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Sustainable Agriculture Model Development to Control Agricultural Land Conversion in Kemiren Tourism Village, Banyuwangi Regency

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Abstract: The conversion of agricultural land in Kemiren Tourism Village has the potential to affect the environment, socioeconomic, and cultural of the surrounding community. To address the issue of land conversion in Kemiren Tourism Village, this study aims to develop a sustainable agriculture model. The development of this dynamic system involves several stages: determining system objectives, conducting a needs analysis, formulating problems, and identifying the system. The analysis suggests an increase in agricultural land conversion from 2020 to 2030, with the potential to convert all agricultural land into non-agricultural land, particularly for tourism purposes. The reduction of agricultural land in Kemiren Tourism Village leads to a decline in both the community's rice production and food security. However, the growing demand for rice due to land being optimized for tourism increases rice production. To address this issue, this study recommends a scenario that includes strengthening the agricultural ecosystem and bolstering the socio-economic conditions of the population, leading to a reduction rate of agricultural land conversion by 25% until 2030.

Keywords: Dynamic System; Land Conversion; Sustainable Agriculture.

Introduction

Population growth has a significant impact on the increasing demand for food globally. However, it also has the potential to negatively affect the sustainability of productive land, particularly agricultural land (Griggs et al., 2013). Agricultural land is a strategic resource for fulfilling human needs, including non-agricultural needs like housing, job creation, household wellbeing (Widyawati, 2017). According to Nurchamidah (2017) and WRI (2022), Indonesia faces issues converting agricultural land to non-agricultural lands, such as residential, business, and education centers, particularly in suburban areas. Although there is a high demand for agricultural products in the community.

The land conversion issue in Kemiren Village, a tourism destination in Banyuwangi Regency, has affected most of its residents who work as farmers. The optimization of the Tourism Village concept through the construction of hotels, restaurants, and entertainment venues has resulted in the conversion of land. The distribution of land use in Kemiren Village is

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disproportionate. Around 27,494 ha/m2 is used for tourism and residential purposes, while agricultural land only reaches 105 ha/m2. This imbalance has resulted in a decline in rice production in Kemiren Village compared to the previous year. The current human needs in the village are related to 3F: food, fuel, and finance. The Food component is closely related to agricultural land. As the population increases, agricultural land becomes increasingly scarce, potentially leading to a food crisis in Kemiren Village and other regions of Indonesia.

This research focuses on formulating a scenario to solve the land conversion problem in Kemiren Village using a Sustainable Agriculture approach. The approach integrates variables in the agricultural sector and optimizes the results to provide significant benefits to the community. Existing variables will be integrated into a dynamic system, where they can change depending on the input type. The research aims to address the issue of agricultural land conversion in Kemiren Village by developing a dynamic system model and several scenarios that are suitable for the existing conditions.

Method

The research will focus on Kemiren Tourism Village in Banyuwangi Regency. This village is known for its traditional social culture and the majority of its residents work as farmers or own agricultural land. The choice of location is because Kemiren Tourism Village is one of the potential tourism villages in Banyuwangi. The impact of the tourism sector on the conversion of agricultural land in Kemiren Tourism Village was analyzed in depth by the researcher.

Data collection involves conducting literature studies and interviews with key stakeholders. This approach allows researchers to objectively assess existing conditions and assist in developing an appropriate model.

The dynamic system model developed will include a several components: (1) simulation of land change (2) simulation of food carrying capacity in Kemiren Village. The model for Sustainable Agriculture Model Development to Control Agricultural Land Conversion in Kemiren Village, Banyuwangi Regency will be analyzed using *Powersim Studio 10*, with the following stages of modeling analysis such as (1) Creation of Causal Loop Diagram, which will illustrate the positive - negative relationship of each variable that will be used in the study; (2) Stock and Flow Diagram, describing the relationship of each variable; (3) Model Simulation, describing the simulation of the relationship between variables with certain time constraints; (4) Model validation and verification involves testing the model with existing conditions and assumptions that shape the structural dynamics model; and (5) Scenario development is used to simulate the results of an intervention or treatment carried out on certain variables (Muhammadi et al., 2001).

Result and Discussion

When creating a dynamic system model for sustainable agriculture, it is important to consider both internal and external inputs, as well as expected and unexpected outputs. For a sustainable agricultural system to function effectively, a system-oriented model that is measurable, predictive, stochastic, and capable of diagnosing conditions is required (Hansen, 1996). This information will aid researchers and the Banyuwangi Regency government in identifying and addressing potential issues. This concept is commonly referred to as the Black Box (see Figure 1).

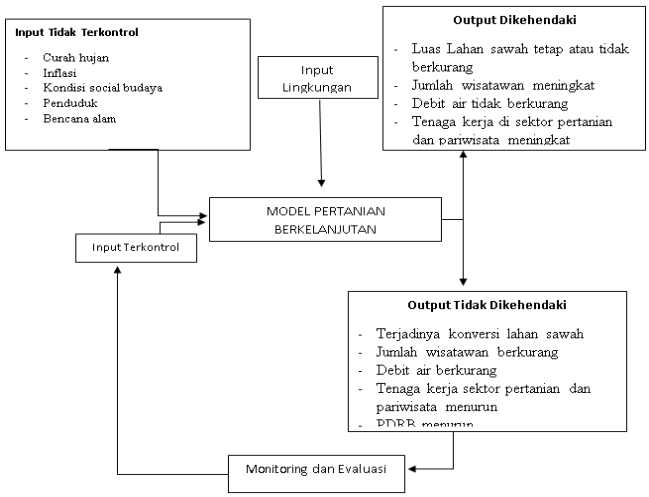

Figure 1. Black Box

During development, researchers must create three input scenarios: controlled input, uncontrolled input, and environmental input. Uncontrolled input, on the other hand, refers to inputs that cannot be manipulated in the system due to their relation to environmental and socio-cultural conditions. Controlled input refers to inputs that can be monitored through Monitoring and Evaluation activities. Figure 2 illustrates the dynamic nature of the system, where arrows rotate in relation to each other. This demonstrates that modifying a single parameter can affect the resulting output (Kumar & Nigmatullin, 2011).

Sub-Model Simulation of Land Conversion

The research employs a dynamic systems approach to model the rate of conversion of agricultural land to tourism land. The variables studied include the rate of conversion of agricultural land and the simulated

rate of change. This approach helps to study the complex system and identify the important variables. The model developed is appropriate for the research conditions (Popli et al., 2017; Artika & Chaerul, 2020).

Figure 3 illustrates the simulation of land conversion impacts in Kemiren Village, Banyuwangi Regency, from 2020 to 2030.

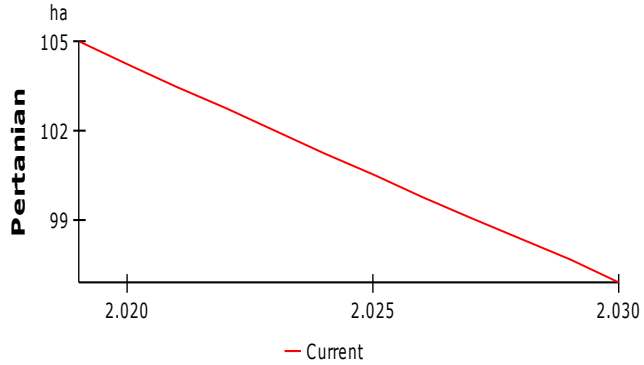

Figure 3. Simulation of Agricultural Area Land Conversion.

Based on the simulation results of the dynamic system model above, it appears that the agricultural land area in Kemiren Village is likely to continue to decline annually until 2030. The current agricultural land area is approximately 105 hectares, and 90% of this area is at risk of significant decline, assuming both controllable and uncontrollable input variables have absolute values. These regulations provide guidance for sustainable development in accordance with Regional Spatial Planning (RTRW) and land use management. To improve land use and optimization, the Banyuwangi Regency Government should adhere to Indonesian government regulations, specifically Government Regulation Number 16 of 2004 concerning Land Use and Law Number 26 of 2007 concerning Spatial Planning.

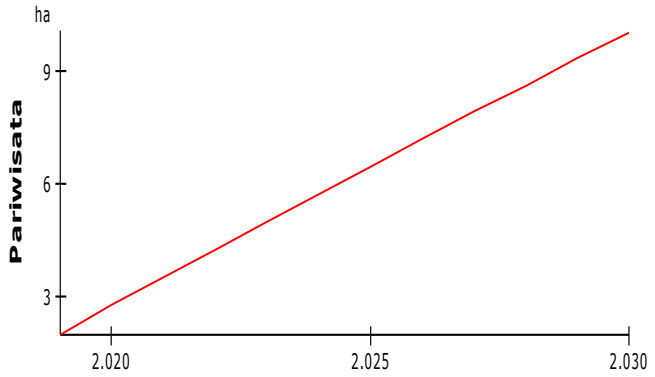

Figure 4. Simulation of Tourism Area Land Conversion

When considering tourism variables (Figure 4), it is evident that land conversion for tourism optimization has the potential to increase from its peak in 2030. This contrasts with the declining trend of agricultural land, which has decreased by up to 90%. This contrasts with the declining trend of agricultural land, which has decreased by up to 90%. Tourism land, on the other hand, has increased by approximately 2 times its original condition. The impact of this trend can be positive or negative, depending on the researcher's perspective.

1) Negative aspects may lead to a decrease in food production and declining environmental conditions, as well as changes in the natural landscape that are related to differences in the climate of a region.
2) The positive aspects of this situation are related to employment opportunities and the emergence of new business alternatives that can stimulate the economy.

Land conversion is a long-standing issue that has been exacerbated by the growing population's demand for non-food items (Nguyen et al., 2016; Harewan et al., 2023). This phenomenon is not limited to rural areas but is also spreading to urban and peri-urban areas. According to Winoto & Siregar (2008) and Harini et al. (2018), the growth rate of agricultural land in Indonesia was -0.17% in 2015, indicating a continuous increase in land conversion in the country. Land conversion cannot always be avoided, but it can be controlled to encourage a balanced use of natural resources and achieve ecosystem harmony.

Sub-Model Simulation of Food Carrying Capacity

This research examines the three components of food carrying capacity: reduction in rice production, food carrying capacity, and rice demand. Land conversion activities can have an indirect impact on reducing rice production (Figure 5), food carrying capacity (Figure 6), and rice demand (Figure 7) in Kemiren Village, Banyuwangi Regency. It is important to note that these impacts are not limited to direct effects on land.

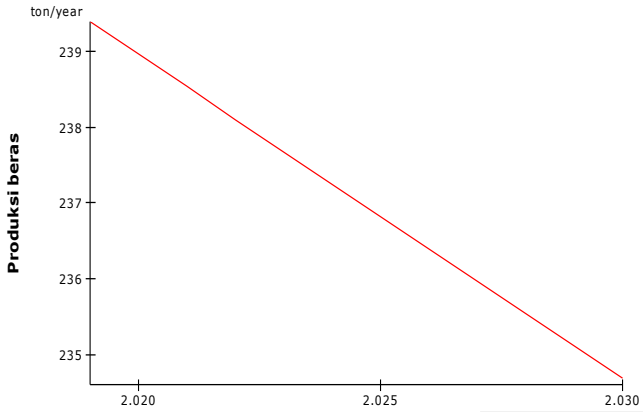

Figure 5. Simulation of rice production

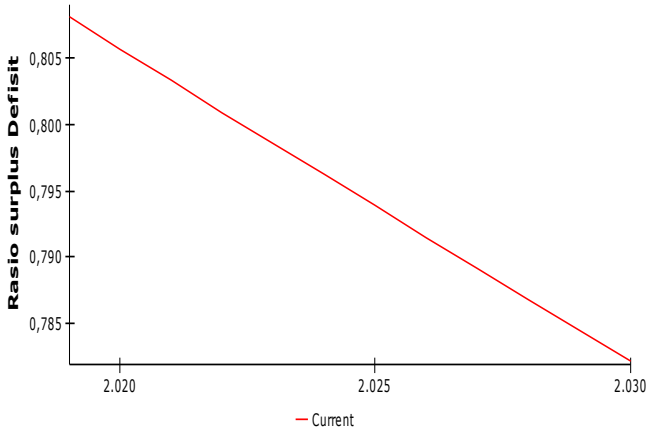

Figure 6. Simulation of food carrying capacity

Rice is the staple food of Indonesians and is highly dependent on both organic and conventional rice fields. Land conversion activities indirectly lead to a decline in rice production due to the decreasing availability of rice farming land and unfavorable environmental conditions. Based on field observations, Kemiren Village has the potential to produce approximately 239 tons of rice per year. However, without integration between the government and community to prevent the negative impacts of land conversion, there is a risk of a 90% decline in production by 2030. This would also reduce the food carrying capacity of the harvest in Kemiren Village, Banyuwangi Regency, affecting the surrounding community.

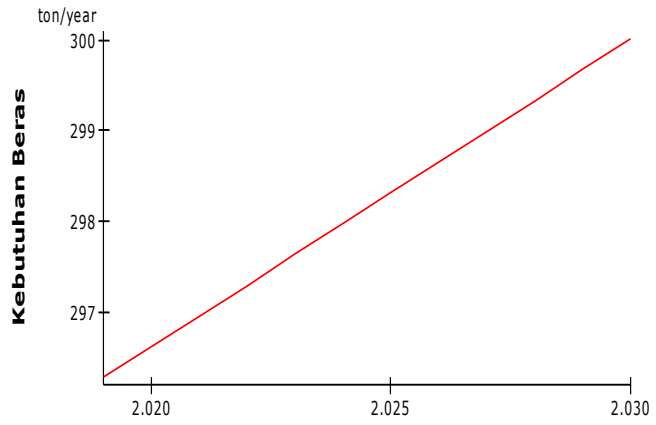

Figure 7. Simulation of rice demand

Field observations that have been carried out explain that one of the impacts that can be felt directly related to agricultural land conversion activities is a large decline in production which has the potential to continue to experience a significant decline until 2030, which is inversely proportional to the demand for rice from the community in Kemiren Village continues to experience improvement. This condition is similar with a study conducted in the Padangsidempuan area, North Sumatra, where the conversion of agricultural land had an impact on reducing agricultural land productivity, not only rice but other agricultural commodities (Harahap et al., 2018). This land conversion can also have a direct effect to social and economic sector in village also it potentially caused indirect impact on farmers' and community income and caused the change on community socio-cultural livelihood (Lestari & Dharmawan, 2011; Harini, 2012, Dewi et al., 2019).

Researchers conducted in-depth data mining through interview sessions and found evidence of a shift in the work preferences of the local community, particularly among farmers who are seeking additional income through tourism activities. The tourism sector is perceived as more profitable despite it not being their primary occupation. Various types of work related to tourism include tour guides, parking attendants, equipment rental, photographers, and other related positions.

Kemiren Village is being developed by the Banyuwangi Regency Government as a tourist destination that showcases the original Banyuwangi culture (Osing Culture). The development process involves close participation from the surrounding community. The development of Kemiren Village is also a collaboration between the Banyuwangi Regency Government and local stakeholders to develop supporting infrastructure. However, it is important to note that during the development process, it is crucial to maintain the traditional conditions and components of the area, especially those that align with the culture of the Osing people. Therefore, this development aims to promote renewal and sustainability rather than land conversion. The Kemiren Village Government has implemented a policy to limit development on productive land due to a significant decrease in the amount of such land, which is projected to reach only 5-20% by 2022. Regarding tourism development, the Kemiren Village Government has focused on developing less productive land, while maintaining productive land, such as agricultural land, alongside the tourism industry. Pretty (2008) argues that a balance between environmental and human needs can be achieved through the implementation of local and national policies.

Sustainable Agriculture Scenario Model

The model simulation is used to make predictions for a 10-year period (2020-2030). Two scenarios were developed: (1) scenarios for controlling the conversion of agricultural land to tourism land and (2) scenarios for controlling population growth. These scenarios have an interrelated causal relationship with the three subsystems that have been developed: environmental, economic, and social.

In the first scenario, the agricultural system is closely related to rice production, which in turn affects farmers' income. Therefore, the first scenario aims to strengthen internal factors. To achieve this, the cultivation process should be optimized, along with agricultural supporting facilities and infrastructure. Additionally, the initial level of productivity of the land should be assessed. To better control agricultural land conversion, priority should be given to land with low agricultural productivity. In cases where agricultural productivity is high, it is important to strengthen other components that can support the production of agricultural products in the community, ultimately having a positive impact on farmers' income.

In the second scenario, the population growth component is intervened. This component is closely related to the condition of the workforce and the need for basic commodities such as rice. The labor force component comprises three main variables: unemployment, farmer professions, and tourism-related professions. Providing support in the form of capital, assistance, mentoring, and market access to professions related to agriculture has the potential to increase the agricultural workforce. This, in turn, can lead to an increase in the number of farmers focusing on improving land productivity, indirectly reducing the rate of agricultural land conversion to tourist land. Meanwhile, the tourism workforce will focus on enhancing the culture and natural conditions of the existing ecosystem without making significant changes.

This scenario could be optimized by finding the right combination to impact the rate of agricultural land conversion, as shown in Figure 9.

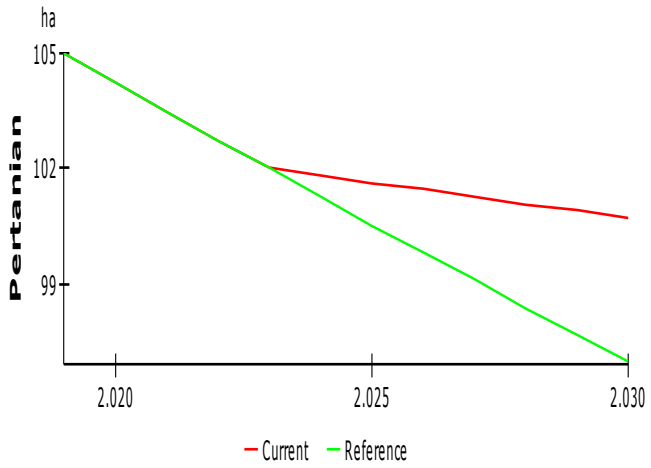

Figure 9. Scenario of Land Conversion Policy

This scenario is optimal for implementation. It focuses on strengthening the agricultural sector, particularly on the ecosystem side, while also considering socio-economic intervention. This balance has a positive impact on the operation of a sustainable agricultural system. According to Figure 9, the combination of these two scenarios has the potential to reduce the rate of land conversion by up to 25% by 2030. The controlled conversion of agricultural land for tourism development in Kemiren Village has the potential to support Banyuwangi Regency in implementing sustainable development, particularly in the tourism and agriculture sectors.

Conclusion

The model for sustainable agriculture with land conversion in Kemiren Village, Banyuwangi, consists of three interrelated subsystems: environmental, economic, and social. The scenario emphasizes the rate of agricultural land conversion by strengthening the agricultural ecosystem and the socio-economic conditions of the population. The two scenarios developed have the potential to reduce land conversion rates by up to 25% by 2030. They were created based on existing conditions in Banyuwangi Regency and can be adjusted to comply with existing policies. The implementation of these scenarios is expected to promote sustainable development in Banyuwangi Regency.

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Author Contributions

Conceptualization, R.P., I.Y., L.H methodology, R.P., I.Y.; software, I.Y.; validation, F.K.G., N.O.R., F.M.A.; formal analysis, I.Y.; investigation, R.P.; resources, L.H.; data curation, F.K.G., N.O.R., F.M.A.; writing—original draft preparation, R.P.; writing—review and editing, L.H.; visualization, I.Y.; supervision, L.H.; project administration, F.K.G., N.O.R., F.M.A.; funding acquisition, R.P.

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Conflicts of Interest

The authors declare no conflict of interest.

References

Artika, I., & Chaerul, M. (2020). Model Sistem Dinamik untuk Evaluasi Skenario Pengelolaan Sampah di Kota Depok. *Jurnal Wilayah dan Lingkungan*, 8(3): 261 – 279.

Dewi, P., Darmawan, S., Didi, R., Eyma, D.B. (2019). Farmers Household Strategy in Land Conversion

Dynamics (Case Study of Penrang District, Wajo Regency, South Sulawesi). *International Journal of Scientific Research in Science and Technology*, 6, 3, 278 – 287. https://doi.org/10.32628/IJSRST196351

Griggs, D., M. Stafford-Smith, O. Gaffney, J. Rockström, M. C. Öhman, P. Shyamsundar, W. Steffen, G. Glaser, N. Kanie, and I. Noble. (2013). Policy: sustainable development goals for people and planet. *Nature*, 495,7441, 305-307. https://doi.org/10.1038/495305a

Hansen, J.W. (1996). Is agricultural sustainability a useful concept?. *Agricultural System*, 50, 117–143. https://doi.org/10.1016/0308-521X(95)00011-S

Harahap, N., Siregar, A.Z., Kansrini, Y., Jamil, A. (2018). Analysis of land Conversion and Function of Rice Production Increase Efforts in Padang Sidempuan City, North Sumatra. *Proceedings of the 3rd International Conference of Computer, Environment, Agriculture, Social Science, Health Science, Engineering and Technology* (ICEST 2018): 303-311. https://doi.org/10.5220/0010042103030311

Harewan, Y., Wurarah, R.N., Santoso, B., Sabariah, V. (2023). Analysis of land conversion to economic growth: the case of other purpose areas. *IOP Conf. Series: Earth and Environmental Science*, 1192. https://doi.org/10.1088/1755-1315/1192/1/01205

Harini, R., Yunus, H.S., Kasto., Hartono, S. (2012). Agricultural Land Conversion: Determinants and Impact for Food Sufficiency in Sleman Regency. *Indonesia Journal of Geography*, 44, 2, 120 – 133. https://doi.org/10.22146/ijg.2394

Harini, R., Ariani, R.D., Supriyati., Satriagasa, M.C., Susilo, B., Giyarsih, S.R. (2018). The Effect of Land Conversion on Agriculture Production in North Kalimantan Province during 2012 – 2016 Period. 1st UPI International Geography Seminar. *IOP Conf. Series: Earth and Environmental Science*, 145. https://doi.org/10.1088/1755-1315/145/1/012093

Kumar, S. & Nigmatullin, A. (2011). A System Dynamics Analysis of Food Supply Chains – Case Study with Non-Perishable Products. *Simulation Modelling Practice and Theory*. 19, 10, 2151–2168. https://doi.org/10.1016/j.simpat.2011.06.006

Lestari, A., & Dharmawan, A.H. (2011). Dampak Sosio-Ekonomis dan Sosio-Ekologis Konversi Lahan, *Sodality: Jurnal Sosiologi Pedesaan*, 5, 1, 1 – 12. https://doi.org/10.22500/sodality.v5i1.5835

Muhammadi, Erman, A., Budhi, S. (2001). Analisis Sistem Dinamis, Lingkungan Hidup, Ekonomi, Manajemen. Jakarta: UMJ Press.

Nguyen, T.H.T., Tran, V.T., Bui, Q.T., Man, Q.H., Walter T.V. (2016). Socio-economic effects of agricultural land conversion for urban development: Case study of Hanoi, Vietnam. Land Use Policy, 54, 538 – 592. https://doi.org/10.1016/j.landusepol.2016.02.032

Nuchamidah, L., & Djauhari. (2017). Pengkonversian Lahan Pertanian Ke Non Pertanian Di Kabupaten Tegal. *Jurnal Akta*, 4, 4, 699-704. https://doi.org/10.30659/akta.4.4.699 - 706

Popli, K., Sudibya, G. L., & Kim, S. (2017). A review of solid waste management using sistem dynamics modeling. *Journal of Environmental Science International*, 26, 10, 1185–1200. https://doi.org/10.5322/JESI.2017.26.10.1185

Pretty, J. (2008). Agricultural sustainability: concepts, principles and evidence. *Philos Trans R Soc Lond B Biol Sci*, 363, 1491, 447–465. https://doi.org/10.1098/rstb.2007.2163

Widyawati, R.F. (2017). Analisis Keterkaitan Sektor Pertanian Dan Pengaruhnya Terhadap Perekonomian Indonesia (Analisis Input Ouput). *Jurnal Economia*, 13, 1. https://doi.org/10.21831/economia.v13i1.11923

Winoto, J., dan Siregar, H. (2008). Agricultural Development in Indonesia: Current Problems, Issues, and Policies. *Analisis Kebijakan Pertanian*, 6, 1, 11-36. https://doi.org/10.21082/akp.v6n1.2008.11-36