, and Management. Assessment of the 5 (five) dimensions of sustainability is carried out using direct observation and interview methods. After the assessment is carried out, an analysis will be carried out using the RAPFISH method. After the RAPFISH method is carried out, an index of the sustainability of fish crackers agroindustry in Palembang City will be obtained.

3.2.1. Social Dimension

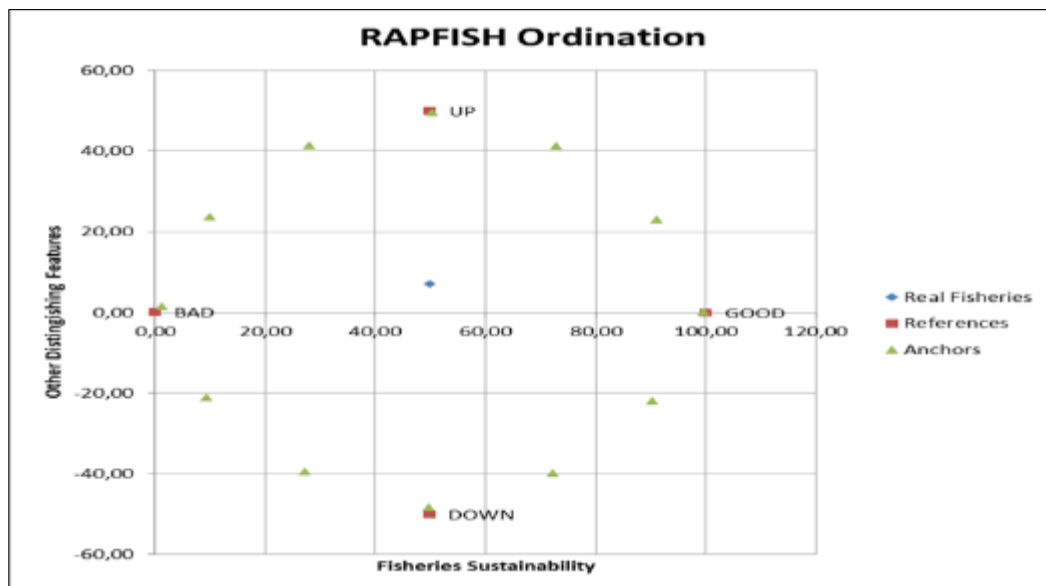


Figure 2 Results of RAPFISH coordination in the social dimension

The social dimension is a reflection of the sustainability of welfare from the side of the community or society that must be a concern in order to develop the fish crackers agroindustry in Palembang City in the long term. This dimension is measured and analyzed using the RAPFISH method with 6 (six) attributes, namely worker age, worker experience, work systems and patterns, how to obtain raw materials, specifications of raw materials, and availability of raw materials. Based on the analysis using the RAPFISH software, it shows that the social dimension sustainability index is 50.75. The index value of the social dimension is in the range of 50.01 – 75.00. These results indicate that based on the criteria of

sustainability status, the social dimension index of the fish crackers agroindustry in Palembang City is in the moderately sustainable category. The results of RAPFISH coordination in the social dimension are presented in Figure 2.

After knowing the value of the sustainability index on the social dimension, leverage analysis can then be carried out which will be presented in the leverage attributes. Leverage attributes are a series of attributes that show the level of sensitivity to changes in the sustainability index of each aspect studied. The purpose of presenting the leverage attributes is to find out the sensitive attributes of the condition index of fish crackers agroindustry in Palembang City on the social dimension. Therefore, it is necessary to know the attributes that have the most significant effect on changes in the sustainability index. The results of the leverage attributes in the social dimension are presented in Figure 3.

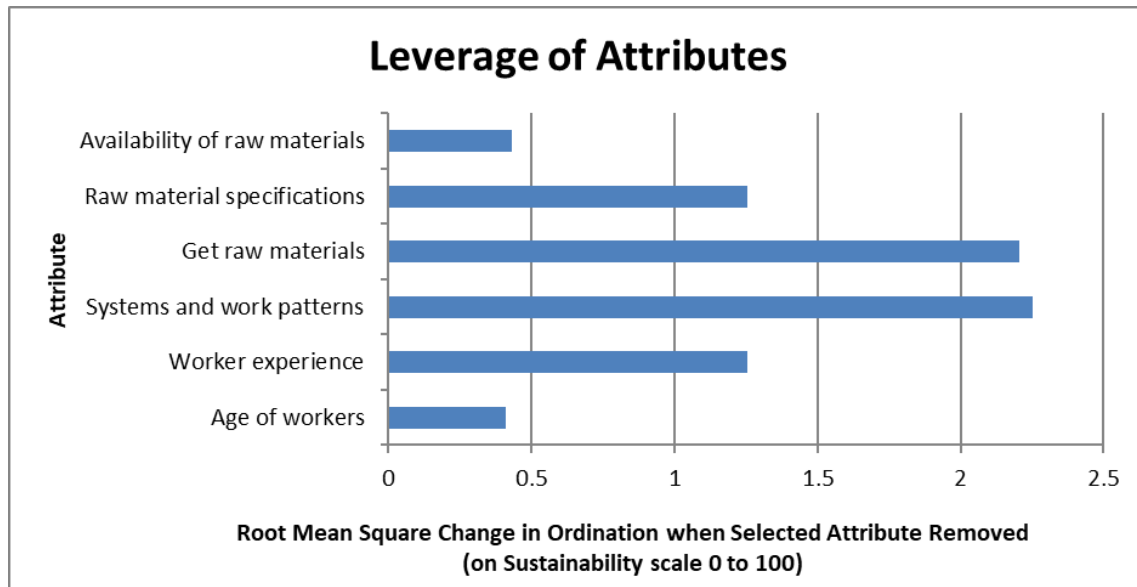


Figure 3 Results of leverage attributes in the social dimension

Based on the results of leverage analysis, it shows that the attributes that provide the most significant sensitivity to changes in the sustainability index on the social dimension are work systems and patterns with a value of 2.32 in the form of a Root Mean Square (RMS) value. The emergence of these attributes, because the management of fish crackers agroindustry in Palembang City has not been accompanied by the provision of information and education on effective work systems and patterns so that public awareness is still relatively low. The worst impact of this is the disruption of the sustainability of the fishery resource itself. Systems and work patterns will certainly have a significant effect on how to get raw materials later. This is in line with the results of the leverage analysis, where the next sensitive attribute that affects the sustainability of the social dimension is how to obtain raw materials with a value of 2.25.

The provision of information and education to fish crackers agroindustry actors in Palembang City has various benefits, one of which is so that the agroindustry actors know the maximum annual catch of fishery resources or what is known as MSY (Maximum Sustainable Yield) which means to support the sustainability of fishery resources so that the risks or threats to the sustainability of the fisheries resource agroindustry are getting smaller. The lowest attribute value on the social dimension of sustainability is the availability of raw materials with a value of 0.4. This attribute has no significant effect because the availability of raw materials in the socially sustainable dimension does not have a significant impact on the management of fish crackers agroindustry in Palembang City. The attribute with the next lowest value is the age of the worker with a leverage value of 0.3. Therefore, opening insights that are educative in nature is an important point in creating sustainable fisheries.

The Monte Carlo analysis method is a probability type simulation that approaches the solution of a problem by performing a random sampling of the distribution to produce data. This method is a special approach that is very useful for simulating risky situations in order to obtain approximate answers that cannot be obtained from physical studies or from the use of mathematical analysis which starts from the generalization of facts that occur by presenting them in numbers random and cumulative probability distributions [11]. The number of iterations in the Monte Carlo analysis method in this study was 25 repetitions. The output graph of the Monte Carlo analysis on the social dimension presented in Figure 4 shows that visually, the iteration points are quite good, which appear to be clustered and indicate that the values between iterations are not much different.

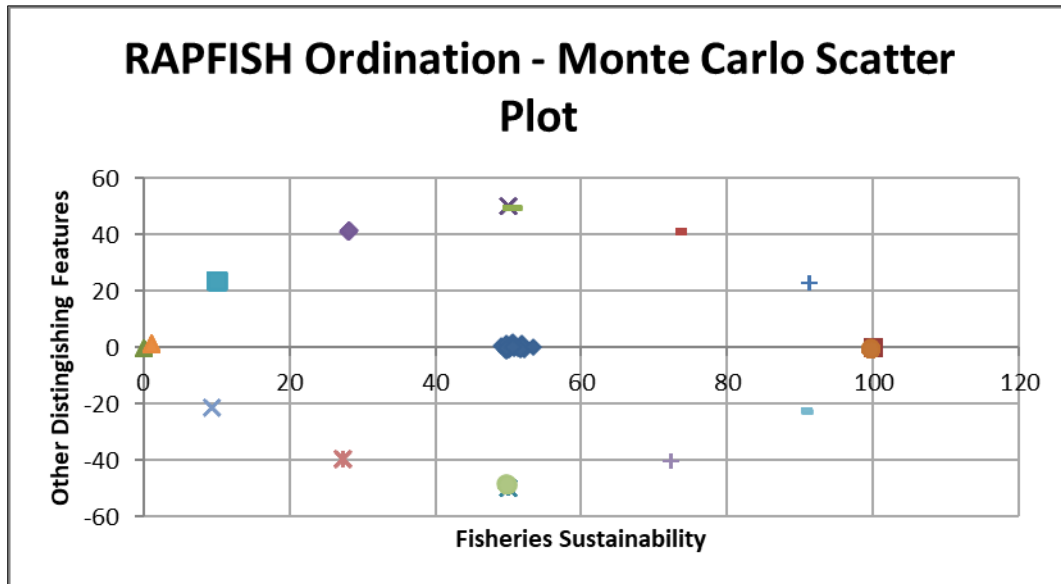


Figure 4 The results of the Monte Carlo analysis on the social dimension

3.2.2. Economic Dimension

The economic dimension implies that fisheries development must pay attention to the sustainability of the welfare of fish crackers agroindustry actors in Palembang City. The result to be achieved in the dimension is to maintain or achieve a higher level of community welfare is the focus in the sustainability framework. This dimension is measured and analyzed using the RAPFISH method with 6 (six) attributes, namely the amount of raw materials, the number of types of fish, production period, raw material prices, marketing price trends, and labor salaries. Based on the analysis using the RAPFISH software, it shows that the economic dimension sustainability index is 51.36. The index value of the social dimension is in the range of 50.01 – 75.00. These results indicate that based on the criteria of sustainability status, the economic dimension index of the fish crackers agroindustry in Palembang City is in the moderately sustainable category. The results of RAPFISH coordination in the economic dimension are presented in Figure 5.

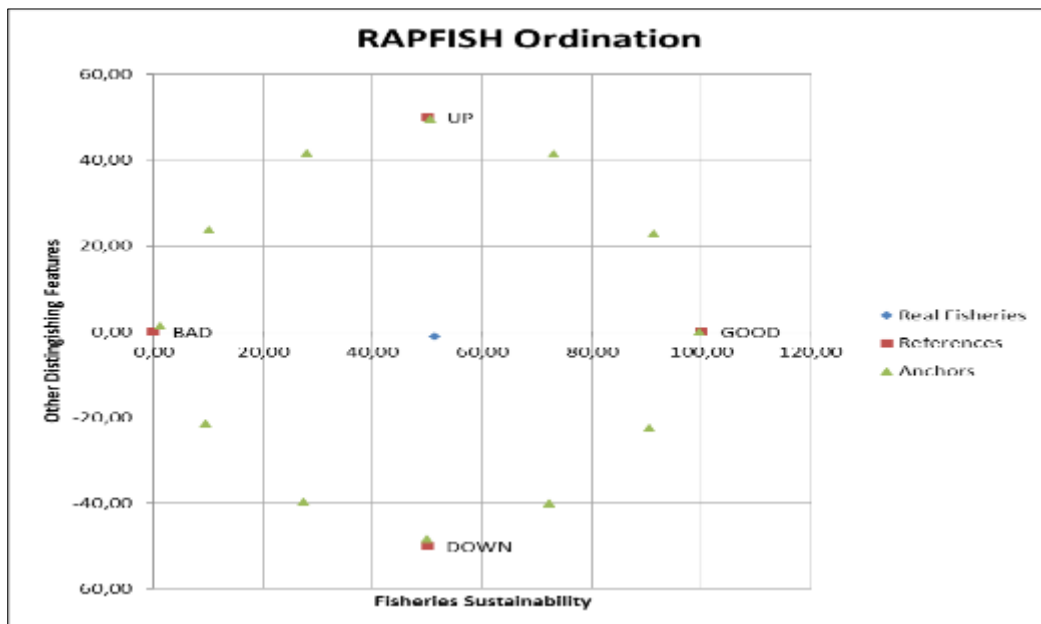


Figure 5 Results of RAPFISH coordination in the economic dimension

After knowing the value of the sustainability index on the economic dimension, leverage analysis can then be carried out which will be presented in the leverage attributes. The results of leverage attributes in the economic dimension are presented in Figure 4.6.

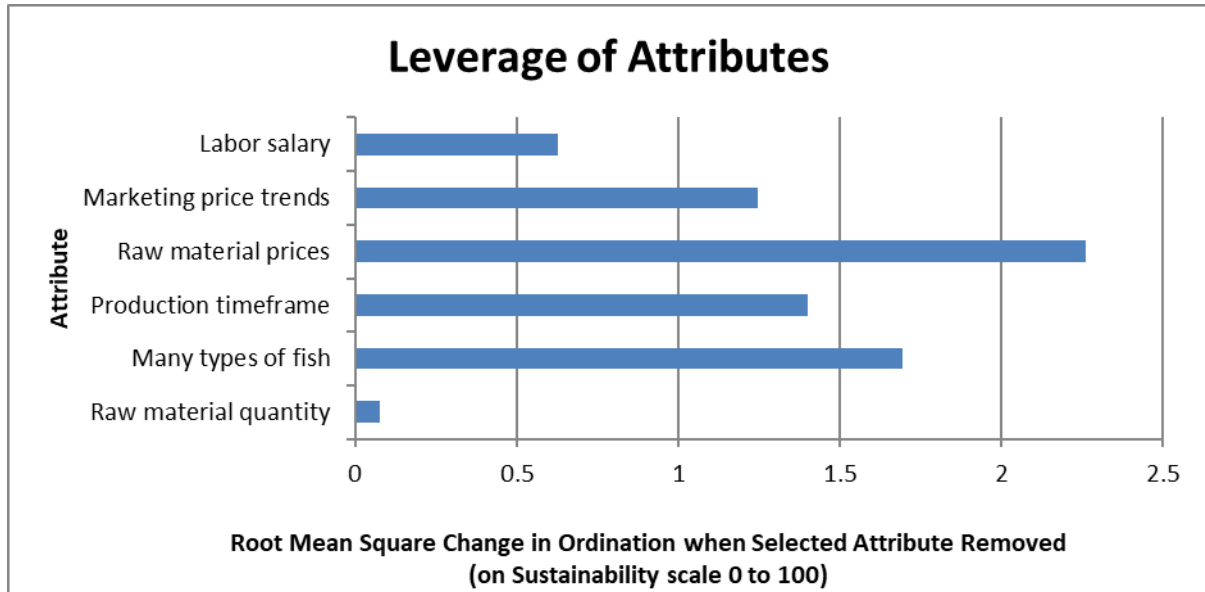


Figure 6 The results of leverage attributes in the economic dimension

Based on the results of leverage analysis, it shows that the attribute that provides the most significant sensitivity to changes in the sustainability index on the economic dimension is the price of raw materials with a value of 2.3 in the form of a Root Mean Square (RMS) value. The emergence of these attributes is due to fish crackers agroindustry in Palembang City, the average price of raw materials is very fluctuating. One of the strategies to deal with the phenomenon of price fluctuations is by substituting the previous raw materials with alternative raw materials at more affordable prices. The price of raw materials will certainly have a significant effect on many types of fish later. This is consistent with the results of the leverage analysis, where the next sensitive attribute that affects the sustainability of the economic dimension is the number of fish species with a value of 1.7. The next effort that can be done is to reduce profits a little, even though every agroindustry player certainly wants to get maximum profits, it is also necessary to pay attention to the situation and conditions in the field.

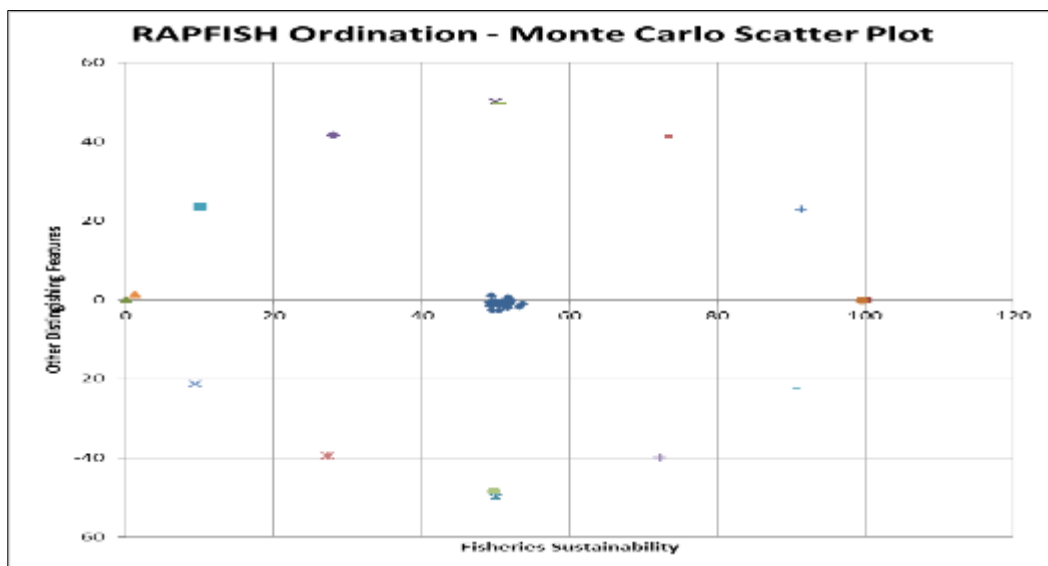


Figure 7 Results of Monte Carlo analysis on the economic dimension

The lowest attribute value on the sustainable economic dimension is the amount of raw materials with a value of 0.2. This attribute has no significant effect because the amount of raw materials in the sustainable economic dimension does not have a significant impact of fish crackers agroindustry in Palembang City. The attribute with the next lowest value is the employee's salary with a leverage value of 0.7. Even though currently the wages of workers at fish crackers agroindustry in Palembang City are quite high, in fact these attributes do not really affect the status of the sustainability of fish crackers agroindustry in Palembang City when the price of raw materials fluctuates very much.

The output graph of the Monte Carlo analysis on the economic dimension presented in Figure 7 shows that visually the Monte Carlo scatter plot analysis as shown in the figure shows that the model is categorized as good and strong (reliable) with iterations not scattering (clustering).

3.2.3. Marketing Technology Dimension

The marketing technology dimension implies that through a holistic approach with the aim of satisfying customer wants and needs while emphasizing technology and marketing issues so as to produce ideal profits. This dimension was measured and analyzed using the RAPFISH method with 6 (six) attributes, namely raw material handling, post-harvest, type of packaging, sales chain process, variations of types of crackers sold, and marketing reach. Based on the analysis using the RAPFISH software, it shows that the marketing technology dimension sustainability index is 54.58. The index value of the social dimension is in the range of 50.01 – 75.00. These results indicate that based on the criteria of sustainability status, the dimension index of marketing technology for fish crackers agroindustry in Palembang City is in the quite sustainable category. The results of RAPFISH coordination in the marketing technology dimension are presented in Figure 8.

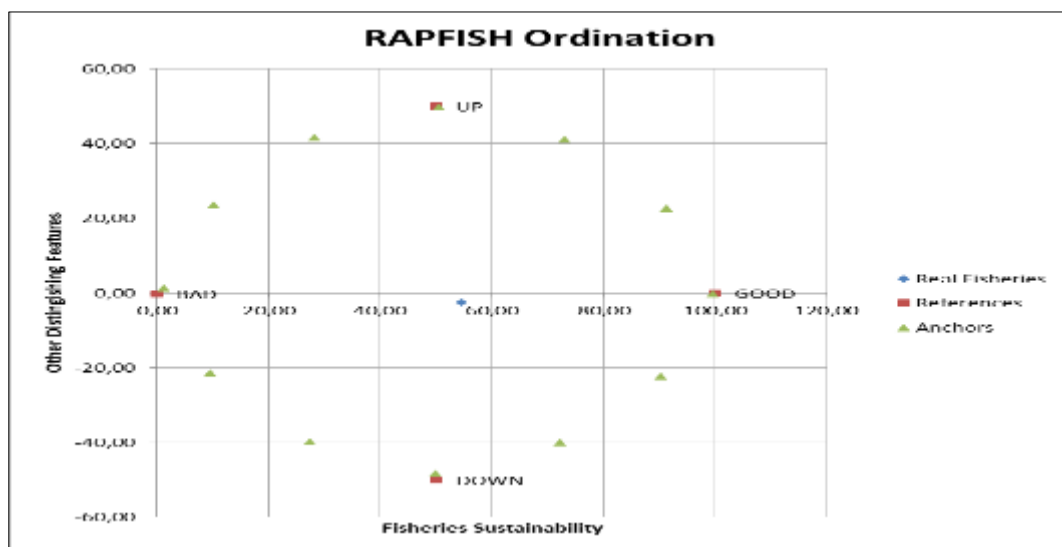


Figure 8 Results of RAPFISH coordination in the marketing technology dimension

After knowing the value of the sustainability index on the marketing technology dimension, leverage analysis can then be carried out which will be presented in the leverage attributes. The results of leverage attributes in the marketing technology dimension are presented in Figure 9.

Based on the results of leverage analysis, it shows that the attribute that provides the most significant sensitivity to changes in the sustainability index on the marketing technology dimension is post-harvest with a value of 2.7 in the form of a Root Mean Square (RMS) value. The emergence of these attributes is because in the management of fish crackers agroindustry in Palembang City so far the post-harvest handling facilities are still not efficient. The benefit of post-harvest handling and treatment, especially fish crackers agroindustry in Palembang City is that it can minimize the decline in product quality with various treatment techniques such as grading, packaging, storage, and technology to eliminate the causes of contaminants either physically, chemically, or biologically.

Fishery product resources are known as raw materials that are easily damaged, therefore it is necessary to carry out further treatment both post-production, post-harvest and processing. Efforts to handle post-harvest will be aligned with reducing the risk of failure in the continuity of the agroindustry so that it can expand the sales chain of fish crackers agroindustry in Palembang City itself. This is consistent with the results of the leverage analysis, where the next

sensitive attribute that affects the sustainability of the marketing technology dimension is the sales chain process with a value of 0.9. Therefore, the better the post-harvest handling of an agroindustry, it is certain that the sales chain process will be wider, which of course has a positive effect on the existence of fish crackers agroindustry in Palembang City.

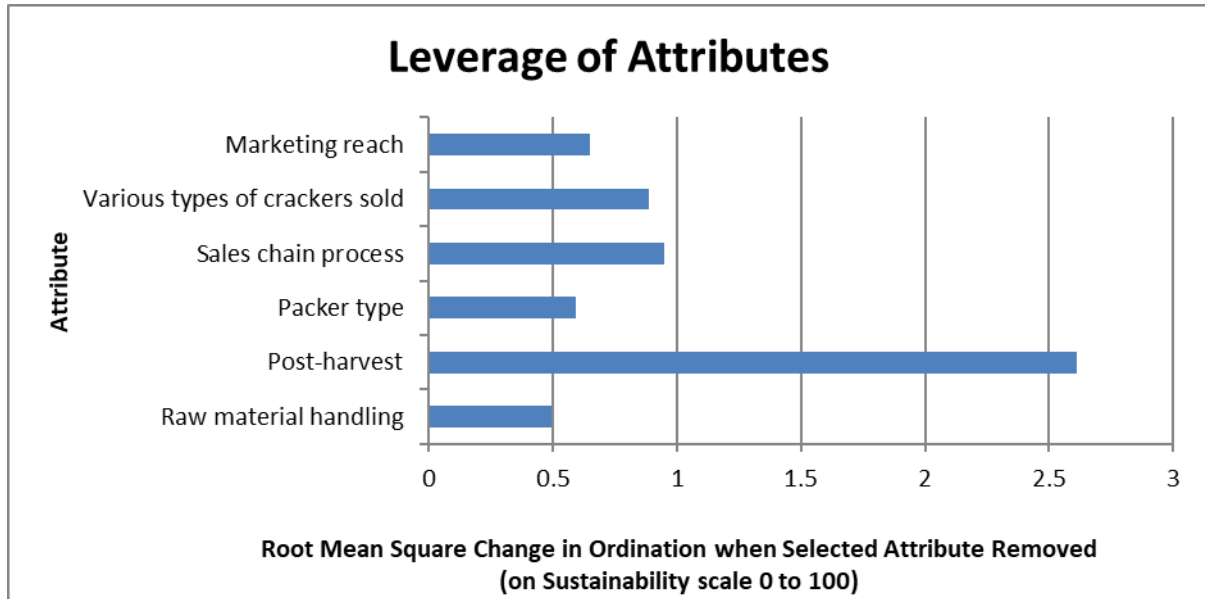


Figure 9 The results of the leverage attributes in the marketing technology dimension

The lowest attribute value on the dimension of sustainable marketing technology is raw material handling with a value of 0.5. This attribute has no significant effect because the handling of raw materials in the dimension of sustainable marketing technology does not have a significant impact on the sustainability of fish crackers agroindustry in Palembang City. The attribute with the next lowest value is the type of packer with a leverage value of 0.7. The type of packaging that is widely used in the fish crackers agroindustry in Palembang City is Polypropylene (PP) plastic packaging. PP is a crystalline polymer produced from the polymerization of propylene gas. This packaging has a fairly high melting point (190 – 200 °C), crystallization point (130 – 135 °C), high chemical resistance, but low impact resistance [12]. The weakness of this packaging is that the oxygen permeability is quite high and the resistance to oil is quite low [13]. Therefore, the attribute value of the type of packaging has no significant effect on the sustainability status of fish crackers agroindustry in Palembang City.

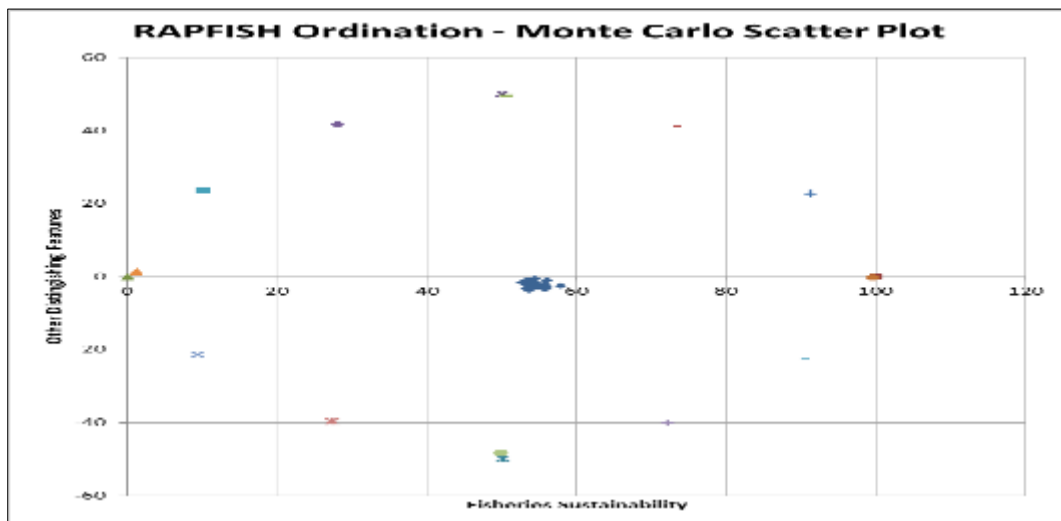


Figure 10 The results of the Monte Carlo analysis on the dimensions of marketing technology

Monte Carlo analysis on the dimensions of marketing technology is presented in Figure 10. Visualization of the Monte Carlo scatter plot as shown above shows that the model is considered good enough and strong enough (reliable), where iterations do not appear to spread.

3.2.4. Institutional Dimension

The sustainable institutional dimension is a reflection of the level of involvement, both the Government, business actors, and the community itself to minimize risks or threats to the sustainability of fish crackers agroindustry in Palembang City. This is because the greater the percentage of involvement, the higher the level of attention and concern for the agroindustry sustainability efforts themselves. This dimension is measured and analyzed using the RAPFISH method with 6 (six) attributes, namely government participation, the role of business actors, application of policies, access to resources, externalities (waste), and mitigation of habitat. Based on the analysis using the RAPFISH software, it shows that the institutional dimension sustainability index is 46.64. The index value of the institutional dimension is in the range of 25.01 – 50.00. These results indicate that based on the criteria for sustainability status, the institutional dimensions of fish crackers agroindustry in Palembang City are in the less sustainable category. The results of RAPFISH coordination in the economic dimension are presented in Figure 11.

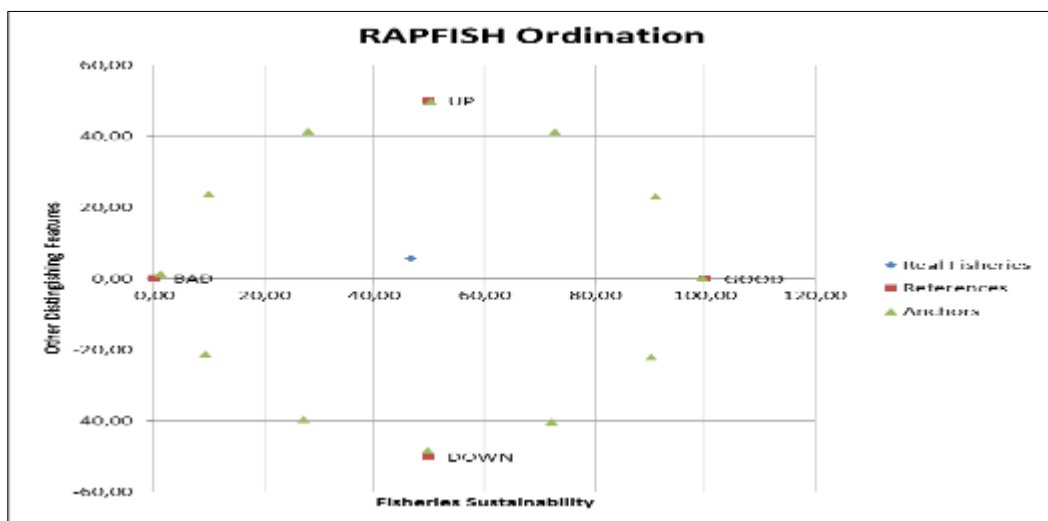


Figure 11 Results of RAPFISH coordination in the institutional dimension

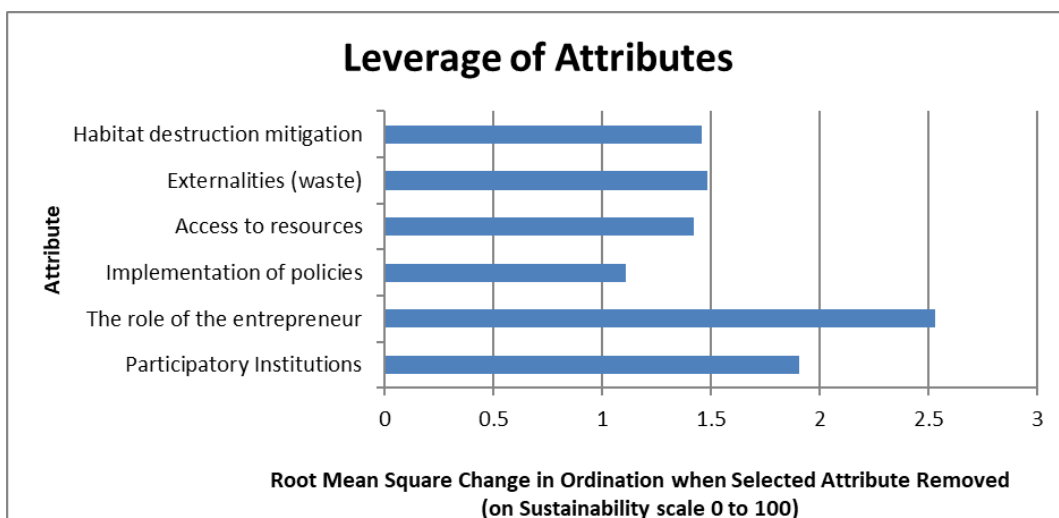


Figure 12 Results of leverage attributes in the institutional dimension

After knowing the value of the sustainability index on the institutional dimension, leverage analysis can then be carried out which will be presented in the leverage attributes. The results of the leverage attributes in the marketing technology dimension are presented in Figure 12.

Based on the results of leverage analysis, it shows that the attribute that provides the most significant sensitivity to changes in the sustainability index on the institutional dimension is the role of business actors with a value of 2.6 in the form of a Root Mean Square (RMS) value. The emergence of these attributes in the management of fish crackers agroindustry in Palembang City is because business actors play a large enough role and cannot be denied in the existence of the agroindustry itself. Business actors can be said to be key players who have a strategic position in the development of agroindustry. However, in order to realize a sustainable institutional dimension, it cannot be fulfilled without the participation and contribution of the Government's participation.

It should be noted that the Government has a dual role, namely as a facilitator and regulator fish crackers in Palembang City, the purpose of which is to facilitate the agroindustry in achieving its business development goals. This is consistent with the results of the leverage analysis, where the next sensitive attribute that affects the sustainability of the institutional dimension is government participation with a score of 1.8.

The lowest attribute value on the institutional dimension is the implementation of policies with a value of 1.2. This attribute has no significant effect because the implementation of policies in this dimension does not have a significant impact on the sustainability of fish crackers agroindustry in Palembang City. Based on field facts, the target of implementing policies on fish crackers agroindustry in Palembang City is still limited to an orientation towards income which tends to override welfare and production development.

The attribute with the next lowest value is access to resources with a leverage value of 1.4. This is because the agroindustry does not yet have definite regulations on regulating access to its resources so that it can be said that access is very open without clear boundaries. If the role of business actors and government participation in an agroindustry is potential enough, but if policy implementation, access to resources, externalities (waste) and mitigation of habitat damage are not in line, the results will stagnate. Therefore, each attribute in the institutional dimension has a role in the same portion of the growth and development and existence of an agroindustry that cannot be separated from one another in each attribute and forms a unified whole.

Monte Carlo analysis on the institutional dimension is presented in Figure 13. Visualization of the Monte Carlo scatter plot as shown above shows that the model is considered good enough and strong enough (reliable), where iterations do not appear to spread.

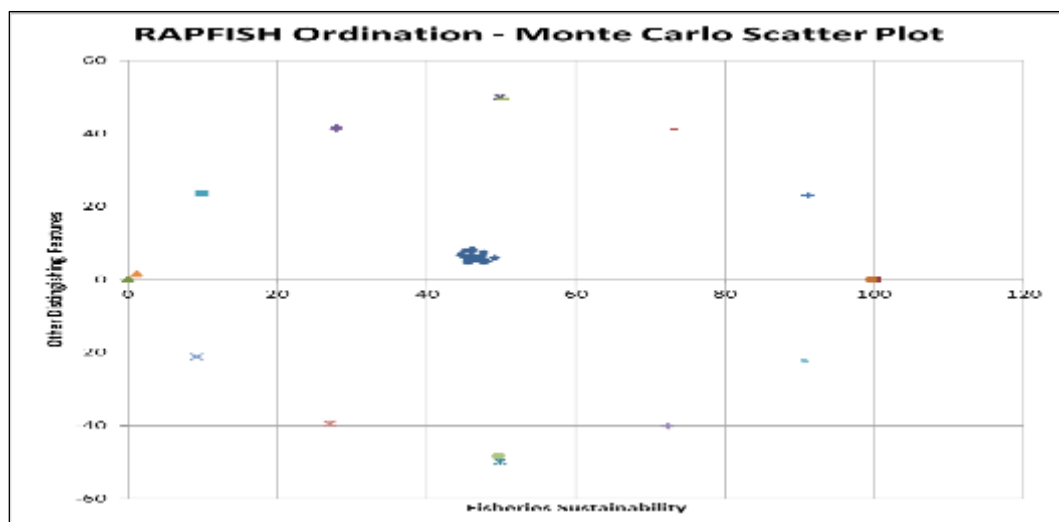


Figure 13 The results of the Monte Carlo analysis on the institutional dimension

3.2.5. Management Dimension

Management dimensions were measured and analyzed using the RAPFISH method with 6 (six) attributes, namely the legality of business licenses, quality of governance, ownership of environmental permits, halal certification, SNI certification, and HACCP certification. The results of RAPFISH coordination in the management dimension are presented in Figure 14.

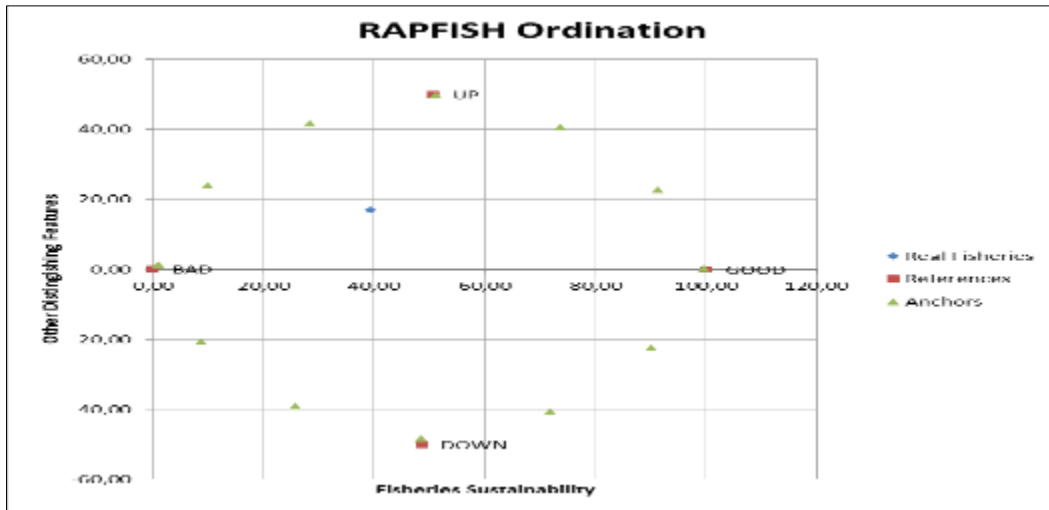


Figure 14 Results of RAPPFISH coordination in the management dimension

Based on the analysis using the RAPPFISH software, it shows that the management dimension's sustainability index is 39.38. The management dimension index value is in the range of 25.01 – 50.00. These results indicate that based on the criteria of sustainability status, the management dimension index of fish crackers agroindustry in Palembang City is in the less sustainable category.

After knowing the value of the sustainability index on the management dimension, leverage analysis can then be carried out which will be presented in the leverage attributes. The results of the leverage attributes in the management dimension are presented in Figure 15.

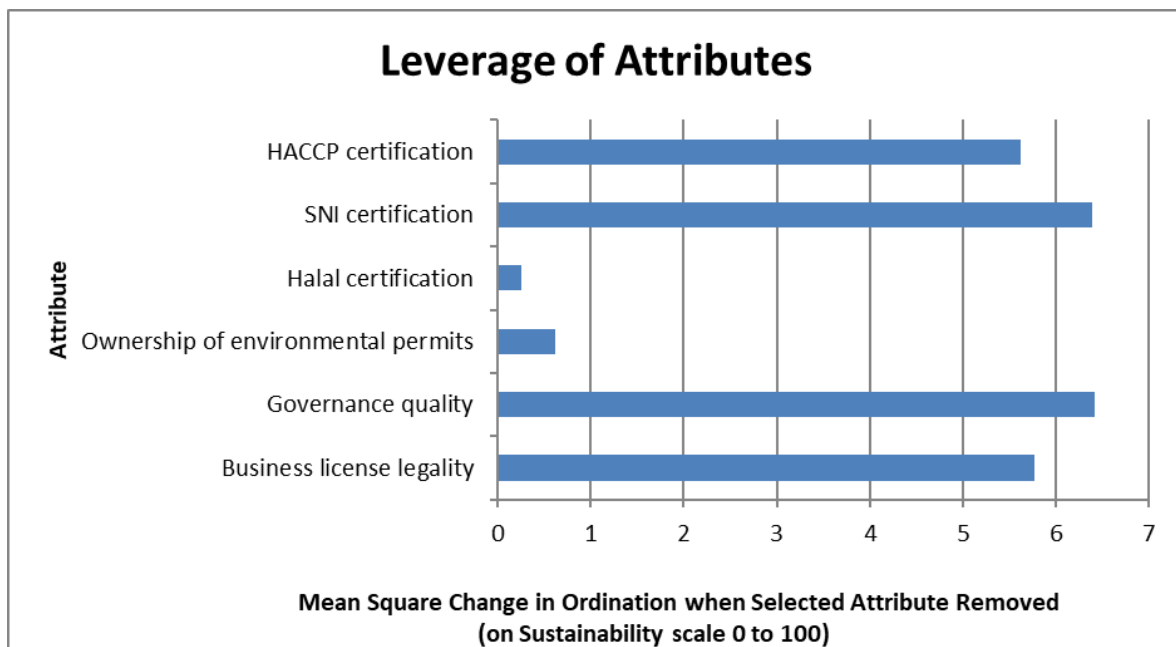


Figure 15 The results of the leverage attributes in the management dimension

Based on the results of leverage analysis, it shows that the attribute that provides the most significant sensitivity to changes in the sustainability index on the management dimension is the quality of governance with a value of 6.5 in the form of a Root Mean Square (RMS) value. The emergence of these attributes in fish crackers agroindustry in Palembang City is due to the quality of governance being able to strengthen the competitive position of agroindustry on an ongoing basis, manage resources and risks more effectively and efficiently, and increase agroindustry value and consumer confidence. The advantages of good quality governance will contribute to the creation of prosperity which is a good solution for facing challenges in the future. If an agroindustry ignores governance, it will cause business losses, reduced

reputation, and weakened competitive position. The quality of governance will be aligned with the application of legal standard certification. This is in line with the results of the leverage analysis, where the next sensitive attribute that affects the sustainability of the SNI certification management dimension is with a value of 6.4.

SNI certificate provides many advantages for agroindustry including increasing product competitiveness, product quality assurance, production process efficiency, increasing consumer confidence, and creating healthy and fair business competition. If a product does not have SNI standards, it can endanger the health and safety of consumers and reduce product quality. According to the Coordinating Minister for Maritime Affairs and Investment that agroindustry actors must have an Indonesian National Standard certificate. This is intended so that if a product already has SNI then the product can compete with foreign products, both in the domestic market and the global market.

The lowest attribute value on the management dimension is halal certification with a value of 0.5. This attribute has no significant effect because the application of halal certification in this dimension does not have a significant impact on the sustainability of fish crackers agroindustry in Palembang City. Halal certification cannot be ignored considering that the majority of Indonesian people, especially Palembang City, adhere to Islam. The benefits of halal certification are guaranteeing health, increasing consumer confidence, increasing market share, and increasing business competitiveness, both domestic and international markets. The obligation of halal certification for all food and beverage products is strictly regulated in Law Number 33 of 2014 Article 4 concerning Halal Assurance which reads "products that enter, circulate and trade in Indonesia must be halal certified".

The attribute with the next lowest value is ownership of an environmental permit with a leverage value of 0.8. Based on the facts on the ground, ownership of environmental permits for fish crackers agroindustry in Palembang City is still not effective. These attributes are deemed necessary as an effort to protect and manage the environment, as well as a prerequisite for obtaining a business license. The advantage of owning an environmental permit is that it can handle waste and pollutant emissions. Business legality in agro-industry is very important to have because it is an identity and identity that confirms an agroindustry so that later it can be recognized by society and the State. The legality of a business license must be legal in the eyes of the law protected by various documents in accordance with statutory regulations.

The output graph of the Monte Carlo analysis on the management dimensions presented in Figure 16 shows that visually the Monte Carlo scatter plot analysis as shown in the figure shows that the model is categorized as good and strong (reliable) with non-spread iterations.

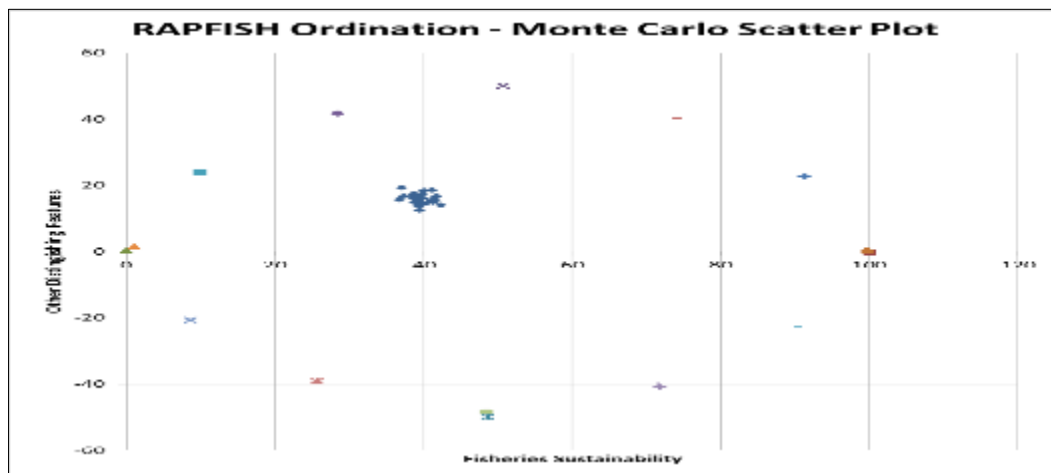


Figure 16 Results of Monte Carlo analysis on management dimensions

3.3. Multidimensional Sustainability Status

The results of the RAPFISH analysis show that all the attributes studied for the sustainability of fish crackers agroindustry in Palembang City are quite accurate. This can be seen from the stress value which is quite low or less than 25%, which ranges from 0.15 to 0.16. This shows that the accuracy of the configuration of the points in the MDS can represent the good sustainability of fish crackers agroindustry in Palembang City. Smaller the stress value means the greater the representative distance can be maintained in the ordinate analysis in a reduced space or the results of the analysis are said to be reliable [14]. Stress value = 10% is considered sufficient, while stress value = 20% is considered

insufficient [15]. However, in the RAPFISH analysis using the $\leq 25\%$ criterion to be able to accept the results of the MDS analysis. The stress value is strongly influenced by the final dimension that is made, which means that the larger the final dimension is made, the smaller the stress value. The degree of determination coefficient (R^2) is close to 1, which is 0.93-0.94. This shows that the attributes used in this analysis can represent 93% - 94% of the diversity that exists in the sustainability of fish crackers agroindustry in Palembang City. This situation means that the variables created in each dimension are quite representative. The results of the analysis are adequate if the stress value is less than 0.25 (25%) and the coefficient of determination (R^2) is close to 1.0 [16]. Therefore, the attributes used to assess the sustainability status of each dimension are stated to be good and adequate.

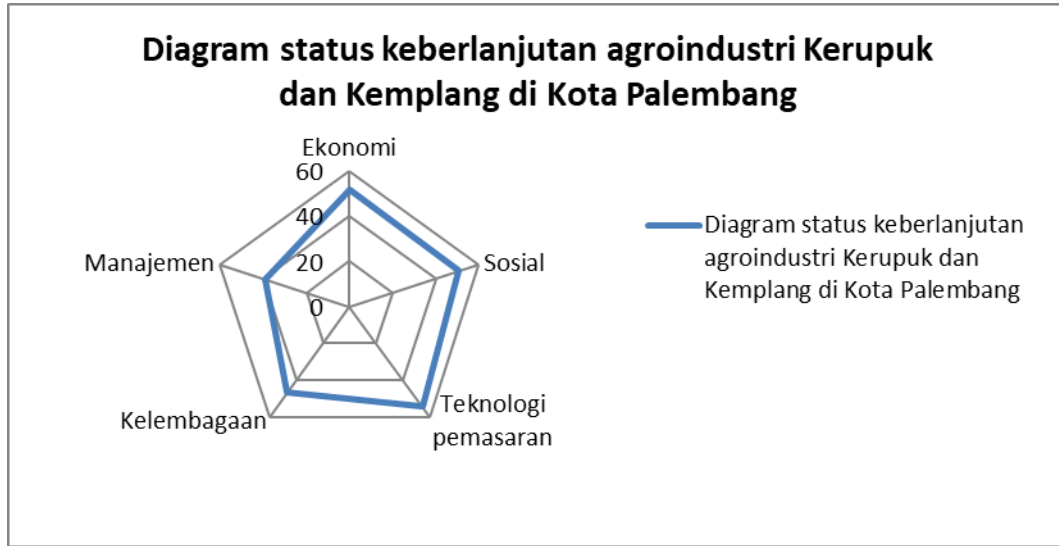


Figure 17 Diagram of the sustainability status of fish crackers agroindustry in Palembang City

Based on Figure 17, it describes the condition and status of the sustainability of fish crackers agroindustry in Palembang City from the five dimensions of sustainability. The order of the sustainability status index values is marketing technology (54.58), economic (51.36), social (50.75), institutional (46.64), and management (39.38). The results of these five dimensions are social, institutional, and management belonging to the less sustainable category, while marketing economics and technology are classified as quite sustainable.

Attributes that are sensitive to access contribute to the value of the multidimensional sustainability index based on leverage analysis on each dimension as many as 10 attributes. Therefore, it is necessary to take corrective actions on the lever attributes so that the sustainability of fish crackers agroindustry in Palembang City can be fulfilled.

Table 3 Status of the sustainability of fish crackers agroindustry in Palembang City

Sustainability Dimension	Index Value	Stress Value	R ² Value	Sustainability Status
Economic	51,36	0,16	0,93	Sufficiently sustainable
Social	50,75	0,16	0,93	Sufficiently sustainable
Marketing Technology	54,58	0,16	0,93	Sufficiently sustainable
Institutional	46,64	0,16	0,93	Less sustainable
Management	39,38	0,15	0,94	Less sustainable
Average	48,54			Less sustainable

Source: Primary Data Analysis, 2023.

The results of the RAPFISH analysis regarding the sustainability status of fish crackers agroindustry in Palembang City based on field conditions, obtained a sustainability index value of 48.56 and is included in the less sustainable status. This value is obtained based on an assessment of 30 attributes from 5 (five) dimensions of sustainability, namely

economic, social, marketing technology, institutions and management. The sustainability status of fish crackers agroindustry in Palembang City can be seen in Table 3.

4. Conclusion

The conclusions that can be drawn from the results of this study are the multidimensional status of the sustainability of fish crackers agroindustry in Palembang City is categorized as less sustainable with an average sustainability index of 48.54. The social, economic and marketing technology dimensions are categorized as quite sustainable with index values of 50.75, 51.36 and 54.58 respectively, while the institutional and management dimensions are categorized as less sustainable with each index value of 46.64 and 39,38. The suggestions that can be given based on the results of this study are the strategy that can be applied in developing fish crackers agroindustry in Palembang is moderate-optimistic. This strategy can be achieved by improving about 50% of the key attributes (factors).

Compliance with ethical standards

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Disclosure of conflict of interest

Authors declare that there is no conflict of interest.

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