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# Integration of Agrotourism Model with Food Crop-Horticulture Livestock in the Batu Bulan Irrigation Area, Sumbawa Regency

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**Abstract**

The development of livestock–crop-integrated agrotourism in the Batu Bulan irrigation area holds significant potential to increase farmers' incomes, enhance ecological sustainability, and diversify rural economies. This study aims to formulate the most strategic development priorities using SWOT analysis and the Quantitative Strategic Planning Matrix (QSPM). Data were collected through farmer surveys, in-depth interviews, and field observations. The findings indicate that the S–O strategy is the top priority, namely the development of integrated livestock–crop agrotourism packages through institutional strengthening and collaboration among local government, universities, and NGOs. The W–O strategy emphasizes improving human resource capacity in digital marketing, tourism management, and livestock bio-ecology, while the S–T strategy recommends developing environmentally friendly tourism infrastructure such as biogas units, composting facilities, and educational trails. Meanwhile, the W–T strategy focuses on strengthening access to capital, risk management, and governance for smallholder farmers. Overall, the QSPM results highlight that multi-stakeholder collaboration, enhanced human resource competence, and the adoption of environmental technologies are key to the successful implementation of integrated agrotourism models in irrigated agricultural areas. These findings are expected to serve as a reference for local governments, universities, and farmer communities in designing sustainable agrotourism development policies in Indonesia's agrarian regions.

**Keywords:** agrotourism; Batu Bulan; livestock–crop integration; SWOT; QSPM; sustainability



## INTRODUCTION

The development of an agrotourism model that integrates livestock with food crops and horticulture in the Batu Bulan Irrigation Area is underpinned by the theoretical foundations of agroecology and integrated production systems, which emphasise ecological efficiency, nutrient cycles, and multifunctional agricultural landscapes. The crop-livestock integration model has been shown to increase productivity, synchronise biomass, and improve soil quality recovery by strengthening nutrient cycling and residue management (Ryschawy et al., 2017). Furthermore, recent research shows that integration at the plot and regional levels can improve agroecological performance by regulating biomass stocks, controlling erosion, and increasing production stability (de Bortolli et al., 2024). In dry tropical regions, crop–livestock integrated farming systems have also been reported to significantly increase farmers' incomes and economic resilience when combined with nutrient management innovations (Shanmugam et al., 2024). Furthermore, agrotourism as part of agricultural business diversification has strong potential to create added value, expand market opportunities, and strengthen rural socio-economic sustainability when developed within a framework of production and education integration (Ndhlovu & Dube, 2024).

The essential concept of integrating agrotourism with crop-livestock systems in the Batu Bulan Irrigation area is based on the idea that agricultural landscapes can be optimised as spaces for production, education, recreation, and conservation by strengthening the ecological relationship between crop and livestock components. Crop-livestock integration has been shown to increase biomass utilisation efficiency, improve soil physical and chemical properties through nutrient recycling, and enhance the stability of a more adaptive production system (de Bortolli et al., 2024). In the context of agrotourism, the presence of food and horticultural crops provides visual and educational appeal. At the same time, livestock serves as a source of organic fertiliser, reinforcing environmentally friendly agricultural practices and enhancing the area's ecological sustainability (Stark et al., 2017). Global research shows that crop–livestock integration can create economic value through land-use diversification and increased farmer income when combined with agrarian-based learning tourism activities (Shanmugam et al., 2024; Ndhlovu & Dube, 2024). Thus, the integration of

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agrotourism–crops–livestock in the Batu Bulan Irrigation area is scientifically grounded in the principles of biophysical efficiency, economic diversification, and sustainable agricultural ecosystem innovation, thereby positioning agriculture as both a production space and a high-value educational vehicle.

The Batu Bulan Irrigation Area in Sumbawa Regency has ecological and socio-economic characteristics highly conducive to the development of agrotourism through the integration of livestock, food crops, and horticulture. The availability of water from the Batu Bulan Irrigation Area allows for year-round agricultural intensification. At the same time, the diversity of commodities such as rice, corn, vegetables, and horticultural fruits provides excellent opportunities for agricultural diversification. The high population of ruminant livestock in this region also provides a supply of biomass and organic waste that can potentially be processed into compost to support organic farming systems. However, several issues, such as low land-use efficiency, suboptimal utilisation of biomass, and a lack of innovation in agricultural tourism management, pose obstacles to the realisation of a sustainable, integrated agrotourism system.

The urgency of developing an integrated agrotourism model in Batu Bulan stems from the need to increase the added value of agriculture through synergy among production, education, and recreational activities. Farmers in this area are still predominantly small-scale farmers, so integrating livestock and crop farming and developing tourism can be a strategy to strengthen household economies. In addition, environmental challenges such as declining soil fertility due to long-term use of chemical fertilisers and biomass waste that has not been optimally utilised indicate the need for an agroecological approach based on nutrient cycling (Paul et al., 2022). In the tourism sector, the absence of professionally managed agrotourism destinations indicates a significant opportunity to develop educational tourism packages based on integrated agricultural practices. Without a structured, proven model, the significant potential of the Batu Bulan region is challenging to develop optimally.

The novelty of this research lies in its formulation of an integrated agrotourism model that combines livestock, food crops, and horticulture to optimise the use of irrigation resources and the flow of biomass between livestock and crops, while developing educational tourism functions in line with the socio-cultural characteristics of the Sumbawa community. Unlike previous studies that emphasised integration only in terms of production, the model developed in this study integrates production, ecological, economic, and educational functions simultaneously. The objectives of the study are: (1) to analyse the existing conditions of the Agrotourism Model Integration with Livestock, Food Crops and Horticulture in the Batu Bulan Irrigation Area, Sumbawa Regency, (2) to identify opportunities, challenges and the capacity of farmers for Agrotourism Model Integration with Livestock, Food Crops and Horticulture in the Batu Bulan Irrigation Area, Sumbawa Regency, and (3) to formulate the Integration of Agrotourism Model with Food Crop-Horticulture Livestock in the Batu Bulan Irrigation Area, Sumbawa Regency, which is applicable, sustainable, and in line with regional needs. Thus, this research is expected to serve as a scientific reference and policy material to strengthen the economy and ecology of integrated agriculture-based areas.

## MATERIALS AND METHODS

### Time and Place of Research

Penelitian dilakukan pada bulan Agustus-November 2025 bertempat di empat desa di wilayah irigasi Batu Bulan yaitu Desa Batu Bulan, Desa Leseng, Desa Pernek yang berada di Kecamatan Moyo Hulu dan Desa Berare kecamatan Moyo Hilir Kabupaten Sumbawa.

### Research Design

This study utilises a descriptive-exploratory research Design with a mixed methods approach, which allows researchers to explore phenomena in depth while combining the strengths of qualitative and quantitative data to produce a more comprehensive understanding (Johnson & Onwuegbuzie, 2004; Tashakkori & Teddlie, 2010) to analyse the potential, existing conditions, and direction of integrating the agrotourism model with food crop-horticulture livestock in the Batu Bulan irrigation area of Sumbawa Regency. The quantitative approach in this study was conducted through a survey using a Likert scale-based questionnaire to measure farmers' perceptions, the level of biomass integration, farming efficiency, and readiness for agrotourism development. The Likert scale is commonly used to measure attitudes and perceptions in social research because it can capture variation in responses more systematically and reliably. Quantitative surveys also provide opportunities to generalise findings to a broader population, especially in agricultural and rural development studies that require valid measurements of farmers' perceptions and behaviour (Creswell & Clark, 2018). Furthermore, this approach is consistent with agrarian research practices and integrated production systems that emphasise analysis based on numerical data and inter-variable relationships (García-Martínez et al., 2021).

Meanwhile, the qualitative approach was implemented through in-depth interviews and participatory observation to explore integration practices, local wisdom, and the region's socio-ecological dynamics. This approach is important because it allows researchers to understand the meaning, values, and local practices in a contextual and emic manner, especially in community-based research (Denzin & Lincoln, 2018). In-depth interviews are compelling for exploring the narratives, experiences, and motivations of farmers in livestock-crop integration systems (Kvale & Brinkmann, 2015), while participatory observation has become a key method for understanding social interactions and ecological adaptation patterns in

rural landscapes (Spradley, 2016). The combination of these two methods deepens the analysis and provides a holistic understanding of the relationship among local knowledge, biomass management practices, and local ecological dynamics. Data analysis was conducted through thematic triangulation, SWOT analysis to identify internal and external strategic factors, and strategy prioritization using QSPM, which is a framework for integrated farming systems and sustainable agroecology (Smith et al., 2020; Paul et al., 2022). This integrated approach is considered relevant for understanding the complexity of rural socio-ecological systems and designing applicable models according to the characteristics of Batu Bulan, as recommended by global sustainable agricultural system studies (Campos et al., 2020; Ravera et al., 2020).

**Population and Sample**

The population in this study consisted of 10 farmers from each of the four villages in the Batu Bulan irrigation area, Sumbawa Regency, who manage food crop and horticultural farming businesses, as well as livestock farming, and are directly involved in irrigation-based integration practices. Given the heterogeneity of farmer characteristics, such as land ownership, commodity types, integration patterns, and access to resources, the sample was determined using purposive sampling to ensure the representation of farmer groups that actually implement livestock-crop integration, in accordance with the recommendations of agroecology and integrated farming system research (Etikan et al., 2016; Khadse et al., 2018). The selection of 40 respondents was considered adequate for quantitative analysis based on perceptions and SWOT–QSPM measurements, in line with sample size guidelines in socio-agricultural studies (Bujang et al., 2018). This approach ensures that the sample obtained reflects variation in integration practices and provides an authentic picture of the potential for developing an agrotourism model based on livestock-crop integration in irrigated areas.

**Research Procedures**

This research procedure was carried out through a series of systematic stages, including: (1) a preliminary study to identify the socio-ecological context of the Batu Bulan irrigation area through literature review and consultation with stakeholders; (2) development of research instruments in the form of questionnaires, interview guidelines, and observation sheets based on livestock-crop integration indicators and agro-educational tourism potential; (3) data collection using quantitative surveys of farmers, in-depth interviews with key informants, and field observations of cultivation practices and integration systems; (4) processing and analyzing data using a mixed methods approach, including descriptive analysis, SWOT, QSPM, and qualitative data triangulation to ensure the validity of the findings; and (5) interpreting the results and developing recommendations for an agrotourism development model based on livestock-crop integration. This procedure refers to mixed-methods social-agricultural research standards that emphasize the complementary integration of quantitative and qualitative data to produce a comprehensive development model (Creswell & Clark, 2023; Johnson et al., 2020). quantitative analysis based on perception and SWOT–QSPM measurement, in line with sample size guidelines in socio-agricultural studies (Bujang et al., 2018). This approach ensures that the sample obtained can reflect the variation in integration practices and provide an authentic picture of the potential for integrating agrotourism models with food crop-horticulture livestock in the Batu Bulan irrigation area of Sumbawa Regency.

## RESULTS AND DISCUSSION

***SWOT Analysis Results***

A SWOT analysis (Table 1) was conducted to identify internal and external factors affecting the development of an integrated livestock-food crop-horticulture agrotourism model in the Batu Bulan irrigation area. Internal factors (Strengths and Weaknesses) describe the condition of resources, farmer capacity, infrastructure, and institutional social readiness. Meanwhile, external factors (Opportunities and Threats) indicate market dynamics, government policies, tourism potential, and environmental and economic risks.

The results of the identification show that the agricultural system in the Batu Bulan irrigation area has dominant strengths, including year-round water availability, connectivity between livestock and crops through the biomass cycle, a large land area suitable for integration, and high cultural value of animal husbandry. Other strengths include educational potential, opportunities for processed products, institutional support, regional accessibility, and a growing interest in educational tourism. These conditions indicate the area's readiness to be developed into sustainable agrotourism, as emphasized by Mason et al. (2021), that agrotourism will be successful in areas with rich natural resources, local culture, and authentic agricultural activities. **Table** 1 shows the SWOT Matrix for the Development of Integrated Livestock-Crop Agro-tourism in the Batu Bulan Irrigation Area.

**Table 1.** SWOT Matrix for the Development of Integrated Livestock–Crop Agro-tourism in the Batu Bulan Irrigation Area

| Strengths (S) | Weaknesses (W) |
|---|---|
| Year-round availability of irrigation water | Limited capital for tourism infrastructure development |
| Large areas of land suitable for livestock-crop integration | Human resources are not yet trained in agrotourism management |
| Product diversification (livestock and crops) | Promotion and branding are still weak |
| Farmers' local knowledge and livestock farming traditions | Limited tourism support infrastructure |
| High educational value for agro-educational tourism | Institutional management is not yet solid. |
| Supporting environmental sustainability (waste → fertilizer, legumes → soil improvement) | No SOPs for tourism-based livestock-crop integration are available yet. |
| Opportunities for processed product development (MSMEs) | Risks of odor, waste, and livestock disease |

| Strengths (S) | Weaknesses (W) |
|---|---|
| Local culture as a tourist attraction<br>Institutional support (government agencies, universities, NGOs)<br>The growing trend of educational tourism<br>Business model is easily developed (scalable)<br>Multiple income streams<br>Simple and educational technology (biogas, fermented feed)<br>The area's accessibility is relatively good. | Diversification of processed products is still minimal.<br>Limitations of local tourism market research<br>Farmers' access to and literacy in digital technology remains low. |
| **Opportunities (O)** | **Threats (T)** |
| Government policy support for agrotourism<br>Increase in educational tourism and ecotourism trends<br>Education tourism market (schools and universities)<br>Demand for healthy and organic products is increasing<br>Digital marketing makes promotion easier.<br>Opportunities for research collaboration with universities<br>Access to CSR and NGO funding<br>Local cultural events as tourist attractions<br>Green economy and carbon farming trends<br>Enhancing the appeal of regional tourism in Sumbawa | Fluctuations in agricultural product prices<br>Competition with Bali and Lombok as destinations<br>The impact of climate change (drought and flooding)<br>Livestock disease outbreaks (PMK, avian influenza)<br>Changes in government policy<br>Low interest among young people in the agricultural sector<br>Risk of environmental degradation<br>Limitations of public transportation<br>Seasonal tourist visits<br>Digital divide |

On the other hand, several internal weaknesses were identified, including limited capital, low human resource capacity in tourism management, a lack of agrotourism support infrastructure, weak promotion and branding, and the absence of SOPs for livestock-crop integration in tourism. These findings are in line with Nguyen & Rieger (2020), which shows that the development of agrotourism in rural areas is often constrained by low institutional and marketing capacity.

External factors indicate significant opportunities, including government support for agrotourism, the growing trend in ecotourism following the pandemic, the educational tourism market, increased demand for healthy and organic products, opportunities for research collaboration, CSR financing, and the green economy trend. Meanwhile, threats such as commodity price fluctuations, livestock disease outbreaks, climate change, competition from other tourist destinations, and low interest among the younger generation are external factors that require mitigation strategies. Similar findings were also reported by Shrestha et al. (2022), who stated that integrated farming systems are highly vulnerable to environmental and market shocks without strong institutional support.

***QSPM results***

QSPM is used to determine priority strategies based on the SWOT matrix. Each strategic factor is given a weight, an attractiveness score (AS), and a Total Attractiveness Score (TAS). Three main strategies are developed from a combination of SO, WO, ST, and WT strategies. The QSPM matrix for integrated agrotourism development of livestock and crops is shown in **Table** 2.

**Table 2.** QSPM Matrix for the Development of Integrated Livestock-Crop Agrotourism

| **S-O Strategy**: | **W-O Strategy**: |
|---|---|
| Development of agrotourism packages based on crop-livestock integration by strengthening farmers' institutions and fostering collaboration among government, universities, and NGOs. | Improving human resource capacity through training in digital marketing, tourism management, livestock bio-ecology, and the development of integration SOPs |
| **S-T Strategy** | **W-T Strategi** |
| Development of environmentally friendly tourism infrastructure (biogas, composters, educational trails). | Institutional strengthening, access to capital, and risk management |

The S–O strategy, namely the development of agrotourism packages based on livestock–crop integration through institutional strengthening and collaboration among the government, universities, and NGOs, is highly significant in the QSPM analysis because it leverages both internal strengths and external opportunities. Multi-stakeholder collaboration has been proven to increase innovation capacity, institutional legitimacy, and the sustainability of community-based programs (Haulle, 2024; Stone & Nyaupane, 2020). This approach is in line with the findings of the FAO (2021), which emphasizes the importance of participatory governance in developing community-based agritourism. Cross-sector integration models have also been shown to increase economic opportunities, tourism service quality, and tourists' positive perceptions of sustainable agricultural products (Bello et al., 2022; Torres et al., 2021). In addition, strengthening farmer groups and cooperatives directly impacts destination management efficiency, access to social capital, and business diversification capabilities (Lessa et al., 2022), making the S–O strategy the foundation of Batu Bulan agrotourism governance.

The W–O strategy, which involves increasing human resource capacity through training in digital marketing, tourism management, livestock bio-ecology, and SOP development, is important for overcoming internal weaknesses related to limited digital literacy and service competencies. Digital marketing training has been shown

to increase product visibility, consumer engagement, and small-business income in the agriculture and tourism sectors (Shanthini & Rajasekaran, 2022; Nugroho et al., 2023). International literature shows that strengthening human resource capacity is a major predictor of improved service quality and tourist satisfaction (Rahman et al., 2021) and a critical factor in the absorption of technology-based agritourism opportunities (Klerkx & Rose, 2020). Training in livestock bio-ecology and integration SOPs also contributes to resource-use efficiency, improved biosecurity, and the professionalization of tourism services (Gebrezgabher et al., 2021). Therefore, the W–O strategy provides a strong foundation for enhancing the competitiveness of Batu Bulan agrotourism.

The S–T strategy, namely the development of environmentally friendly tourism infrastructure such as biogas, composters, and educational trails, demonstrates the ability to turn external threats into opportunities for destination development. Small-scale biogas technology has been proven to be technically and economically viable in rural areas of Asia, especially when livestock waste is available in sufficient quantities and managed collectively (Roubík & Mazancová, 2020; Surendra et al., 2022). Composting horticultural biomass and livestock waste is a key circular economy practice that improves soil fertility and reduces environmental burdens (Nika et al., 2020; Padmapriya & Abhilash, 2021). Environmental interpretation-based tourism infrastructure has also been shown to increase visitor interest and expand the education-based market segment (Gao & Wu, 2023). Thus, the S–T strategy strengthens the identity of Batu Bulan ecotourism and enhances the added value of livestock–crop integration for environmental sustainability.

The W–T strategy, namely institutional strengthening, access to capital, and risk management, is crucial to mitigate smallholder farmers' vulnerability to market volatility, production failure risks, and financing constraints. Farmers in developing countries often face barriers to accessing formal credit due to a lack of collateral, documentation, and managerial skills (Khan, 2024; Mohan & Pandey, 2021). Strengthening cooperatives, village-owned enterprises, and business groups is an important mechanism for improving bargaining power, creating economies of scale, and reducing financial transaction costs. Risk management instruments such as business diversification, microinsurance, and safety SOPs can enhance the resilience of agritourism systems to external shocks (Meuwissen et al., 2019). Thus, the W–T strategy not only reduces the structural vulnerability of farmers but also ensures the economic sustainability and long-term resilience of integrated agrotourism in Batu Bulan.

## CONCLUSION

The conclusions indicate that the development of integrated livestock-food crop-horticultural agrotourism in the Batu Bulan irrigation area has a firm strategic foundation, thanks to the dominance of internal strengths, including resource availability, mutually supportive biomass cycles, cultural values, and increasing opportunities in the educational tourism market. However, its successful development can only be achieved if critical obstacles, such as limited capital, human resource capacity, tourism infrastructure, and weak governance, are systematically overcome. The QSPM results confirm that the highest-priority strategy is to strengthen farmer-based institutions through collaboration among the government, universities, and NGOs to drive innovation, legitimacy, and long-term sustainability. Other supporting strategies, such as improving digital and managerial competencies, developing environmentally friendly infrastructure, and strengthening access to capital and risk management, are important prerequisites for mitigating external threats and ensuring system resilience. Overall, this combination of strategies provides a clear and operational direction for the transformation of Batu Bulan into a productive, resilient, and sustainable leading agrotourism destination.

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