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# Oyster Mushroom Agrotourism Development Design in Kekeri, West Lombok

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**Abstract**

The development of oyster mushroom agrotourism in Kekeri, West Lombok, offers a strategic solution to improve the sustainability of the rural economy. This study aims to formulate an integrated and applicable agrotourism development Design and determine priority strategies. The research method combines qualitative methods (surveys, observations, interviews, FGD) and uses the Analytical Hierarchy Process (AHP) to analyze stakeholder data. The results of the AHP analysis indicate that diversification of processed products is the top-priority strategy (weighted at 0.570), followed by infrastructure strengthening (0.198), digital marketing & collaboration (0.126), and educational tour packages (0.107). To address the technical challenges posed by temperature and humidity fluctuations, integrating IoT (Internet of Things) technology into the oyster mushroom cultivation system is recommended. In conclusion, the development of oyster mushroom agrotourism in Kekeri is highly feasible and supported by strong local potential. The implementation of priority strategies, supported by innovative technology, is expected to add value, increase farmers' income, and enable sustainable agrotourism.

**Keywords:** Agrotourism; AHP;Kekeri Village; IoT; Oyster Mushrooms



## PENDAHULUAN

The annual increase in global and national populations has driven an ever-growing demand for high-nutritional-value, sustainable food commodities. (Fadli et al., 2025). White oyster mushrooms (Pleurotus ostreatus) have emerged as one of the primary horticultural commodities in Indonesia, with excellent development potential, ranking second in global production after button mushrooms. (Laksono et al., 2024; De Cianni et al., 2023; Wardhana et al., 2025). Oyster mushrooms are widely recognized as a reliable and profitable option for addressing hunger and malnutrition, especially amid rising food prices. (Effiong et al., 2024; Pathmashini et al., 2009). The advantage of white oyster mushrooms lies in their exceptional nutritional profile: they are high in protein (19–35%), contain nine essential amino acids, are rich in 72% unsaturated fat, and provide dietary fiber (7.4–24.6%). (Rahmawati & Marabudi, 2021) even has important functional and medicinal properties, including antibacterial, antioxidant, anti-cancer activities, and potential as a prebiotic and special dietary ingredient (Kusumastuty et al., 2024; Piazza et al., 2021). In addition, oyster mushroom cultivation is an efficient and sustainable endeavor because the process is relatively easy, low-cost, and chemical-free (Silva et al., 2024), and supporting the circular economy (Valenzuela-Cobos et al., 2023) through the use of agroindustrial lignocellulose waste (such as sawdust and husks) as a growing medium (Albuja-Narváez et al., 2024; Valenzuela-Cobos et al., 2023).

Kekeri Village has an ongoing oyster mushroom cultivation activity called Agro Jamur Lombok. The cultivation process, from baglog production to harvesting, has high educational and visual value. The people of Kekeri Village already have the knowledge and technical skills to cultivate oyster mushrooms, so there is no need to start from scratch. This is a valuable social asset. The farmer groups in Kekeri Village have mastered good cultivation techniques, from baglog production and incubation to harvesting. Integrating agricultural output with tourism, known as agrotourism (Agro-Tourism Integration), is an effective strategy for sustainable rural development, as it balances the needs of tourists with those of the community while also catalyzing increased income, job creation, and local socioeconomic development. In West Lombok Regency, white oyster mushroom farming is widespread, and data show that this farming business is financially viable, with an R/C ratio of 2.28 (>1) and a B/C ratio of 1.28 (>0) at the Lombok Mushroom Agro MSME in Gunungsari (Fadli et al., 2025). To support rural economic development and agricultural diversification, oyster mushroom agrotourism offers a strategic solution that integrates agricultural production with tourism, balances the needs of tourists with those of rural communities, and

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serves as a catalyst for increased income, job creation, and socioeconomic development in rural areas (Sriyadi & Yekti, 2021; Laksono et al., 2024). This integration (Agro-Tourism Integration) often encompasses production, processing, recreation, and visitor experiences, as observed in other mushroom agrotourism developments (Yang & Xia, 2021).

Understanding the synthesis between mushroom cultivation science (agronomy and biotechnology) (Wen-Ta et al., 2025). Sustainable tourism strategic planning serves as a critical conceptual framework for agrotourism development (Suazo & Viana-Lora, 2022). Integrated in Kekeri, West Lombok. Compared to other agricultural commodities, oyster mushrooms have a relatively short harvest period, resulting in smoother business cash flow. The success of cultivation is primarily determined by strict control of environmental factors (Chen et al., 2025). The optimal conditions for oyster mushroom growth require an air temperature of 20–28°C or 21–29°C and a high relative humidity (RH) of 60–95% (Rahmawati & Marabudi, 2021; Bastari et al., 2022; Permata et al., 2024). Therefore, to overcome the instability of conventional cultivation environments, the application of innovative Internet of Things (IoT)- based technology is important for real-time monitoring and automated control of watering, humidification, and ventilation. ( Zainuddin et al., 2023). In addition, effective agrotourism Design requires a systematic methodological framework, such as the application of the Analytical Hierarchy Process (AHP) to prioritize alternative strategies (Dey et al., 2024). The use of this method is significant for formulating sustainable agro-industry development strategies, identifying skilled human resource needs, and overcoming structural barriers that often arise (Wardhana et al., 2025).

Although the potential of commodities and supporting technologies has been identified, the realization of the oyster mushroom agrotourism development Design in Kekeri, West Lombok, faces challenges that hinder the transition from financially viable small-scale farming to an integrated and competitive tourism agroindustry. Technically, the main problem at the production level is farmers' inability to maintain optimal temperature and humidity in the cultivation room (kumbung), which are vital for mushroom growth (Bastari et al., 2022; Fadli et al., 2025). Conventional manual methods are ineffective, resulting in environmental instability and inefficiency. In addition, farmers are often faced with problems of planting media contamination and pest/disease attacks due to unsuitable environmental conditions (temperature and humidity). (Ogbu et al., 2021; Fadli et al., 2025). However, the biggest challenge lies in the managerial and strategic planning aspects; extensive studies show that the main obstacle is the lack of precise and applicable planning for the oyster mushroom agroindustry. The lack of stakeholder involvement exacerbates this problem (Wardhana et al., 2025). Another challenge, and a weakness, is the suboptimal utilization of local products. Oyster mushroom cultivation in Kekeri is still oriented towards raw products and has not yet developed into high-value, high-appeal processed food products, such as unique souvenirs. This lack of planning directly hinders efforts to develop superior oyster mushroom-based products. It makes it challenging to meet the need for skilled human resources (which is a key requirement) (Dey et al., 2024). Given the issues faced, this study presents a state-of-the-art, integrative approach that has not been implemented in Kekeri, West Lombok (Fadli et al., 2025). Using the AHP method in determining the main processed oyster mushroom products (Wardhana et al., 2025), and designing innovative cultivation control systems (IoT) (Permata et al., 2024). There has been no study that holistically combines the optimization of IoT-based oyster mushroom production technology with the agroindustry strategic Design framework (AHP) to formulate an integrated and applicable agrotourism model in the specific context of the Kekeri tourist village.

Based on these descriptions and issues, the main objective of this study is to determine priority strategies (e.g., improving product quality and human resources) and to recommend technological solutions to overcome production obstacles (temperature/RH) (Budiarto et al., 2024). The urgency of this study is based on the urgent need to: (a) improve the economic sustainability of rural areas in West Lombok by capitalizing on the proven viability of mushroom cultivation (Fadli et al., 2025; Sriyadi & Yekti, 2021); (b) Providing a structured roadmap to overcome systemic barriers (unclear planning and stakeholder issues) that hinder national and international market penetration (Wardhana et al., 2025); (c) Promoting the adoption of innovative technology (IoT) as a stable production foundation to support reliable and educational agrotourism experiences (Kumar et al., 2024).

## MATERIALS AND METHODS

### Time and place

The research study was conducted in October-November 2025 at the Agro Jamur Lombok business location in Kekeri, West Lombok. The Kekeri village community has substantial social capital and technical knowledge and expertise in cultivating oyster mushrooms, from baglog production and incubation to maintenance and harvesting. Agro Jamur Lombok, located in Kekeri Village, West Lombok, is classified as a small-to-medium-sized enterprise with traditional cultivation facilities that are vulnerable to environmental conditions.

### Research Design

Dalam penelitian ini menggunakan studi literatur review terkait informasi penerapan IoT dalam pengontrolan iklim pada budidaya jamur tiram, menggunakan pendekatan kualitatif dengan metode survey, observasi langsung, dokumentasi, dan wawancara terstruktur, dimana yang menjadi sampelnya yaitu pemilik usaha Agro Jamur Lombok, Pokdarwis, dan masyarakat Kekeri Kabupaten Lombok Barat dan penggunaan pendekatan kuantitatif dengan metode *Analytical Hierarchy Process* (AHP) untuk menentukan strategi prioritas pengembangan agrowisata dengan menggunakan sofware CDP4.

**Research population and sample**

This study uses several data sources, including documents, scientific publications, and secondary data, related to oyster mushroom agrotourism and community empowerment. The sample selection criteria included document types such as journals, books, reports, and policies. The relevance of the topic, namely those that explicitly discuss community agrotourism, oyster mushroom farmer empowerment, or sustainable rural economy, as well as the availability of statistical data from the Kekeri area of West Lombok on mushroom cultivation, tourists, and socio-economic conditions.

The research instruments were developed based on the research objectives and variables determined, taking into account the specific context of the research location in Kekeri, West Lombok. The quantitative instrument used was an Analytical Hierarchy Process (AHP) questionnaire to collect expert and stakeholder assessments to determine the priority of agrotourism development strategies. The variables measured were the main criteria (technical, economic, social, and environmental aspects) and alternative strategies (development of educational tourism packages (edu-tourism), product diversification, strengthening of tourism infrastructure and facilities (infrastructure development), digital marketing, and collaboration).

**Research procedure**

This research procedure consists of two stages, including a preparation stage that begins with a literature study and instrument development (AHP questionnaire), followed by data collection consisting of primary data (AHP: distribution of paired comparison questionnaires to 5-10 respondents, interviews with 5-10 key informants, FGD, observation, documentation) and secondary data (oyster mushroom production data from farmer groups, tourism potential data from the West Lombok Tourism Office, literature data from various scientific journals related to agrotourism and oyster mushroom cultivation).

**Research Data Analysis**

Data analysis was conducted, namely quantitative data analysis for AHP in the form of determining a hierarchical structure consisting of Goal → Criteria → Alternatives, followed by the creation of a pairwise comparison matrix and calculation of criteria and alternative weights by conducting a consistency test (Consistency Ratio) and determining strategy priorities. Problem solving using the AHP method was carried out through the following stages: a) decomposing the problem, which involved structuring the problem hierarchy as a first step in defining the issues to be analyzed. At this stage, the assessment criteria and alternatives to be considered in the decision-making process are determined. b) Setting priorities, which involves arranging the criteria in the form of a pairwise comparison matrix, where each element of the matrix contains a comparison value between one criterion and another. The numerical values used in pairwise comparisons come from the assessment scale developed by Thomas L. Saaty, as listed in **Table** 1 (Alrawad et al., 2023).

**Table 1.** Paired Comparison Rating Scale

| Intensity of Interest | Numbers |
|---|---|
| Equally important | 1 |
| More important | 3 |
| More important/strongly | 5 |
| Very strong | 7 |
| Extreme | 9 |
| **Average value (compromise)** | **2,4,6,8** |
| **The opposite** | **1/n** |

## RESULTS AND DISCUSSION

**Feasibility of Oyster Mushroom (Pleurotus ostreatus) Agrotourism and Commodity Added Value**

White oyster mushrooms (Pleurotus ostreatus) are a strategic agricultural commodity with great potential in supporting food security and the circular economy. (Bhattacharjya et al., 2015). From a nutritional and functional perspective, oyster mushrooms are globally recognized for their high nutritional content. This commodity is high in protein, contains nine essential amino acids and fiber, and has functional properties, including antioxidant, anti-cancer, and antimicrobial activities, as well as potential prebiotic activity (Shah et al., 2004; Fedeli et al., 2024). Analysis of the nutritional value of oyster mushrooms cultivated on various substrates shows that these mushrooms are an important source of nutrients (Shah et al., 2004).

Oyster mushroom cultivation is highly relevant to the concepts of sustainability and the circular economy (El-Ramady et al., 2022; Valenzuela-Cobos et al., 2023). Oyster mushrooms are effective in the bioconversion of agro-industrial lignocellulosic waste, such as wood sawdust (Hultberg et al., 2023), rice husk (Bhattacharjya et al., 2015), coconut shell (Laksono et al., 2024), and anaerobic digestion waste (anaerobic digestate)—into edible protein. Utilizing this waste not only reduces environmental pollution but also creates low-cost, chemical-free business opportunities (Shah et al., 2004). In addition, mushroom-growing media waste (spent mushroom substrate, or SMS) can be further utilized as bio-briquettes, supporting a zero-waste management approach (Maharani & AP, 2022).

Specifically in West Lombok, a financial feasibility study of white oyster mushroom farming at Agro Jamur Lombok, a micro, small, and medium enterprise (MSME) in Kekeri, Gunungsari, showed positive results. The analysis indicates that this business is feasible. Using quantitative descriptive techniques, the obtained R/C and

B/C ratios are 2.28 and 1.28, respectively. These results confirm the presence of strong profit potential (R/C > 1 and B/C > 0), providing a solid financial basis for the development of mushroom agrotourism in Kekeri.

**Improving Production Stability Through Smart Technology Integration (IoT)**

Mushroom agrotourism in Kekeri, like other mushroom cultivation, is highly susceptible to environmental fluctuations. Abiotic factors such as temperature and humidity are critical determinants in mushroom growth, with oyster mushrooms being particularly sensitive to these conditions (Permata et al., 2024; Bastari et al., 2022).

**Table 2.** Kondisi Lingkungan Optimal Target dan Stabilitas Produksi dengan Teknologi Cerdas (IoT) (Budiarto et al., 2024; Villafuerte et al., 2025; Laksono et al., 2024).

| Environmental Parameters | Ideal Range | Improved Production Stability |
|---|---|---|
| Air Temperature | 20−26°C | Automatic temperature control ensures ideal conditions. |
| Air Humidity | 75−88% | Humidity fluctuations are reduced to ±5%. |
| Moisture content of the growing medium | 50−65% | Ensure that the moisture content of the growing medium is consistent, neither too dry nor too wet. |
| The Impact of Mushroom Quality | - | Produces mushrooms with higher weight per baglog, more uniform diameter, and fresher texture. |

The optimal conditions for stable oyster mushroom growth require a temperature range of 20–29°C and high relative humidity (RH) (60–95%) (Bastari et al., 2022). This is consistent with the data in **Table** 2, which shows that the optimal temperature range is 20-26 °C and the optimal humidity range is 75-88%. Failure to maintain optimal conditions directly affects the quality and yield of the harvest. To overcome these challenges, designing an Internet of Things (IoT)-based system has become essential for collecting new data in Kekeri agrotourism. The study presented in this research has developed an automatic temperature and humidity control system using Mamdani Fuzzy logic and sensors (such as DHT22) integrated with a microcontroller. This system enables real-time monitoring and automatic control of watering/humidification and ventilation via a smartphone (Budiarto et al., 2024). The DH22 sensor used was tested beforehand to determine its error rate. The DHT22 sensor's error rate is shown in **Table** 3.

**Table 3.** Sensor Accuracy in IoT-Based Mushroom Cultivation System Design (Budiarto et al., 2024).

| Sensor | Parameters | *Mean Error* | Description |
|---|---|---|---|
| DHT22 | Air Temperature | 1,0% | Tingkat akurasi tinggi. |
| DHT22 | Air Humidity | 3,8% | Still within the DHT22 error tolerance limit (MAX ± 5%RH). |
| Resistive Sensor | Soil Moisture | 9,3% | Able to achieve a reasonably high degree of accuracy up to a specific limit. |

Improved Efficiency and Quality: The implementation of IoT-based monitoring and control systems has been proven to improve crop yields and quality, as well as operational efficiency, compared to traditional manual methods (Zainuddin et al., 2023). Although testing this system requires a stable internet connection for real-time fuzzy calculations, this technology enables the development of Smart Kumbung, which ensures consistent stability in the cultivation environment. (Budiarto et al., 2024). Therefore, the agrotourism Design in Kekeri must include integrating IoT technology into cultivation houses (kumbung) to enhance educational appeal and maintain a stable mushroom supply, a prerequisite for agro-industrial and agrotourism activities.

Agrotourism is an effective tool for achieving sustainable rural development by balancing the needs of tourists and local communities and providing economic and social opportunities. In the context of Kekeri, the formulation of development strategies must take into account the constraints and main objectives identified through structural and hierarchical analyses (Ammirato et al., 2020).

***Existing Conditions of Oyster Mushroom Cultivation in Kekeri***

Based on field observations and documented data, Agro Jamur Lombok in Kekeri Village has established a relatively stable oyster mushroom cultivation process, with farmers who have several years of experience. Oyster mushroom cultivation (**Figure** 2) is carried out in simple sheds made mainly of bamboo and wood, using baglog media made from sawdust. However, technical observations indicate that temperature and humidity control are still carried out manually, leading to frequent environmental fluctuations that affect mushroom quality. In-depth interviews with business owners revealed that humidity often drops during the day, while temperatures rise above the optimal range (28–30°C). These conditions are consistent with the literature, indicating that oyster mushroom cultivation is highly sensitive to temperature and RH fluctuations (Budiarto et al., 2024; Najmurrokhman et al., 2020). This challenge then became the basis for the need to implement an IoT-based automatic control system. In addition to technical constraints, the results of the FGD with farmer groups and Pokdarwis showed that the oyster mushroom business value chain in Kekeri still stops at raw products, has not developed into a diversified value-added processed product chain, and has not been fully maximized as an educational attraction for tourists. In fact, this village has strong potential for social and cultural capital in agrotourism development.

**Figure** 1. Oyster Mushroom Cultivation at Agro Jamur Lombok

In oyster mushroom cultivation, environmental conditions significantly affect harvest success. RH fluctuations can reach ±20% in a day (Huidrom et al., 2024). States that the use of IoT applications can create greater humidity stability, with humidity changes limited to ±5%. Based on research (Villafuerte et al., 2025), shows that mushroom farms that use automatic control systems produce mushrooms with higher weight per bag, more uniform mushroom diameter, and fresher texture due to stable humidity conditions.

**Stakeholder Assessment of Oyster Mushroom Agrotourism Development**

The results of interviews and focus group discussions show that all stakeholders (farmers, Pokdarwis, and the community) support the development of mushroom agrotourism. Qualitative findings confirm that the educational aspect is the main selling point, as the mushroom cultivation process is visually appealing and can serve as a learning medium. The community's social readiness is high, as evidenced by its experience managing tourist villages. The main limitations lie in the lack of strategic planning and management weaknesses, as also mentioned in the research background. The need to improve human resources is considered urgent, especially for tourism services and product processing. The results of this analysis will form the basis of the AHP process to determine priority strategies.

**AHP Analysis: Determining Priority Strategies for Agrotourism Development**

Analysis using the Analytical Hierarchy Process (AHP) in the development of oyster mushroom agroindustry shows clear priorities. Two major structural obstacles hindering development are the lack of precise, applicable agroindustry planning and stakeholder involvement, as well as business licensing issues. (Wardhana et al., 2025). The AHP analysis of the priority strategies for developing oyster mushroom agrotourism is explained in **Figure** 2 below:

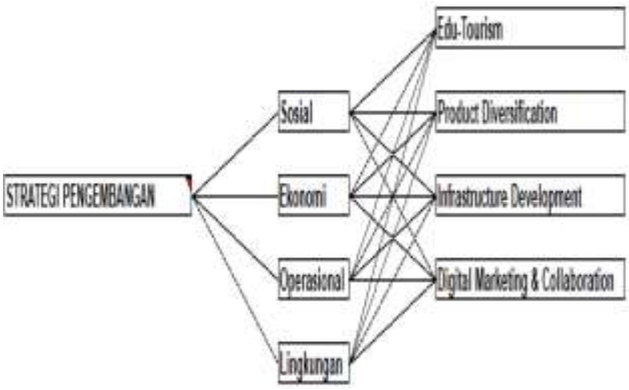


**Figure 2.** Hierarchical Model for Determining Priority Strategies for Oyster Mushroom Agrotourism Development

As explained in the research method and hierarchical model in **Figure** 3, AHP was conducted on four main criteria, namely economic, social, operational, and environmental criteria, against four strategic alternatives, namely the development of educational tourism packages (edu-tourism), diversification of processed products & souvenirs (product diversification), strengthening of tourism infrastructure & facilities (infrastructure development), and digital marketing & collaboration. This hierarchy explains that the goal to be achieved is the strategy that is a priority in the development of oyster mushroom agrotourism. Each criterion will be linked to each alternative to see which relationships are a priority. The data obtained from respondents on the level of importance between criteria, as explained earlier in **Table** 1, was then entered into the criteria comparison matrix presented in **Table 4**.

**Table 4.** Comparison Matrix Between Criteria

| Criteria | Economy | Social | Operational | Environment |
|---|---|---|---|---|
| Economy | 1.0000 | 3.0000 | 2.0000 | 4.0000 |
| Social | 0.3330 | 1.0000 | 0.5000 | 2.0000 |
| Operational | 0.5000 | 2.0000 | 1.0000 | 3.0000 |
| Environment | 0.2500 | 0.5000 | 0.3333 | 1.0000 |
| **Total** | **2.0830** | **6.5000** | **3.8333** | **10.0000** |

After stakeholder data is entered according to the level of importance of criteria (1-9), as presented in **Table** 4, the data is reprocessed with CDP4 software to obtain normalization and local priority calculations. Normalization data and local priority calculations are presented in **Table** 5.

**Table 5.** Normalization and Local Priority Calculation for Criteria

| Criteria | Economy | Social | Operational | Environment | *Local Priority* | *CR* |
|---|---|---|---|---|---|---|
| Economy | 0.4801 | 0.4615 | 0.5217 | 0.4000 | **0.4658** | 0.05102 |
| Social | 0.1599 | 0.1538 | 0.1304 | 0.2000 | 0.1610 | 0.01908 |
| Operational | 0.2400 | 0.3077 | 0.2609 | 0.3000 | 0.2772 | 0.06426 |
| Environment | 0.1200 | 0.0769 | 0.0869 | 0.1000 | 0.0960 | 0.01806 |
| **Total** | **1.0000** | **1.0000** | **1.0000** | **1.0000** | **1.0000** | |

Based on **Table** 5, it is explained that of the four criteria provided, the most important criterion is economic, with the highest local priority value of 0.4658, which means that economic criteria are a priority for development in oyster mushroom cultivation at Agro Jamur Lombok, followed by environmental, social, and finally environmental criteria. After obtaining the priority criteria, the analysis of the main priorities among the four available development alternatives is continued.

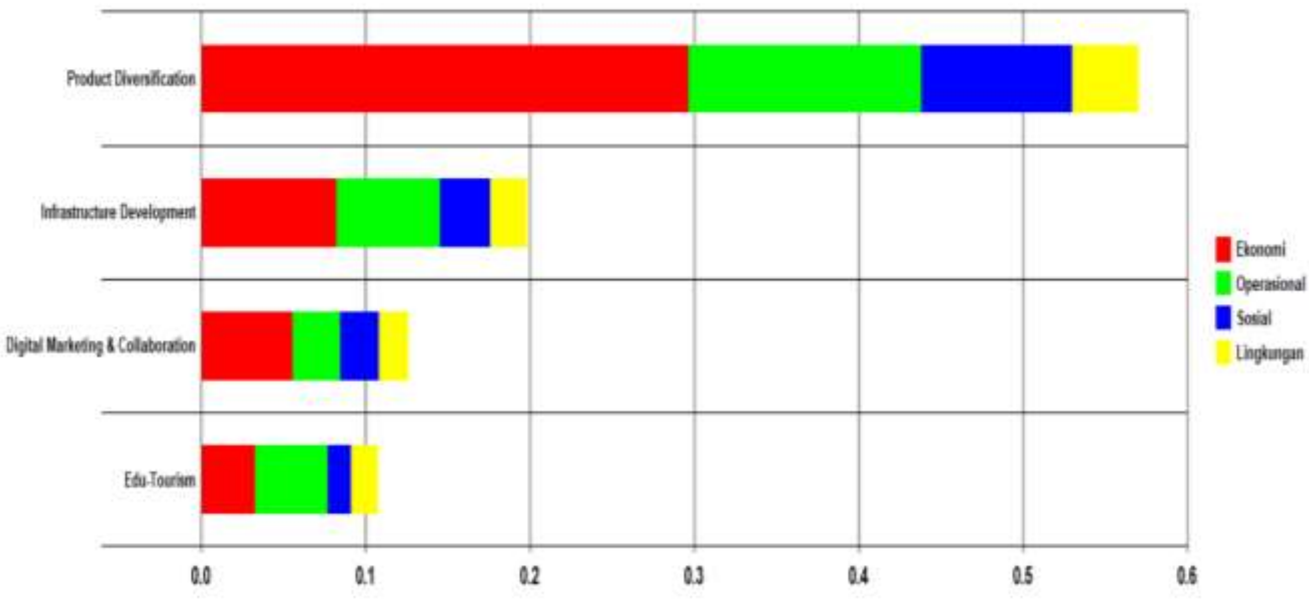


**Figure 3.** Global Priority Matrix for Oyster Mushroom Agrotourism Development

**Figure** 3 shows that, based on the criteria and selected alternatives, the final priority is the economic criterion, with the selected strategy: diversification of oyster mushroom-processed products to develop Lombok Mushroom Agriculture. This data was then used as the basis for developing a business in the field of Lombok Mushroom Agriculture, which can then be continued with other alternatives, namely strengthening infrastructure and tourist facilities, digital marketing, collaboration, and developing educational tour packages.

In the AHP analysis, the Consistency Ratio (CR) values shown in **Table** 5 were all less than 0.1 (CR < 0.1). This value indicates that the weighting for all alternatives for each criterion is consistent and acceptable. The data processing results show that the priority alternative strategy for developing oyster mushroom agrotourism at Agro Jamur Lombok Kekeri is product diversification, with the highest value as the top priority and a priority weight of 0.570. The following strategy is strengthening tourism infrastructure and facilities (infrastructure development) with a weight of 0.198, digital marketing and collaboration with a weight of 0.126, and finally, developing educational tourism packages (edu-tourism) with a weight of 0.107. Oyster mushrooms, which are rich in nutrients, have great potential for processing into high-value-added products, such as powdered mushroom broth (Wardhana et al., 2025) or special dietary foods (FSDU) for diabetic diets (e.g., combined with brown rice) (Kusumastuty et al., 2024). Diversification into oyster mushroom chips with various flavors has made them one of the most in-demand oyster mushroom-derived products among consumers. In addition, processing oyster mushrooms into mushroom meatballs and nuggets is also a promising business opportunity (Diana et al., 2025; Fadli et al., 2025). This strategy directly addresses the need to produce competitive products in a broader market.

Agrotourism provides farmers with an alternative source of income and diversifies their businesses. It also serves as a channel for distributing agricultural products directly to consumers and developing new market niches, with proven financial viability in West Lombok. Agrotourism will be a catalyst for local economic growth. Agrotourism provides alternative employment opportunities for farmers' family members. It also supports women's empowerment by providing opportunities to build a professional image and expertise (Ammirato et al., 2020). Most importantly, educational agrotourism helps visitors learn about agriculture, heritage preservation, and rural traditions (Yang & Xia, 2021).

## CONCLUSION

Through AHP analysis, it was found that the priority alternative for the Lombok Mushroom Agro business is product diversification, with a weight of 0.570; priority 2 is infrastructure development, with a weight of 0.198; and priority 3 is digital marketing & collaboration, with a weight of 0.126. Priority 4 is the development of educational tourism packages (edu-tourism) with a weight of 0.107. The proposed solution is to apply IoT to regulate the temperature and humidity of the mushroom-growing environment, which will be used as a new activity to be tested. It is considered helpful in overcoming problems in oyster mushroom production.

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