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Understanding Technopreneurship in Agricultural E-Marketplaces

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ABSTRACT

Competition in the global market is challenging for technopreneurs to develop strategies that provide a comparative advantage to win the competition. **The article aims** to develop a model for applying agricultural product e-marketplaces, including the involvement of related stakeholders in Semarang and Magelang Regency, Indonesia. The study employs two primary analytical **methods**: the **MACTOR framework**, which assesses alliances, conflicts, and strategic recommendations, and the **Analytical Hierarchy Process (AHP)** to prioritize decision-making criteria. **The results showed** that developing agricultural product e-marketplaces requires collaboration from various stakeholders. Notably, consumers, who play a crucial role in the success of the e-marketplace, emerge as the most influential actors, while middlemen are identified as the most dependent. **The primary challenge** in developing an agricultural product e-marketplace is ensuring smooth food distribution. At the same time, alternative priorities include increasing business partnerships between local agricultural cooperatives and entrepreneurs/investors and providing infrastructure to support the development of e-marketplaces. **This study emphasizes the importance of collaboration** between various stakeholders in e-marketplace development and implementation of agricultural products so that they can be aligned for the success of the entire e-marketplace system.

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1. INTRODUCTION

Horticultural commodities play an important role in meeting national food needs, especially fruit and vegetable commodities [1], [2], [3]. The main problem in horticultural commodities is the length of the sales distribution chain, which provides a reasonably high price difference from the producer level, in this case, farmers, to the consumer level. Central Java Province is one of Indonesia's provinces with abundant potential for horticultural commodities. This potential is also found in several buffer areas, which are horticulture centers, namely Semarang Regency and Magelang Regency [4]. The geographical conditions in the two areas

dominated by highlands cause horticultural commodities to flourish and have superior quality. An Agribusiness sub-terminal was established in both regions to market horticultural commodities directly [5], [6], [7]. Horticultural commodities, especially fruits and vegetables, are easily damaged agricultural commodities, so they must be sold directly [8], [9], [10], [11]. This condition sometimes forces farmers to sell their crops at a low price, especially during the harvest.

The condition of horticultural commodity prices that often fluctuate causes farmers to experience losses [12]. In addition to weather factors, these fluctuations are also caused by the distribution chain's length, so there are often price games from middlemen [13], [14]. The length of the distribution chain is due to the fact that most of the distribution of agricultural products is dominated by traders, both village and sub-district level collecting traders, wholesalers, and exporters who often do not provide any added value to the products to be marketed, but still, take margins [15], [16].

This situation results in many agricultural business profits that are still enjoyed by middlemen and not by farmers and will directly impact consumers (end users) [17], [18], [19]. The poor condition of the logistics infrastructure also often impacts the size of the distribution of horticultural commodities [20]. This condition is also aggravated by post-harvest technology and storage that is not yet qualified, so the harvest must be sold immediately, even at a low price [21], [22]. Of course, this situation must be improved so that consumers or farmers can enjoy Indonesian agricultural products properly [23], [24]. One solution that can be applied to overcome the problem of the long distribution chain of horticultural commodities is to build an e-commerce-based trading system in agriculture [25], [26], [27]. E-commerce is one of the tools that meets the wishes of companies, consumers, and management in cutting service costs when improving the quality of goods and the speed of service [28], [29], [30], [31]. Therefore, the marketing system more widely used in horticultural commodities uses an e-marketplace because it accommodates many sellers [27].

E-marketplace is an internet-based online media platform where business activities and transactions between buyers and sellers occur [32], [33], [34]. Meanwhile, e-marketplace is an electronically interactive business community forum that provides a market where companies can participate in e-commerce or other e-business activities [35], [36], [37], [38], [39]. The e-marketplace-based business system can be used as an alternative for farmer farmers, used as a medium for promotion, communication, and information, and can cut the distribution chain of marketing agricultural products [40], [41].

The benefits farmers and consumers feel directly or indirectly have a positive influence, especially from a wider marketing channel for agricultural products [42]. This condition can spur an increase in production demand among farmers, and the price offered to consumers will be much cheaper to increase sales in agricultural products [43], [44]. Based on the above background, this study aims to develop models and concepts for applying e-marketplaces for agricultural products and to analyze the involvement of relevant stakeholders [45]. This study uses a vector approach to horticultural products in the Central Java area, which other researchers have not studied [46]. This research also aligns with several of the United Nations Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger), SDG 8 (Decent Work and Economic Growth), and SDG 12 (Responsible Consumption and Production). By promoting efficient agricultural practices through the development of e-marketplaces, the study supports SDG 2 by improving food security and reducing waste . Furthermore, by encouraging technopreneurship in the agricultural sector, the research contributes to SDG 8 by fostering innovation and creating economic opportunities for farmers and other stakeholders. Lastly, the focus on enhancing the distribution and marketing of agricultural products aligns with SDG 12 by promoting sustainable consumption patterns and reducing the environmental impact associated with traditional distribution methods [47].

Horticultural commodities play a critical role in meeting national food needs, especially in regions like Central Java Province, which has a significant potential for agricultural production. However, the length of the sales distribution chain and the involvement of middlemen have led to inefficiencies and financial losses for farmers. These challenges underline the need for a more streamlined and equitable system. This study aims to address these issues by developing a model for the implementation of agricultural e-marketplaces, which can reduce the distribution chain's inefficiencies and improve collaboration among stakeholders. The research focuses on identifying the roles and influences of various stakeholders in Semarang and Magelang Regency, providing a strategic framework to enhance the effectiveness of e-marketplaces in the agricultural sector.

2. RESEARCH METHOD

We used a mixed methods approach to analyze the role of stakeholders and strategies for implementing e-marketplaces for agricultural products in Semarang and Magelang in 2023. These issues were deepened through focus group discussions/FGD. The results of the FGD were used as material for analysis using a strategic factor approach, and the role of actors was assessed using Mactor and AHP analysis tools. Data collection methods in this research were interviews, FGDs, and questionnaires conducted with key people determined in this research. Data for this study were collected through a combination of interviews, focus group discussions (FGDs), and questionnaires administered to key stakeholders, including local government agencies, farmers, agricultural cooperatives, and middlemen. The selection of these stakeholders was based on their significant roles and influence in the agricultural value chain in Semarang and Magelang Regency. The MACTOR method was chosen due to its ability to analyze the strategic positions of various stakeholders, assessing both alliances and conflicts, which is crucial for understanding the dynamics within the e-marketplace ecosystem. The AHP was selected for its robustness in decision-making, particularly in prioritizing complex criteria involving both qualitative and quantitative aspects. Together, these methods provide a comprehensive framework for evaluating the interplay of stakeholder interests and the strategic decisions necessary for successful e-marketplace implementation.

The first analytical method used in this research is the Mactor. Mactor is used to analyze the role of actors/stakeholders in implementing the e-marketplace of agricultural products [48], [49]. The MACTOR method is employed to analyze the roles and relationships of stakeholders by examining alliances and conflicts among them. For instance, in developing an agricultural e-marketplace, stakeholders such as local governments, farmer cooperatives, and middlemen may have varying objectives and levels of influence. The MACTOR analysis allows us to map these relationships, identify potential alliances (e.g., between farmer cooperatives and local governments), and anticipate conflicts (e.g., middlemen may resist efforts to shorten distribution chains). By understanding these dynamics, strategic recommendations can be made to enhance collaboration and reduce conflicts [50]. In the process of prospective strategy and scenario thinking, actors play an essential role. The prospective analysis intends to rank stakeholder positions on many strategic issues, assess convergence and divergence, and anticipate coalitions and conflicts [51], [52], [53]. In the long-term view, policymakers must anticipate justifications for future prime movers that may affect key variables [54]. The prospective analysis approach stems particularly from formal scenario planning show in Figure 1 [55], [56].

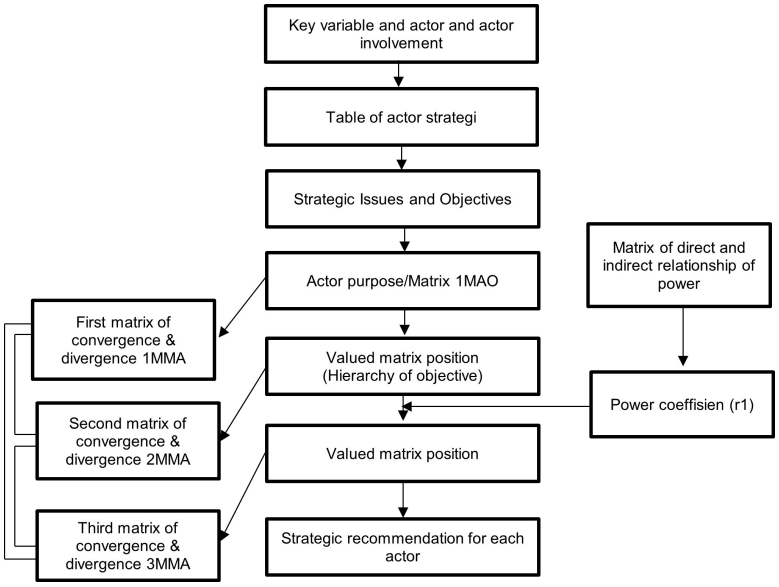


Figure 1. Analysis Framework Using Mactor

Mactor's method was developed in response to the increasing criticism of traditional extrapolation-based forecasting methods. Godet has contributed by further developing the methodology and procedures of the Mactor method for use in scenario analysis. Structural analysis has been used to uncover the factors that

guide the nuclear energy sector in France. Iranian futurist scholars have also applied a lot of structural analysis to develop several scenarios for the national science and technology roadmap [57]. A formal multifaceted actor methodology that aims to analyze the effects of actors' strategies on the environment [58]. Mactor's method is an analytical method based on an alliance and conflict matrix that makes better use of the value-added information contained in the principal's strategy table. 1 describes the analysis framework using Mactor. Mactor's method is applied to various situations involving many actors and issues, such as supporting decision-makers to identify and choose between strategic options [51], [59], [57] [60]. Issues that have developed include the problem of the agricultural sector and the interrelationships between stakeholders.

The second analysis is the AHP. AHP is a comprehensive decision-making model considering qualitative and quantitative aspects [61], [62], [63]. The AHP method can help set priorities and goals from various options using several criteria. To determine the priority of the elements in a decision problem, pairwise comparisons are made, where each element is compared in pairs against a specified standard. The form of pairwise comparison is a matrix. Filling in the pairwise comparison matrix uses numbers that describe the relative importance of one element over another. This research uses Expert Choice, software designed to assist in the AHP process, which provides various features that make it easier to build decision models, analyze, and obtain reliable results.

The scale defines and explains the value from 1 to 9, which is determined as a consideration in comparing pairs of similar elements at each level of the hierarchy to a criterion one level above it. Through the AHP method, several e-marketplace implementation strategies for agricultural products will be produced. In solving problems with the AHP, several principles must be understood, including the following:

- Decomposition (creating a hierarchy). When compiling the hierarchy, the objectives must be determined through the criteria for assessing the existing alternatives. Each criterion sometimes has sub-criteria below, which have their respective intensity values.
- Comparative judgment (criteria and alternative assessment). Pairwise comparisons were carried out using the criteria and alternatives. According to Saaty (1988), the assessment uses a scale of 1 to 9 for various problems.
- Synthesis of priority. The priority of each criterion is determined and used as the weight of the criteria in decision-making. The AHP method performs a priority analysis of each criterion using a pairwise comparison method between two elements so that all existing elements are included in the comparison.
- Logical Consistency. Consistency has two meanings. The first is that similar objects can be grouped according to their type. The second concerns the level of relationship between objects based on specific criteria.

Basically, the mathematical formulation of the AHP model is done using a matrix. For example, in an operating subsystem to the operating elements, namely the operation elements A1, A2,..., An, the pairwise comparison of these operating elements will form a comparison matrix. Pairwise comparisons start from the highest level of the hierarchy, where a criterion is used as the basis for making comparisons. A pairwise comparison matrix = PC Matrix is a basic tool for analyzing data using the AHP method. It provides the results of the comparison between each item expressed in the fundamental Saaty scale, after which they are subject to mathematical analysis. Pairwise comparison matrices are usually marked with the symbol A and have the following form:

$$A = [a_{ij}] = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ \frac{1}{a_{12}} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ \frac{1}{a_{1n}} & \frac{1}{a_{2n}} & \cdots & 1 \end{bmatrix} \quad (1)$$

The value of each in the matrix A(a_{ij}) refers to the degree to which (how much) element x_i is preferred over x_j with respect to a particular feature (criteria, objective, etc.) For each such matrix, a so-called preference vector is determined. The latter is most commonly referred to as a priority vector or a weight vector and, in related literature, is denoted by the letter w (see equation 2).

$$w = [w_1, w_2, \cdots, w_n]^T \quad (2)$$

This model represents the ranking of decision-making criteria or options according to their relative significance or preference. Many methods are used to define priority vectors, which Saaty recommends the eigenvector method. Other methods of determining weight vectors, which researchers are also willing to apply, include the LLSM least-squares logarithmic method, also called the geometric mean method/GM, and the column normalization, the arithmetic mean method. The result of the comparison of items x_i and items x_j is inversely proportional to the comparison between x_j and x_i; as a result, the matrix is called a reciprocal matrix. Each item corresponds to the characteristics described by Equation 3.

$$a_{ji} = \frac{1}{a_{ji}}, \quad j = 1, \ldots, n \tag{3}$$

Where $a_{ji} = 1$ for every $i = 1, 2, \ldots, n$.

The higher the value of the weight coefficient, the more significant and influential the criteria concerned. The AHP method consists of two kinds (ranking) of weight coefficients: local priority and global priority. The literature regarding the AHP method very often refers to group decision-making. Four sequential paths of aggregate scoring can be distinguished: consensus, voting, aggregated individual scoring - AIJ, and individual priority aggregation - AIP. If consensus cannot be reached or voting cannot take place, AIJ or AIP procedures are applied. In the case of AIJ, the independent matrices A1,. . . , Am are combined to form one composite matrix: AG = (aij G), and only after that the priority vector is estimated. In this case, the aggregation precedes the priority estimate, so it is a comparison aggregation. AIJ is applied when several decision-makers act synergistically like a unified team.

Consistency is an important attribute of any comparison matrix. A consistent matrix means that respondents answered wisely rather than randomly, and consistent results are synonymous with their credibility. With regard to mathematics, a matrix is consistent if:

$$a_{ik} = a_{ij} \cdot a_{jk} \tag{4}$$

For every i, j, k = 1, . . . , n.

In the related literature, a series of indices are proposed to measure the size of this deviation. The index most often applied in the AHP method is the Consistency Index, and the normal version is the Consistency Ratio. Saaty proposed the index in combination with a weight estimation method through the right eigenvector (EV) method. Consistency is measured based on the assumption that the ideal consistency of the comparison square matrix of n items (An $\times$ n) is maintained when the highest eigenvalue ($\lambda_{\max}$) is equal to the number of items being compared n, namely:

$$\lambda_{\max} = n \text{ for all } a_{ij} = \frac{w_i}{w_j} \tag{5}$$

The closer the max is to n, the more consistent the matrix is. Saaty also proves that an inconsistent matrix has a max value higher than n. Deviations from the ideal consistency are measured by the CI consistency index according to the following equation formula:

$$CI = \frac{\lambda_{\max} - n}{n - 1} \tag{6}$$

Where max -1 is the deviation of all a_{ij} from the estimated value of w_j i.e. the deviation from the ideal consistency.

The simulation results show that the expected CI value of the randomly generated $n + 1$ dimension matrix is higher than the expected CI value of the n-dimension matrix. This implies that the CI is tighter for matrices with higher dimensions and must be scaled. In this way we arrive at the consistency ratio CR, the normalized CI value. It is determined by dividing the CI by the so-called Random Index (RI):

$$CR = \frac{CI}{RI} \tag{7}$$

RI is the arithmetic mean of the CI for a large number of randomly generated matrices of various n dimensions. They are described as constants, tabulated values for n = 3, . . . , 15., which must be assigned to the formula of the equation. According to Saaty [35]:

- Matrix A is completely (ideally) consistent if CR = 0.
- Almost consistent (or inconsistent within the allowable limit) if 0 $<$ CR 0.10.
- Matrix A is inconsistent if CR $>$ 0.10.

Although CR = 0.10 is the limit value for a consistent matrix, many experts criticize this level for being too restrictive and arbitrary. It is also difficult to assess more than three elements simultaneously. Additionally, Saaty emphasized that minimizing CR should not be the ultimate goal. However, the assessment should be repeated if the matrix has a CR significantly exceeding the 0.10 level (especially 0.20 or more).

3. FINDINGS

3.1. Actors in Agricultural Product E-Marketplace Development

Developing an e-marketplace for agricultural products requires collaboration and synergy from several relevant stakeholders/actors. These stakeholders come from local government groups, village governments, communities, entrepreneurs, farmer organizations, and non-profit organizations. Involvement of these stakeholders by considering several things as follows:

- Stakeholders/actors have the authority to develop e-marketplaces for agricultural products in Semarang Regency and Magelang Regency.
- The development of e-marketplaces for agricultural products in Semarang Regency and Magelang Regency will affect stakeholders/actors.
- Stakeholders/actors are prerequisites for success in developing e-marketplaces for agricultural products in Semarang Regency and Magelang Regency.
- Stakeholders/actors have the competence to develop e-marketplaces for agricultural products in Semarang Regency and Magelang Regency.

Based on these considerations, the stakeholders/actors who are the sources of data in this study are as follows in Table 1:

Table 1. Stakeholder/Actor Mapping

No	Stakeholders/Actors	Issue	Objective
1	Bappeda	Development of e-marketplaces for agricultural products in Semarang and Magelang districts.	1. Smooth distribution of food products 2. Agricultural product marketing effectiveness and efficiency 3. Increased farmer profits 4. Simplify the distribution chain of agricultural products 5. Providing affordable prices for consumers 6. Economic Equity
2	Department of Agriculture		
3	Farmer Women's Group		
4	Middleman		
5	Agricultural Processing Industry		
6	Retailer seller		
7	Farmer		
8	Wholesalers		
9	Agricultural Extension		
10	Village Apparatus		
11	Non-governmental organization		
12	Community/consumers		

In the Table 1, actors involved and interested in developing e-marketplaces for agricultural products in Semarang and Magelang Regency consist of 12 actors. The composition of the actors involved in developing the e-marketplace of agricultural products shows heterogeneous characteristics and the involvement of cross-sectoral, cross-governmental organizations and non-governmental institutions. These actors are entities that have an interest and have a role in mobilizing their resources to influence the development of e-marketplaces for agricultural products in Semarang and Magelang Regency. An understanding of the relationship between

actors in developing an agricultural product e-marketplace is needed to find a strategy for developing an agricultural product e-marketplace. This understanding of stakeholder dynamics can be directly applied to design interventions that promote collaboration and reduce conflicts, ensuring that all key players are aligned towards common goals. For instance, local governments can facilitate partnerships between farmers and tech companies to provide tailored digital tools that improve market access.

3.2. Mapping Relationships between Actors in the Development of E-Marketplace for Agricultural Products

A comprehensive understanding of the relationship between actors in supporting the development of agriculture begins with mapping the relationship between actors. The data processing results and the influence between actors with the Mactor tool can be seen in Table 2. Numbers in column Ii indicate influence scores, while numbers in row Di indicate dependencies between actors.

Table 2. Matrix of Influence and Dependency between Actor

MDII	**Fmr**	**Fmr-WG**	**Mdl-man**	**Wl-salers**	**Agri-cpi**	**Reta-iler**	**De-Agri**	**Reg-PDA**	**Agri-ext**	**Vill Ap**	**Non-gor**	**Consu-mers**	**=**
Fmr	29	26	30	24	28	23	26	16	25	15	25	26	**264**
FmrWG	28	25	30	22	29	22	25	16	24	15	24	27	**262**
Mdlman	28	28	28	23	25	22	24	18	24	14	25	25	**256**
Wlsalers	27	25	29	22	24	22	24	17	23	15	23	25	**254**
Agricpi	18	17	18	17	16	14	18	12	17	11	17	16	**175**
Retailer	25	22	25	21	22	18	21	14	22	13	22	22	**229**
DeAgri	23	20	22	17	20	18	16	13	18	12	18	19	**200**
RegPDA	22	21	22	18	21	18	20	12	19	10	21	21	**213**
Agriext	26	23	25	20	24	20	20	16	21	14	21	21	**230**
Vill Ap	22	20	22	17	20	17	19	15	18	14	19	19	**208**
Non-gor	23	21	24	19	23	20	22	17	23	14	18	21	**227**
Consumers	31	29	34	25	29	24	26	19	27	17	26	27	**287**
Di	**273**	**252**	**281**	**223**	**265**	**220**	**245**	**173**	**240**	**150**	**241**	**242**	**2805**

Information:

- Fmr: Farmers
- FmrWG: Farmers Women Group
- Mdlman: Middleman
- Wlsalers: Wholesalers
- Agricpi: Agricultural Commodity Processing Industry
- Retailers: Retailers
- DeAgri: Department of Agriculture
- RegPDA: Regional Planning and Development Agency
- Agriext: Agricultural Extension
- VillAp: Village Apparatus
- Non-gor: Non-governmental organization
- Consumers: Consumer

Table 2 shows that the stakeholders who have a high influence on the development of e-marketplaces for agricultural products are consumers with a score of 287, farmers with a score of 264 and women farmers groups with a score of 262. Meanwhile, the stakeholders with the lowest influence are the agricultural commodity processing industry, which has a score of 175. The stakeholders with a high dependency tendency are middlemen, with a score of 281, and farmers, with a score of 273. Meanwhile, the stakeholders with the lowest dependence are village officials, scoring 150. This can also be seen in Figure 2, which will map stakeholders in the influence and dependence quadrant.

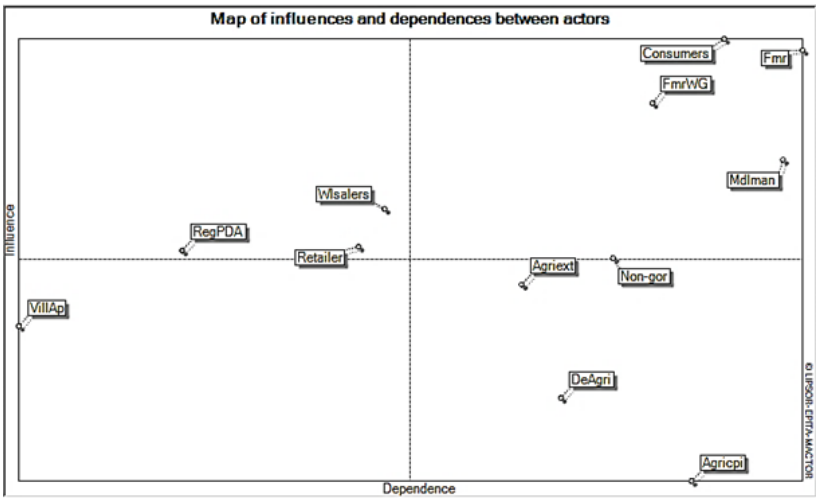


Figure 2. Map of Influence and Dependence between Actors

The actors with the strongest influence and dependence in developing an e-marketplace for agricultural products include consumers, middlemen, farmers, extension workers, wholesalers, and women's farmer groups. Farmers, as providers of agricultural products, must be provided with training to increase their efficiency and effectiveness. This includes access to agricultural inputs, distributors, and financial institutions. Technology such as the internet also provides access to the latest technological information to increase the competitiveness of farming businesses.

3.3. Actor's Preference to Goals

Actor preference matrix for the purpose of presenting the preferences of actors involved in efforts to develop e-marketplace agricultural products towards the expected goals or objectives. There are three aspects: the smooth distribution of food products and the effectiveness and efficiency of marketing agricultural products. The second aspect is increasing farmers' profits and simplifying the distribution chain of agricultural products. The third aspect is the provision of affordable prices for consumers and equitable distribution of the community's economy.

Table 3. Degree of Actor Mobilization and Goals

MDII	Smfooddis	Markeffe	Farminc	EcoEqui	Dischasim	Lowpricon	Absolute Sum
Fmr	3	4	3	4	3	2	**19**
FmrWG	3	3	4	2	4	4	**20**
Mdlman	-4	-2	1	1	-3	-4	**15**
Wlsalers	-3	1	-3	-2	-2	-3	**14**
Agricpi	3	3	2	4	3	-2	**17**
Retailer	-2	-3	-4	0	-1	-2	**12**
DeAgri	3	4	2	3	4	3	**19**
RegPDA	4	3	3	2	3	4	**19**
Agriext	4	2	4	3	2	3	**18**

MDII	Smfooddis	Markeffe	Farminc	EcoEqui	Dischasim	Lowpricon	Absolute Sum
Vill Ap	3	4	3	3	2	3	**18**
Non-gor	3	0	3	2	1	3	**12**
Consumers	4	3	2	3	3	4	**19**
Number of agreements	**30**	**27**	**27**	**37**	**25**	**26**	-
Number of disagreements	**-9**	**-5**	**-7**	**-2**	**-6**	**-11**	-
Number of positions	**39**	**32**	**34**	**29**	**31**	**37**	-

Whereas:

- Smfooddis: Smooth Food Distribution
- Markeffe: Marketing Effectiveness and Efficiency
- Farminc: Farmer's income
- EcoEqui: Economic Equity
- Dischasim: Distribution Chain Simplification
- Lowpricon: Low Prices for Consumers

The sign indicates whether the actor is likely to reach an objective or not.

- 0: The objective has a bleak outcome
- 1: Objective jeopardizes the actor's operating procedures (management, etc . . .) / is vital for its operating procedures
- 2: Objective jeopardizes the success of the actor's projects/is vital for the success of its projects
- 3: Objective jeopardizes the accomplishment of the actor's mission/is indispensable for its missions
- 4: Objective jeopardizes the actor's existence/is indispensable for its existence

Table 3 presents the position of each actor on each target/objective by considering the degree of opinion of the actors on the competitiveness targets and the hierarchy of targets; the outputs of this matrix are two: the first is the degree of mobilization, which will explain the goals/objects that most move the stakeholders. The second is mobilization, which will explain the actors who are most mobilized to use resources to achieve these objectives or goals.

The degree of mobilization (bottom row) indicates which goals are expected to be the main issues that provoke stakeholder reactions. In an effort to develop an e-marketplace for agricultural products, the greatest concern is the smooth distribution of food (39). Meanwhile, the most mobilized actors are women farmers (20), farmers (19), and consumers (19). These actors are the ones who are most actively mobilized to answer problems in developing e-marketplaces for agricultural products. In more detail, we can see how the preferences of the actors towards the issues/goals in developing an e-marketplace for agricultural products are shown in Figure 3.

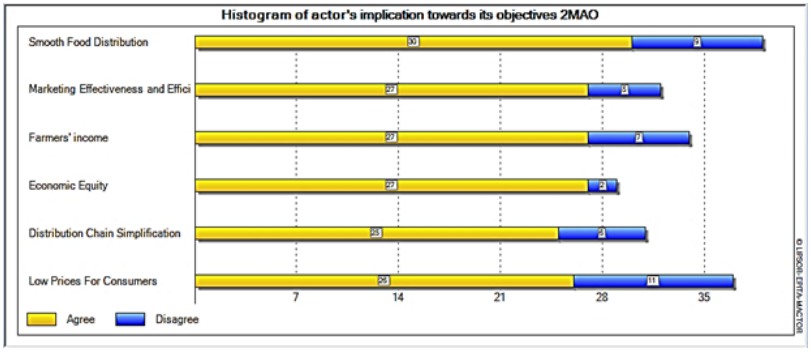


Figure 3. Histogram of Actor's Perception of Goals

Based on the perception mapping between these actors, it can be further explored that the objective of the area is to get a little resistance or rejection from some actors. However, more actors agree with the goals to be achieved in developing an e-marketplace for agricultural products. Several objections exist, namely economic equality (wholesale). Marketing effectiveness and efficiency (middlemen and retailers). These various rejections arise because the stakeholders concerned feel that the goals to be achieved in developing an e-marketplace for agricultural products can interfere with achieving the business they are running.

The mapping of actors who agree and disagree with the objectives in developing an e-marketplace for agricultural products can be seen in the image of the scales between actors and objectives as follows.

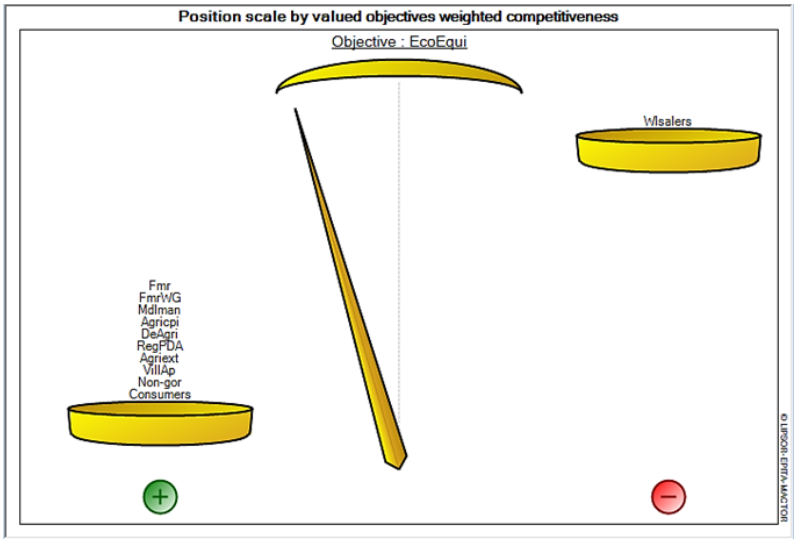


Figure 4. The Balance between Actors and the Goal of Economic Equity

Figure 4 shows the "scales" of actors who agree and disagree for the purpose of developing an e-marketplace for agricultural products. Actors/stakeholders who agree with the goal of developing an e-marketplace for agricultural products are on the "scales" + sign (positive), and actors who reject the goal of conservation are on the "scales"– (negative). Analysis of "scales" with the aim of economic equality shows that almost all actors agree that one of the goals to be achieved in developing e-marketplaces for agricultural products is to simplify the distribution chain. However, there are actors who are not willing, namely wholesalers.

3.4. Actor Competitiveness

Figure 5 illustrates the actors' competitiveness as indicated by their level of direct and indirect influence on other actors in the development of e-marketplaces for agricultural products.

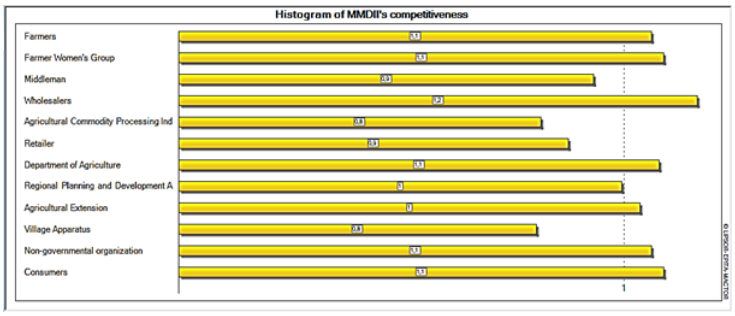


Figure 5. Actor's Competitiveness

Based on Figure 5, it can be seen that actors who have high competitiveness include consumers (1,2), farmers (1,2), and women farmer groups (1,2). These actors have directly and indirectly important roles in developing e-marketplaces agricultural products. Meanwhile, the actor that has low competitiveness is the agricultural commodity processing industry.

3.5. Potential Conflict between Actors

Analyzing potential conflicts between actors aims to determine the actors with the greatest possible conflict in their interactions in developing e-marketplaces for agricultural products.

The findings of this study have significant implications for the development and implementation of agricultural e-marketplaces. By identifying the roles and influence of various stakeholders, this research provides a strategic roadmap for fostering collaboration among key actors, such as farmers, local governments, and middlemen. The practical application of these findings can be seen in efforts to streamline the distribution chain, which is often plagued by inefficiencies due to the involvement of multiple intermediaries. For instance, local governments can use these insights to design policies that support direct farmer-to-consumer transactions, reducing dependency on middlemen and improving farmers' profit margins. Moreover, the emphasis on consumer influence highlights the need for marketing strategies that align with consumer preferences, thereby ensuring the success of the e-marketplace. By applying these strategies, stakeholders can create a more equitable and efficient agricultural market, leading to better outcomes for all involved. The results of the analysis of potential conflicts between actors can be seen in Figure 6.

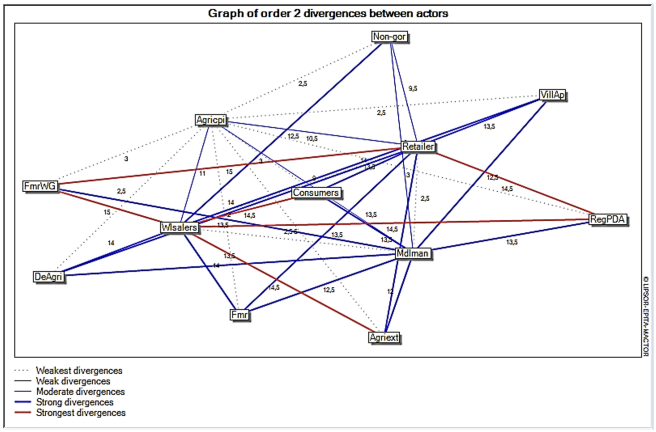


Figure 6. Potential Conflicts between Actors

Figure 6 shows that in developing an e-marketplace for agricultural products, there is a potential for conflicts of interest to arise. The activities of the actors that have the most power to cause conflict are those of wholesalers and retailers. These two actors have the potential to create strong divergences. In addition, the two actors are also prone to conflict with other actors, such as women's farmer groups, wholesalers, consumers, and agricultural extension workers. In implementing this e-marketplace, it is necessary to prioritize a participatory approach and in-depth discussion so that potential conflicts that arise can be minimized.

3.6. Potential Cooperation between Actors

Developing an e-marketplace for agricultural products requires synergy and collaboration between actors. The degree of convergence in Figure 7 shows the potential for collaboration.

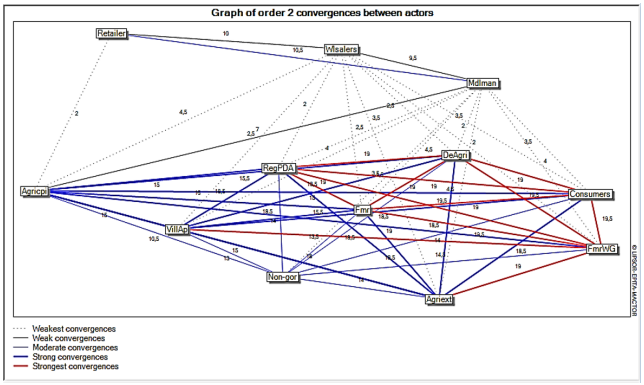


Figure 7. Convergence Matrix between Actors

Figure 7 explains that the degree of convergence (agreement and agreement) between actors in developing e-marketplaces for agricultural products tends to be very strong and strong. Based on the objectives/objectives and roles they have to mobilize resources, we can map the actors with the "strongest convergences" who have the most important role in developing e-marketplaces for agricultural products. The actors with the strongest convergence are women farmer groups, consumers, farmers, and the agricultural service. Farmers and farmer groups must be willing to market their products through e-marketplaces. Meanwhile, the agriculture office must be ready to assist and provide supporting infrastructure. In this case, consumers must change conventional shopping patterns to online shopping. The significant role of these actors will be supported by actors in the " strong convergences "category, which will consist of consumer actors, non-governmental organizations, and processing industries.

3.7. Map of Net Distances between Objectives in the Development of an E-Marketplace for Agricultural Products

A map of net distances between objectives is used to identify goals for which actors take the same position (either for or against). In practical terms, this mapping of goals can help policymakers and development organizations prioritize resources and efforts towards areas where there is broad consensus, such as enhancing food distribution efficiency. By focusing on these aligned objectives, the implementation of e-marketplaces can be more effective and sustainable, leading to long-term improvements in the agricultural sector. This graph maps the objectives with respect to the scale value (the difference between the value of the convergence matrix and the value of the divergence matrix, as shown in Figure 8.

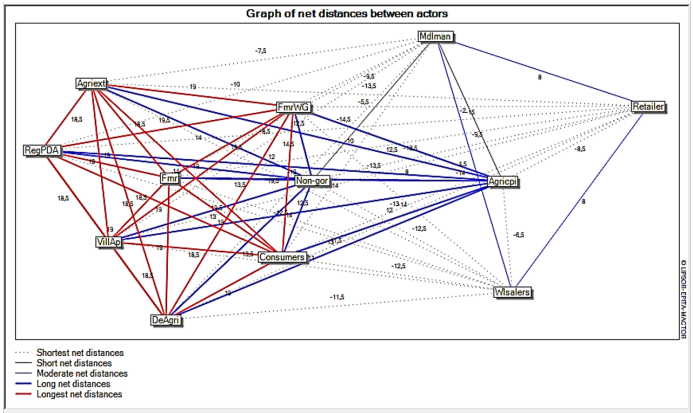


Figure 8. Distance between Destinations

The image of the distance between the objectives presented in Figure 8 provides an overview of the interrelationships between the program objectives. Possible levels of closeness that occur between destinations are depicted in red and blue. The red color indicates a stronger relationship distance than the blue color. The distance linkage between objectives in the development of e-marketplaces where the smooth distribution and simplification of the distribution chain have a very strong relationship. Meanwhile, low prices for consumers and farmers income have a strong relationship with smooth distribution.

3.8. Map of Net Distances between Actors in the Development of E-Marketplaces for Agricultural Products

The distance between actors gives an idea of the possibility of cooperation. Possible levels of collaboration among actors are depicted in red and blue. The red color indicates a more substantial distance, which allows for stronger cooperation. The graph of the distance between actors can be seen in Figure 9.

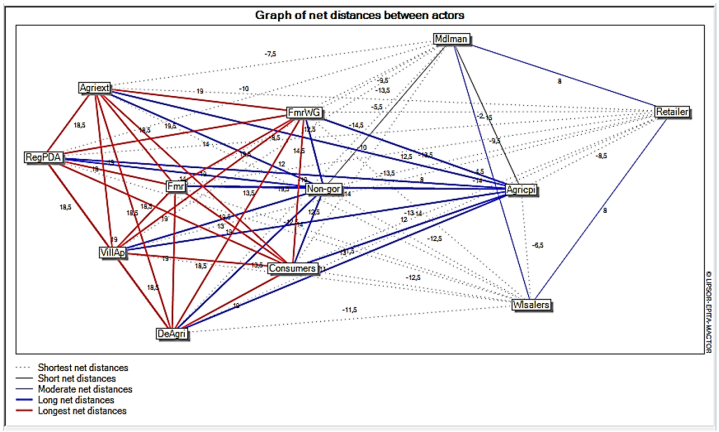


Figure 9. Distance between Actors

The distance relationship between actors in the development of the e-marketplace shows a powerful relationship (shown in bold red). This shows the strong relationship between these actors in the development of e-marketplaces. The actors with a strong relationship are farmers, farmer women's groups, the agricultural service, consumers, and agricultural extension workers. Agricultural extension workers are stakeholders who have an important role in developing e-marketplaces for agricultural products because they are directly related to farmers in the field. The farmers are the most strategic actors in carrying out agricultural development programs. Developing an e-marketplace for agricultural products is difficult, so formulating the right strategy is essential.

3.9. AHP Analysis Results

We use AHP analysis to prioritize the development strategy of e-marketplace agricultural products. The components used for AHP analysis in this study include several criteria and alternatives based on a literature review, previous research, and interviews with predetermined and competent key persons in agriculture. The key persons involved in this study comprised 12 people, including the government, entrepreneurs, farmers, communities, and other related organizations. The calculation of AHP for all criteria for developing an e-marketplace for agricultural products is obtained in Figure 10.

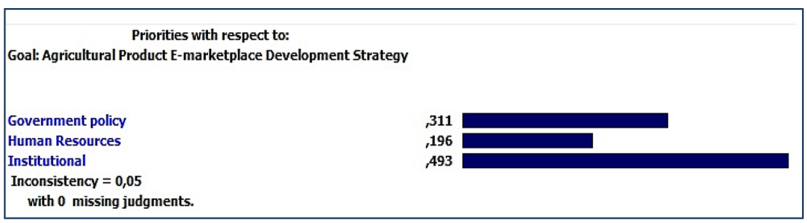
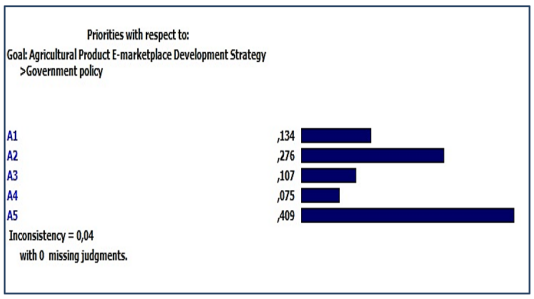


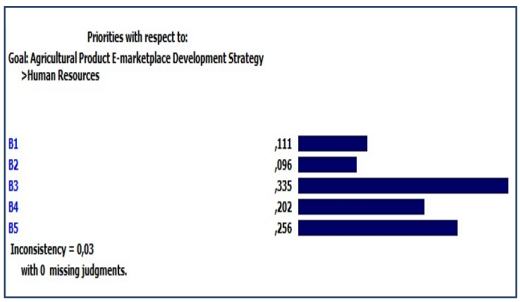
Figure 10. AHP for All Criteria

The most prioritized criterion in developing an e-marketplace for agricultural products is institutional development, with a weighted value of 0.493. Then the second priority criterion is government policy, with a weighted value of 0.311, and the third priority criterion is human resources, with a weighted value of 0.196. From the AHP calculation with the expert choice 11 program, an inconsistency ratio of $0.05 < 0.10$ means that the answers given by key persons are consistent.

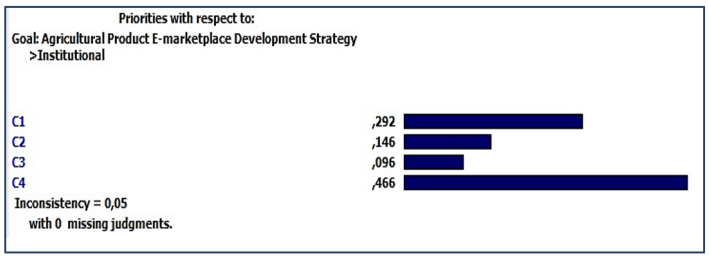
The results of calculating the AHP against the institutional criteria with the expert choice program are shown in Figure 11. The most prioritized alternative in the government policy criteria is the provision of supporting infrastructure for e-marketplace development, with a weighted value of 0.409. Then the second priority alternative is the provision of information facilities, promotions, and market guarantees for farmers and agribusiness actors with a weight value of 0.276. In contrast, the last priority alternative is providing farmers and agribusiness actors with easy access to information and communication technology with a weight value of 0.075. From the AHP calculation, an inconsistency ratio of $0.04 < 0.10$ means that the answers given by key persons are consistent.



(a) Government Criteria



(b) Human Resource Criteria



(c) Institutional Criteria

Figure 11. AHP Analysis on All Criteria Strategy

Information

- A1: Provision of agricultural business capital needs
- A2: Providing information, promotion, and market guarantee facilities for farmers and actors in agribusiness
- A3: Providing assistance with vital production tools
- A4: Providing easy access to information and communication technology to farmers and agribusiness
- A5: Provision of supporting infrastructure for e-marketplace development
- B1: Providing motivation to farmers and agribusiness actors to improve their skills and skills in running their business
- B2: Increasing managerial and business management skills
- B3: Guidance and training for farmers and agribusiness actors in creating business innovation

- B4: Capacity building of farmers and agribusiness actors in the use of tools-based production renewable technology
- B5: Promotion and marketing training using technology information and communication
- C1: Capacity building and quality of special institutions assisting farmers
- C2: Formation of an organizational forum/community to establish cooperation between farmers and businessmen
- C3: Training on the management of cooperatives and farmer organizations and agribusiness actor
- C4: Increasing business partnerships between local agricultural cooperatives with entrepreneurs or investors

Figure 11b shows that the most prioritized alternative in the criteria for developing human resources is coaching and training for farmers and agribusiness actors in creating business innovation, with a weight value of 0.335. The second priority alternative is promotion and marketing training using technology information and communication with a weighted value of 0.256. Meanwhile, the last priority alternative is to increase managerial ability and business management with a weighted value of 0.096. From the AHP calculation, an inconsistency ratio of $0.03 < 0.10$ means that the answers given by key persons are consistent. Figure 11c shows that the most prioritized alternative in institutional criteria is increasing business partnerships between local agricultural cooperatives and entrepreneurs/investors, with a weighted value of 0.446. The second priority alternative is to increase the capacity and quality of special institutions accompanying farmers with a weight value of 0.292. The last priority alternative is establishing an organizational forum/community to establish cooperation between farmers and business actors with a weight value of 0.146. From the AHP calculation, an inconsistency ratio of $0.05 < 0.10$ means that the answers given by the key persons are consistent. In the calculation of the AHP for the overall alternative strategy for developing e-marketplace agricultural products with the expert choice, the following results were obtained:

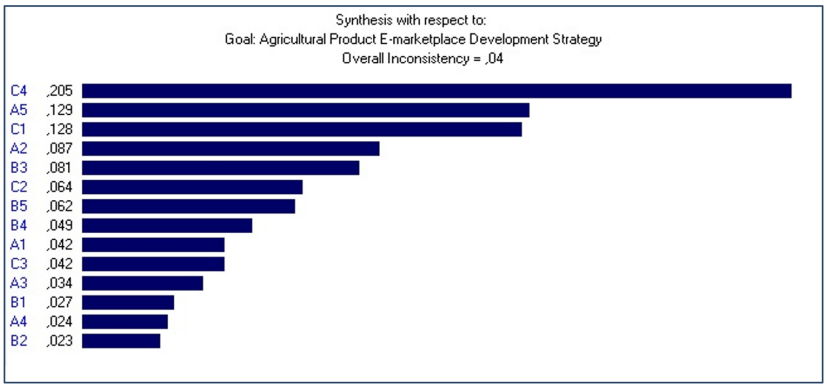
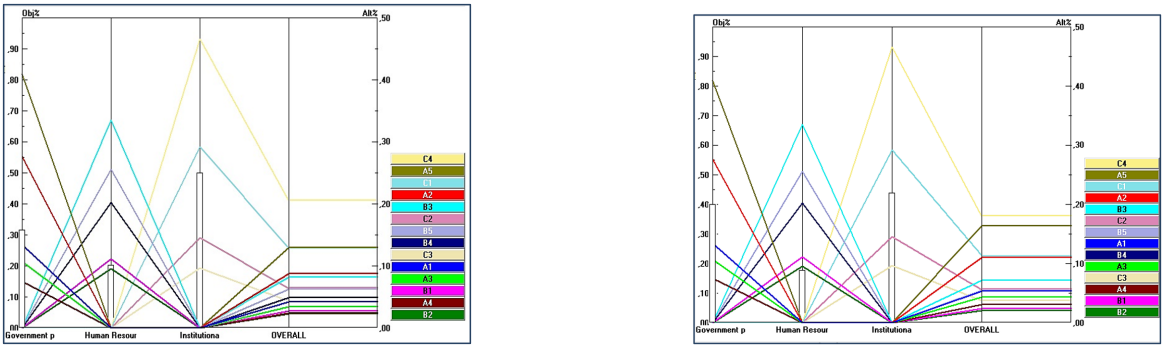


Figure 12. AHP Output Overall Policy Alternative

The calculation results from the AHP show that the most prioritized alternative in developing an e-marketplace for agricultural products is increasing business partnerships between local agricultural cooperatives and entrepreneurs, with a weighted value of 0.205 (see Figure 13). The second priority alternative is supporting infrastructure for e-marketplace development with a weight of 0.129. The last priority alternative is to increase managerial ability and business management with a weighted value of 0.023. From the AHP calculation with the expert choice 11 program, an inconsistency ratio of $0.04 < 0.10$ means that the answers given by key persons are consistent.

The partnership pattern in the agricultural sector significantly increases people's income, thereby mobilizing rural resources to produce competitive products. For example, the company's Creating Shared Value (CSV) concept by becoming a farming partner has increased the income of banana farmers in Tanggamus Regency, Indonesia. Through partnerships with companies, farmers get benefits such as overcoming financing

problems, improving product quality, and increasing market access for their products. Meanwhile, the company will also obtain a supply of quality raw materials. Another partnership pattern that can be developed in the agricultural sector is cooperation between farmers and SOEs, such as the corn and soybean planting program in Purwakarta involving Perum Perhutani and communities around the forest.



(a) Before Simulation (b) After Simulation

Figure 13. Results of Sensitivity Analysis

Based on Figure 13, the initial results of the AHP calculation on the product's e-marketplace development strategy can be seen. In agriculture, it was found that the most prioritized policy alternatives were increasing business partnerships between local agricultural cooperatives and entrepreneurs and providing supporting infrastructure for the development of e-marketplaces, as shown in Figure 13a. Then, after the simulation was carried out by increasing the input of government policies from 0.311 or 31.1% to 40%, the priority policy alternatives were the same, as shown in Figure 13b. These results indicate that the assessment is stable.

The advancement of information technology needs to be utilized by farmers in Semarang and Magelang to develop their businesses through e-commerce. The use of information technology for trade and services, known as e-commerce, can be done for both B2B (business to business), such as between factories and raw material suppliers or between distributors and dealers, and B2C (business to consumer), such as between transportation companies and prospective passengers, hospitals and patients, and merchants and buyers. Additionally, there is a type of utilization for e-marketplaces: virtual markets that connect sellers and buyers. By utilizing e-commerce in their business operations, farmers get access to broader markets and have the opportunity to attract new customers. Customers will find it easier to obtain the necessary information online. Various savings and efficiencies will be achieved in transportation costs, telephone or fax communication, document delivery, printing, time, and labor. In Semarang, Sayur Organik Merbabu (SOM) is an SME that has collaborated with the government and subsistence farmers to produce and market organic vegetables. The business owner has also used ozone technology to refresh products to remain fresh when consumers receive them.

4. MANAGERIAL IMPLICATIONS

The findings of this study offer significant managerial implications for stakeholders involved in the agricultural sector, particularly in the development of e-marketplaces. First, the study underscores the importance of collaboration among various stakeholders, including farmers, local governments, and middlemen, to create a more efficient and equitable agricultural supply chain. Managers in agricultural cooperatives and government agencies should prioritize initiatives that enhance direct connections between farmers and consumers, reducing reliance on intermediaries and improving profit margins for farmers.

The emphasis on consumer influence suggests that managers should focus on developing marketing strategies that align with consumer preferences, ensuring the success and sustainability of e-marketplaces. This may involve investing in digital literacy training for farmers to better understand market demands and adapt their practices accordingly. Additionally, the study's alignment with SDG goals highlights the need for managers to integrate sustainable practices into their operations, promoting responsible consumption and production.

The identification of potential conflicts and the mapping of stakeholder relationships provide managers with a strategic roadmap to anticipate and mitigate conflicts, ensuring smoother implementation of e-

marketplaces. By fostering stronger partnerships and providing necessary infrastructure, managers can enhance the overall effectiveness and scalability of e-marketplaces, contributing to broader economic growth and sustainable development in the agricultural sector.

5. CONCLUSION

The study concludes that developing e-marketplace products and agriculture requires stakeholders to collaborate and synergize to achieve the desired goals. The actor with the highest influence is the consumer, and the actor with the highest dependence is the middleman. Meanwhile, the actors with the strongest influence and dependence include consumers, middlemen, farmers, extension workers, wholesalers, and women's farmer groups. In an effort to develop e-marketplace products in agriculture, the most significant concern is the smooth distribution of food. Meanwhile, the most mobilized actors are women farmers, farmers, and consumers. Actors who are highly competitive include consumers, farmers, and women's farmer groups. The activities of actors that have the most power in causing conflict are middlemen, wholesalers, and retailers. These two actors have the potential to create strong divergences. The actors with the strongest convergence are women farmer groups, consumers, farmers, and the agricultural service. Based on the priority order of criteria in the product e-marketplace development strategy, agriculture is institutional, government policy, and human resource development. Meanwhile, the order of alternative priorities includes the policy of increasing business partnerships between local agricultural cooperatives and entrepreneurs/investors and the policy of providing infrastructure to support the development of e-marketplaces. Suggestions regarding the development of e-marketplace products can be given in this research. Agriculture requires synergy and collaboration between stakeholders. There needs to be a consensus/agreement and discussion space so that efforts to develop e-marketplace products can be made. Stakeholders who have important roles must be optimized for their roles. Goals that have the power to be realized need to be encouraged by providing appropriate programs.

This study highlights the critical role of collaboration among stakeholders in the development of agricultural e-marketplaces, particularly in reducing the inefficiencies of the distribution chain and enhancing market access for farmers. The key findings underscore the influence of consumers as pivotal actors and the dependency of middlemen, which suggests that future strategies should focus on empowering farmers and directly connecting them with consumers. The significance of these findings lies in their potential to transform traditional agricultural practices through technology-driven solutions, contributing to a more equitable and efficient market system.

Future research could explore the long-term impacts of e-marketplaces on rural economies and investigate the role of emerging technologies, such as blockchain and AI, in further optimizing agricultural supply chains. Additionally, comparative studies between different regions could provide insights into the scalability and adaptability of the e-marketplace model in various socio-economic contexts.

6. DECLARATIONS

6.1. About Authors

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6.2. Author Contributions

EP, SD, SL, EP, and MI contributed to conceptualization, methodology resources, writing original draft preparation, review, investigation, visualization, and editing supervision. EP, FA, EP, and SD contributed to software resources, writing original draft preparation, and reviewing and editing project administration. EP, SD, and EP contributed to supervision and funding acquisition. All authors have read and agreed to the published version of the manuscript.

6.3. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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6.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

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