

Value Chain Model for Straw Mushroom (*Volvariella volvacea*) Agribusiness Performance in Karawang, Indonesia

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Abstract

Straw mushroom is one of the potential commodities in Indonesia with consumption growth always increasing every year. This commodity has great potential to be developed but must be accompanied by the right value chain performance. In this study, the mapping and value chain performance of straw mushroom quality were analyzed. This research was conducted using a descriptive survey method to 56 respondents through interviews and questionnaires. Data were collected and analyzed using the value chain analysis model and the Analytical Hierarchy Process (AHP). The results showed that there were 6 patterns of the straw mushroom value chain. The actors involved consisted of farmers, traders, wholesalers, retailers, and consumers. The performance element that needs great attention is reliability (37.4%), followed by cost (22.6%), agility (20.1%) and responsiveness (19.9%). The results of this study are then used to facilitate decision making in improving value chain performance.

Keywords: value chain, performance, agribusiness, straw mushroom

1. Introduction

Mushroom production has increased rapidly and is expected to further increase in the future (Grimm & Wösten, 2018a) with its consumption growth always increasing every year (Grimm & Wösten, 2018b). Mushrooms is not only used as a delicious food or flavour but also for health (Pop et al., 2018) since they are enriched with proteins, phenolics, vitamins, antioxidants, and microelements (Kora, 2020). Plants that contain phenolics and antioxidants can be used as medicine (Al-Ghamdi et al., 2020) and treatment goals (Abdel-Mawgoud et al., 2019). So, apart from being food, mushrooms can also be used as a medicine (Ashraf et al., 2020); and they are good for diet because they are low in calories, carbohydrates, fat and cholesterol (Fontes et al., 2019).

Straw mushroom is one of the most widely cultivated food types in tropical and subtropical regions (Liu, 2020). Apart from being a source of food and good for health, this product has an environmentally friendly production process and can be a source of income for the community (Datta, 2019). Straw mushroom cultivation has economic and environmental feasibility (Atila, 2019), but there are still obstacles in the procurement of seeds, limited technical information, and lack of agricultural extension role. In addition, farmers also have constraints in marketing and pest control, climate or weather inconsistencies (Robinson et al., 2019), water quality (Sakinah, 2019), and there is no added value for straw mushrooms.

Straw mushroom is one of the leading commodities in Karawang Regency, Indonesia with an increase in consumption that always increases every year. Demand per day reaches 4-10 tons, while the supply is only around 4-7 tons. This condition shows that straw mushroom agribusiness has the potential to be developed, but the performance of the value chain (starting from the planning process, procurement of agro-input facilities, production, distribution, to returns) needs to be improved. These activities are very important for the development and competitiveness of the company as well as the company's supply chain management strategy (Florescu et al., 2019). Therefore, this study aims to determine the structure of the value chain and measure the performance of the mushroom value chain. It is important to select performance attributes to improve the mushroom value chain. This study uses the Analytical Hierarchy Process (AHP) methodological approach with its ability to make decisions from various criteria (Bunyan Unel & Yalpir, 2019). This approach is also able to measure supplier performance which can help organizations to optimize costs and quality of functions (Touil et al., 2019). The AHP method developed by Saaty (saaty, 1990) is an effective and easy-to-apply tool to assess criteria that influence intuitive decision-making problems through a multi-level hierarchical structure (Sevinç et al., 2018).

2. Methodology

The method used in this study is a descriptive method by surveying, interviewing, and distributing questionnaires to respondents, namely 40 mushroom farmers by

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purposive sampling and 16 sellers by snowball sampling. Surveys and interviews were conducted to find out the main actors involved in the performance of the value chain and to get an overview of the straw mushroom business process. The research location is in the center of straw mushrooms in Jatisari District, Karawang Regency. The location determination was carried out by purposive sampling, with the consideration that the location of this study was the center of straw mushrooms. This research was conducted from January to August 2020. Furthermore, the measurement data was processed by value chain analysis and the Analytical Hierarchy Process (AHP) method.

2.1. Value Chain Analysis.

Value chain analysis refers to a series of activities required to present a product or service starting from the conceptual stage, the production stage, to delivery to the final consumer and destruction after use. The stages in value chain analysis are as follows:

1. Entry point

The entry point is to determine the point where the research will begin. The selected entry point is a mushroom farmer, then tracing with snowball sampling to get a sample at the next point to the consumer, as in the cotton industry value chain research (Mapanga et al., 2018).

2. Value chain mapping

Market mapping is very much needed in value chain mapping analysis. It is used to determine the contribution of the actors involved and the relationship between the actors. Identification of factors that affect value chain

performance can be obtained from the interaction information (Muloi et al., 2018).

3. Improve the value chain

Value chain improvements are carried out to identify possible improvements, by optimizing the performance of the edible mushroom value chain.

2.2. Model Analytical Hierarchy Process (AHP).

The AHP method was developed by Thomas Saaty (Saaty, 1990). This method is used to update the value chain performance by making decisions and determining the best alternative by considering various criteria (Improta, 2018). This method is also used for decision making by making pairwise comparisons of the available criteria options (Leśniak et al., 2018). The AHP model software expert choice 11 can be used to select the performance criteria of the mushroom value chain based on priority. Data to measure performance are obtained from literature studies and in-depth interviews with several experts / actors who are directly involved in the mushroom value chain. AHP working principle stages are as follows (Susanawati & Fauzan, 2019):

1. Problem Identification

The first step is to identify the problem in depth. The next process is the identification and selection of elements that will be included in the system components, such as goals (target), objectives, criteria, sub criteria and alternatives in the AHP structure. AHP method is able to break down complex problems into sub-problems, classify these sub-problems based on domination relations, and build an orderly hierarchy (Beiragh, 2020). The hierarchical structure of the mushroom value chain performance is shown in the Figure 1.

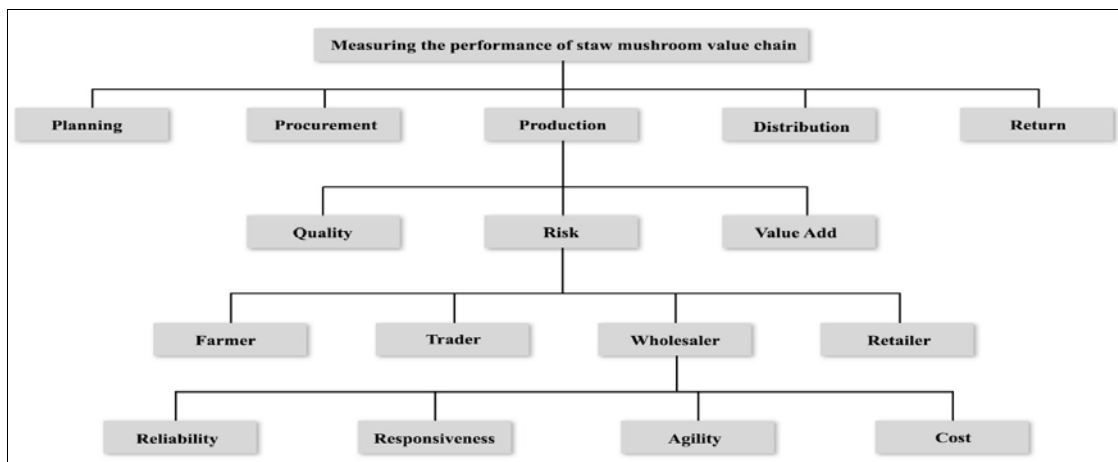


Figure 1. Hierarchy Structure of Value Chain Model for Performance of Straw Mushroom AgribusinessCreating a hierarchical structure

The AHP process method involves consideration of a hierarchical structure in the form of goals (targets), criteria, sub criteria and alternatives (Improta, 2018). The goals is to measure the performance of the mushroom commodity value chain, the criteria consist of planning, procurement, production, distribution and return. Sub criteria consist of quality, risk and value-added (Setyabudi, 2018), actors consist of farmers, traders, wholesalers and retailers (Sachan, 2020). While the alternatives are reliability, responsiveness, agility and cost.

2. Assessment of each level of the hierarchy

The assessment process is carried out to find the elements that most influence the overall objectives. The initial step is to make an assessment of the importance of the two elements at a given level in relation to the higher-level hierarchy. The results of the assessment are presented in a paired matrix of size nxn. Saaty gives a rating of 1 to 9 to assess the comparison of the importance of one element to another (Susanawati & Fauzan, 2019).

Table 1. Comparison Scale.

Comparison Scale	Definition	Description
1	Both elements are equally important	Two elements have the same influence greatly to the goals
3	Elements of a little more important than other elements	Experience and judgement slightly favor one element compared to other elements
5	Elements which one is more important than other elements	Experience and strong vote supporting one element compared to the other elements
7	One element is obviously more important than other elements	One very powerful element supported, and the domain has been in practice
9	One absolutely essential element than other elements	The evidence that supports one element against another element has the highest possible degree of confirmation strengthens
2,4,6,8	The values between two adjacent values	Values considerations is given when there are two compromises between two options

3. Determination of element priority

Each level of the hierarchy needs to be compared in pairs to determine priority. Paired elements must be compared based on certain standards and considerations. Relationships between elements from each level of the hierarchy are established by comparing them in pairs. This relationship describes the relative influence of an element at a hierarchical level to each element at a higher level. Elements at this higher level function as criteria and are called properties. The result of this differentiation process is the priority vector or the relative importance of an element to each trait. Pairwise comparisons are repeated for each element in each level. Then the next step is to give weight to each vector with its priority properties. The first comparison is performed starting at the top of the hierarchy in the comparison process. The second comparison is performed by comparing the elements at the lower level.

Table 2. Random index Value (RI).

Matrix Size	RI	Matrix Size	RI
1	0	9	1,45
2	0	10	1,49
3	0,58	11	1,51
4	0,90	12	1,48
5	1,12	13	1,56
6	1,24	14	1,57
7	1,32	15	1,59
8	1,41		

4. Logical Consistency

In making decisions, an assessment that has high consistency is needed so that the results are accurate. Authentic results can be obtained by applying an overall consistent assessment by considering a consistency ratio of 10% which is measured using the AHP method in equation (1). If the consistency is > 10% then the assessment must be increased because it is still considered random.

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad \text{and} \quad CR = \frac{CI}{RI} \quad (1)$$

where, Ci is consistency index, CR is Ration consistency, RI is random index, and n is size of the matrix.

3. Results and Discussion

3.1. Value Chain Mapping

In the straw mushroom value chain pattern, there are four main components that form the value chain, namely products, actors, activities and inputs (Figure 2). The product referred in the picture is a straw mushroom that is

produced to be delivered to consumers. Straw Mushrooms have perishability and low durability while product freshness is a measure of marketing quality. Therefore, the longer the marketing pattern, the lower the freshness quality. The straw mushroom value chain structure consists of six value chain patterns involving five actors, namely farmers, traders, wholesalers, retailers and consumers. These services/institutions are supporting actors of the straw mushroom value chain.

Explanation of the functions and roles of actors in the value chain of hay mushroom commodities, namely:

1. Farmers or producers

Farmers are the parties who carry out the cultivation of the straw mushrooms. The productivity of the mushrooms in one crop averages 200-250 kg per mushroom house. The process of cultivating straw mushrooms to harvest takes 23 days, with details: the composting process about 7 days, the planting period until ready to harvest about 9 days and the length of harvest from beginning to end about 12 days. Straw mushrooms produced are sold to traders, wholesalers, or retailers.

2. Traders

Traders play a role in buying crops from farmers and also carry out collection, packaging, and delivery to wholesalers and retailers as well as selling directly to consumers. The trader purchases straw mushrooms in one growing season as much as 100-1,000 kg depending on the capital and availability of the mushrooms. Next, the merchant will sell the product to wholesalers and retailers.

3. Wholesaler

Wholesaler play a role in buying straw mushrooms from traders and farmers in a large volumes. The average purchase is normally in about 2,000-3,000 kg in one harvest season. Wholesalers usually market this product also to retailers in local markets and outside Karawang, for example Jakarta, Bogor, Tangerang and other cities.

4. Retailers

Retailers play a role in buying straw mushrooms from traders, wholesalers or directly from farmers to be sold to local consumers for small volume sizes of around 20-30 kg per one harvest season.

Among the actors in the value chain pattern, usually traders are the most influential parties. This is because traders have a big role in marketing and providing capital. In marketing straw mushrooms, farmers rely heavily on traders. More than 50% of farmers sell their crops to traders. The selling price of straw mushrooms tends to be around 20-30 percent cheaper than other middlemen. Even in the procurement of capital, farmers are still very dependent on traders. This is because the majority of farmers do not have sufficient capital, so they are forced to

borrow from traders to get raw materials whose prices are around 20-30% higher than the cash price.

Activities carried out by value chain actors along the marketing pattern include production, collection, sorting, packaging, transportation, and sales. Input is an instrument needed to carry out every activity in the value chain pattern, from product manufacturing to distribution to final consumers. Some of these inputs include labor,

information, skills, knowledge, and capital. The quantity and quality of products, performance of actors, activities and value chain inputs are influenced by business processes, from planning, procurement, production (processing), distribution and returns. Based on field observations, business processes need to be improved in line with value chain performance.

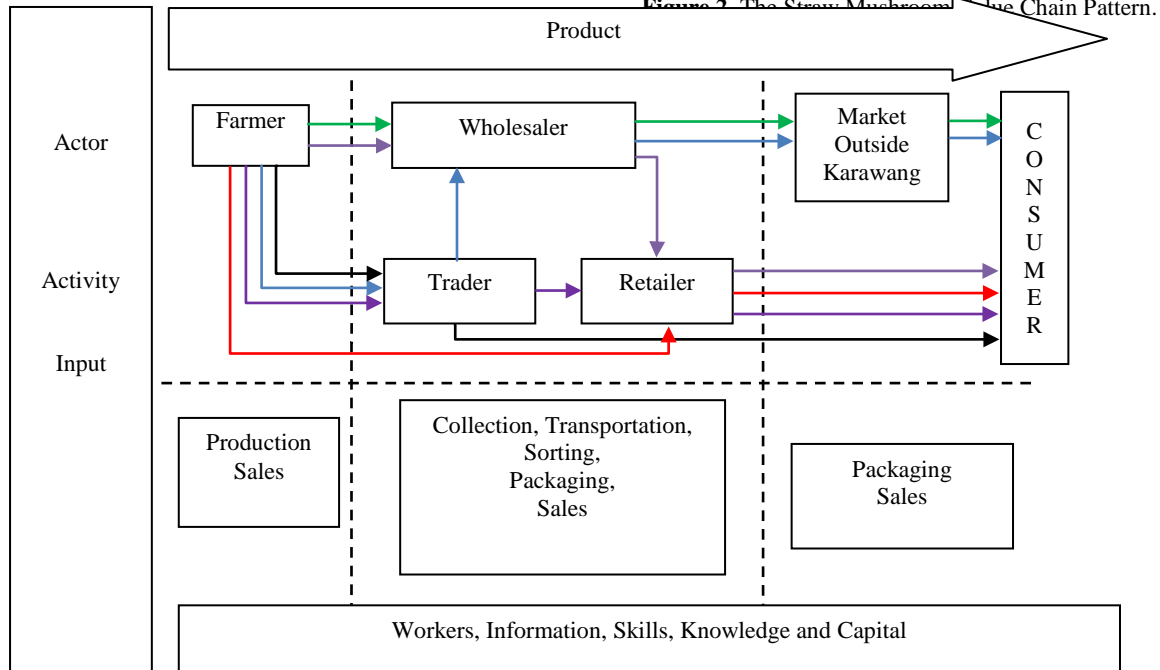


Figure 2. The Straw Mushroom Value Chain Pattern.

3.2. Performance Measurement of the Straw Mushroom Value Chain

The measurement of the performance of the straw mushroom value chain consists of objectives, criteria, sub-criteria, actors and alternatives. The aim is to measure the performance of the hay mushroom value chain as shown in Figure 1. The criteria contained in the hierarchical structure are the hay mushroom business processes, which consist of planning, procurement, production, distribution and returns, while the sub-criteria are performance parameters in the form of quality, risk and added value. The actors directly involved in the performance of the straw mushroom value chain are farmers (producers), traders, wholesalers and retailers.

Based on the comparison of pairs between criteria, the measurement results show that the production business process with a value of 0.386 is the most important process compared to other business processes (Figure 3). This is because the production process is the main process in determining the success of the straw mushroom business. Things that can affect the production process or straw mushroom cultivation are weather, water quality, seed quality, pests and diseases and flooding. So far, farmers get mushroom seeds directly from nurseries outside the city, or through seed stalls in the city. Farmers have not been able to cultivate straw mushrooms independently; this is due to the lack of farmers' abilities. In addition to production, the next business process is procurement, distribution, planning and returns.

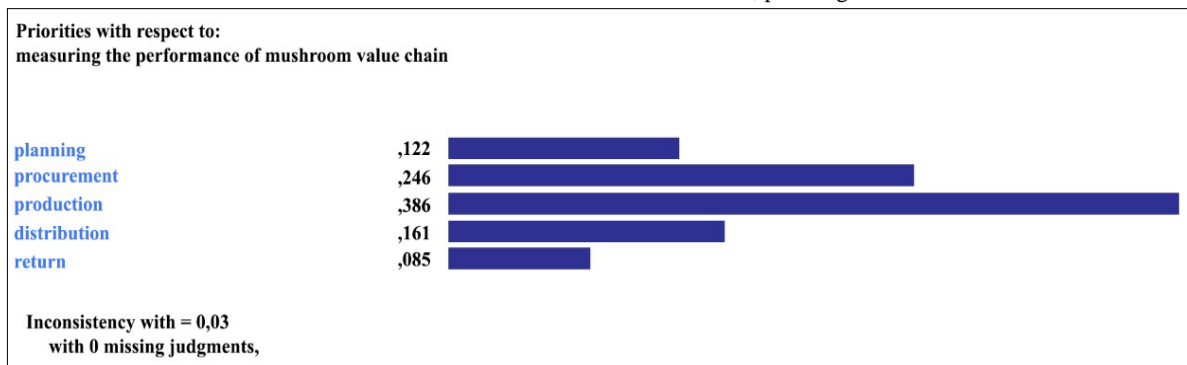


Figure 3. Comparison of Inter-Criteria Pairings

The comparison of pairs of criteria in measuring the performance of the straw mushroom value chain can be seen in Table 3. In terms of performance parameters, the most important element in the planning process is quality

followed by added value, then risk. In the procurement process, the most important element is quality, followed by risk and finally added value. In the production process, the most important element is risk, the second element is

added value, and the last element is quality. An important element in the distribution business process is quality, followed by value added and finally risk. Meanwhile, in the return business process, the most important element is risk, followed by quality and added value. In general, quality performance parameters are considered as the most

important element when compared to other performance parameter elements; this is because quality greatly affects the quality of mushroom products that will be distributed to consumers and can be a measure of consumer confidence.

Table 3. Pairwise Comparisons Between Criteria in Value Chain Performance Measurement.

Performance Parameters	Planning	Procurement	Production	Distribution	Return
Quality	0,493	0,540	0,196	0,594	0,311
Risk	0,196	0,297	0,493	0,157	0,493
Value-Added	0,311	0,163	0,311	0,249	0,196
Consistency Index	0,05	0,01	0,05	0,05	0,05

Assessment of performance parameters based on value chain actors can be seen in Table 4. Farmers are very interested parties in the production and return process, both in terms of quality, risk and value-added parameters. Meanwhile, traders are very interested in quality parameters in the procurement process. This is because quality is closely related to the quality of the final product that will be distributed to consumers and becomes a measure of consumer confidence.

Wholesalers have a strong interest in the parameters of quality, risk and value-added in the distribution process. In the product procurement process, wholesalers have a strong interest in quality and value-added. This is because the quality of the product and the value-added of the product are the benchmarks in the success of the mushroom business. Moreover, large traders usually buy products in large quantities and distribute them to other regions. In addition, straw mushroom is a product that is not durable and easily damaged. Product durability is only up to 1-2 days. It is very necessary to handle efficiently and effectively in the distribution process. Thus, the parameters of quality, risk and value-added are very important. Based on research conducted by Sakinah (2020), the straw mushroom can last up to 6 days if stored with PVC film packaging at the temperature of 15 degrees Celcius. Therefore, it might reduce business losses.

Meanwhile, retailers are a party that has less interest than other value chain actors. Retailers are the value chain actors with the lowest risk compared to other actors. Moreover, the number of product purchases is not as many as other intermediary traders and product marketing is only carried out in traditional markets, which do not demand high quality. The consistency index value of all assessments between sub criteria is below 10%, so it is consistent.

Table 4. Pairwise Comparisons Between Sub Criteria in Value Chain Performance Measurement

Value Chain Actor	Quality	Risk	Value Add
Planning			
Farmer	0,124	0,276	0,138
Trader	0,389	0,195	0,276
Wholesaler	0,299	0,391	0,391
Retailer	0,188	0,138	0,138
Consistency Index	0,05	0,05	0,05
Procurement			
Farmer	0,276	0,391	0,138
Trader	0,195	0,276	0,276
Wholesaler	0,391	0,195	0,391
Retailer	0,138	0,138	0,195
Consistency Index	0,05	0,05	0,05
Production			
Farmer	0,391	0,461	0,391
Trader	0,276	0,236	0,195
Wholesaler	0,195	0,168	0,276
Retailer	0,138	0,135	0,138
Consistency Index	0,05	0,08	0,05
Distribution			
Farmer	0,138	0,124	0,107
Trader	0,276	0,299	0,293
Wholesaler	0,391	0,389	0,415
Retailer	0,195	0,188	0,185
Consistency Index	0,05	0,05	0,03
Return			
Farmer	0,391	0,395	0,395
Trader	0,276	0,278	0,239
Wholesaler	0,195	0,163	0,198
Retailer	0,138	0,163	0,168
Consistency Index	0,05	0,02	0,02

In alternative elements, the performance attribute shows the reliability value which is considered the most important element compared to other elements. This shows that the level of consumer trust in the mushroom value chain actors in meeting consumer demand on time and in perfect condition needs to be carefully considered. This is because reliability is necessary to ensure successful sustainable value chain performance. The value chain performance assessment can be seen in Table 5.

The combined assessment of the edible mushroom value chain performance measurement is shown in Figure 4. The most important performance attribute was reliability (37.4%), followed by cost (22.6%), agility (20.1%) and

lastly responsiveness (19.9%). Reliability should receive greater attention where the delivery of ordered products must be delivered in full, delivery accuracy and products delivered must be perfect both in quality and quantity.

In cost performance, it is necessary to pay attention to all expenses such as production and labor costs. In agility performance, what needs to be considered is the response to changes, including the fulfilment of production capacity and product stock inventory. Meanwhile, on responsiveness performance, things that need to be considered are the cycle time to obtain seeds and other input facilities, as well as the production cycle time.

Table 5. Performance Assessment of Straw Mushroom Value Chain in Karawang Regency.

Performance Attributes	Planning	Procurement	Production	Distribution	Return
Reliability	0,397	0,392	0,357	0,402	0,319
Responsiveness	0,195	0,224	0,201	0,188	0,143
Agility	0,182	0,179	0,197	0,251	0,216
Cost	0,226	0,205	0,245	0,158	0,322
Consistency Index	0,005	0,04	0,06	0,05	0,004

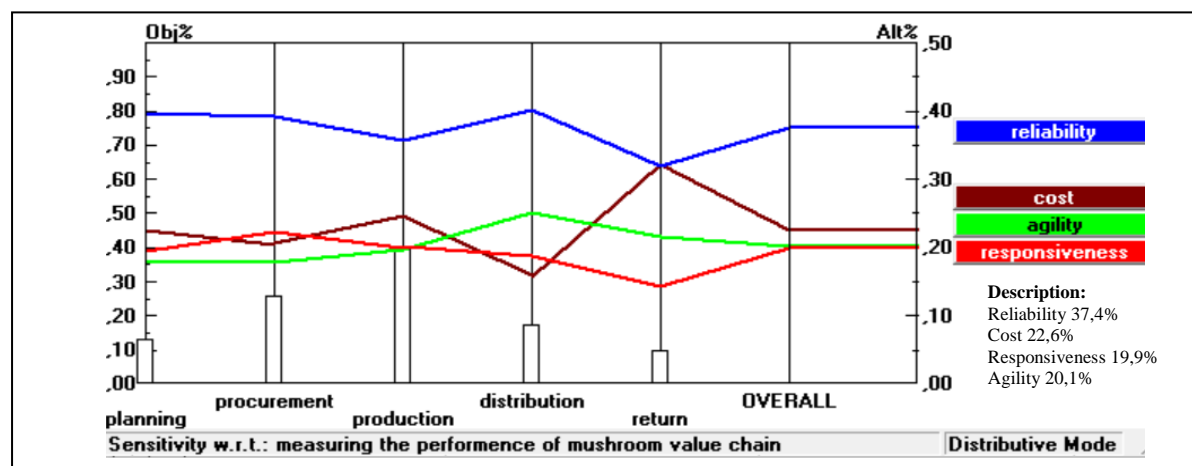


Figure 4. Combined Measurement of Straw Mushroom Value Chain Performance.

4. Conclusion

The actors of the straw mushroom value chain in Karawang consist of 5 actors, namely farmers, traders, wholesalers, retailers and consumers. The pairwise comparison results show that the production process (0.386) was the most important business process compared to procurement (0.246), distribution (0.161), planning (0.122) and return (0.085). From the results of measuring the performance of the mushroom value chain, the attributes that need great attention are reliability performance attributes (37.4%), followed by cost (22.6%), agility (20.1%) and responsiveness (19.9%). The essential things that must be considered in the performance of the reliability element are the delivery of product orders that must be sent as the consumer's demand, the accuracy of delivery, and the delivery of the product must be in perfect condition, both in quality and quantity.

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