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Factors Affecting Sustainability of Agriculture Land Management in Sarangan Magetan Indonesia

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Abstract

The Satoyama Agriculture Development Tools (SADT) is a widely used set of measures used across the globe to assess the sustainability of agriculture land management. While the SADT only use three dimensions: environmental, economic, and social factors, a fourth dimension, namely, institutional factors, is considered important to understand the authority and ability to facilitate sustainable development in a comprehensive, harmonious, and balanced manner. This study adds an institutional dimension to the SADT framework to evaluate the sustainability of agriculture land management in Magetan Regency, Indonesia. Specifically, we compare the perceptions of farmers and government officials regarding current agriculture land management by conducting a questionnaire survey and semi-structured interviews. The results reveal that there are gaps between the perceptions of farmers and government officials, especially regarding the environmental and socio-economic dimensions of land management. Government officials tend to believe that the environment, including keystone species, is well protected while farmers disagree. The Satoyama Evaluation shows that Sarangan Village is viewed as "Satoyama Like" from the point of view of government officials but appears to be "In Transition" based on farmer perceptions. Adding an institutional factor provides fruitful information on the perception gap between farmers and government officials in terms of local government conflict management performance.

Keywords

sustainable agriculture land management, Satoyama assessment, Magetan, farmers, government officials, institutional dimension

1. Introduction

The Sustainable Development Goals (SDGs) are international targets set at UN Summit for creating a sustainable society, which cannot be achieved without a strong and sustainable agricultural sector. The performance of the agricultural sector directly affects whether the second goal of the SDGs, namely, "End hunger, achieve food security and improve nutrition and promote sustainable agriculture," can be achieved. The agricultural system is also linked to other development challenges addressed in the SDGs. Nine of them are directly or indirectly related to farming, conferring a special multi-dimensional status to agriculture. The corresponding dimensions include poverty alleviation (first SGD goal), education (fourth), gender equality (fifth), water use (sixth), energy use (seventh), economic growth and employment (eighth), sustainable consumption and production (twelfth), climate change (thirteenth), and ecosystem management (fifteenth) (Michalopoulos, 2016).

In addition to maintaining food and livelihood security, in recent years natural resource conservation and environmental protection have emerged as major challenges worldwide. It has been globally accepted that sustainable development is the best way to promote rational utilization of resources and environmental protection without hampering economic growth, while sustainable agricultural practice is expected to provide a way to overcome both economic and environmental issues (Sabarinathan, 2016). As land degradation resulting from agriculture has become a major problem, many conventional farmers are resorting to farming systems that are more environmentally or ecologically friendly and which contribute to the long-term sustainability of the agricultural practice (Suzuki, 2016). In promoting coexistence between people and nature, the chemicals used in farming should be replaced and the agro-ecosystem should be redesigned to maximize the ecological, economic, and social synergies and minimize the conflict between conservation and development (Komatsuzaki, 2011).

As economic development progresses, production capacity and living standards improve, leading to a higher demand for land that could threaten agriculture land management (Zeng, 2012). Growing economic activities, such as tourism and industry, demand land and clearly affect its management. Many developing countries in the tropics have relied on tourism to generate economic wealth and job opportunities and diversify their economies (Gössling, 2001; Rico-Amoros et al., 2009).

Numerous assessments of agriculture land management for sustainability have been performed in recent years. Hurni (2000) proposes to undertake the assessment of agricultural land management using the Sustainable Development Appraisal (SDA) method. This is a methodological tool for the participatory assessment of sustainability from local to regional planning levels. SDA is comparatively low-cost and has the potential to achieve participatory land management solutions, because it includes multi-level stakeholders in the negotiation process and looks at the sustainability of the different uses of resources in large-scale units.

Dublin (2015) develops a sustainability assessment method for agriculture land management using the Satoyama concept called the Satoyama Agriculture Development Tools (SADT). Satoyama is a Japanese term for landscapes that comprise a mosaic of different ecosystems which include forests,

agricultural lands, grassland irrigation ponds, and human settlements aimed at promoting viable human-nature interaction (Duraiappah & Nakamura, 2012). This concept became well known globally after the International Partnership for Satoyama Initiative (IPSI) was launched in 2010 to revitalize the concept of Satoyama in Japan and promote it internationally. The Noto Satoyama in the Ishikawa Prefecture and the Minabe-Tanabe Ume System in Wakayama Prefecture were recognized as a Globally Important Agricultural Heritage System (GIAHS) by the Food and Agriculture Organization of the United Nations (2002).

Previous studies on agriculture land management have highlighted the importance of sustainability in the agriculture sector. Studies on the implementation of sustainable agriculture concepts are conducted mostly use the Triangular Framework of Sustainability (TFS), which measures Sustainable Agriculture Land Management (SALM) through three dimensions: economic, environmental, and social (Serageldin, 1996; Serageldin & Steer, 2000). However, the TFS model has been criticized for not providing a logical explanation of how these three dimensions of sustainability can grow together in a balanced way. Valentin and Spangenberg (2000) argue that achieving a balance between economic, environmental and social dimensions is hardly possible without an institutional dimension that manages, mediates, and facilitates growth. The interrelationships between these four dimensions of sustainability, namely, economic, environmental, social and institutional, are collectively known as the Pyramid of Sustainability (PoS) model (Valentin & Spangenberg, 2000). Shen et al. (2009) also explain that, by utilizing the Prism of Sustainability theory, the institutional dimension plays a significant role to ensure the harmonious and equal growth of the other three dimensions. Furthermore, they argue that although indicators for institutional sustainability have been introduced as far back as 1995, these have not been widely used and tend to be neglected in studies on sustainable development (Shen et al., 2009).

In Indonesia, the government is still struggling to assess the sustainability of agriculture land management. Although Regulation of The Minister of State Number 56 for the Year 2014 was issued to regulate the role of the community in spatial planning, the government should nevertheless get more involved in the regulation of agricultural land management, especially in developing policies to ensure sustainable food agricultural land protection. However, it seems that the government is concerned that by letting local communities manage their land, the sustainability of agricultural land could be threatened (Kusniati, 2013).

Considered the approaches mentioned above, the most suitable methodology to assess the sustainability of agriculture land management in Indonesia is the Satoyama Concept via the Satoyama Agriculture Development Tools (SADT). In the study site of this research, namely, Sarangan Village, Magetan Regency, Indonesia, the farming practice is managed by means of the Integrated Farming System (Agriculture Office, 2016), applying a cyclic use of natural resources and collaborative management in order to sustainably maintain the ecological landscape. In Sarangan Village, the way land is managed as well as the landscape itself resembles those of Satoyamas in Japan. Therefore, in order to evaluate sustainability of Sarangan Village in terms of agriculture land management, the Satoyama Concept and

Satoyama Agriculture Development Tools (SADT) should be used. To overcome the kind of criticism generally aimed toward the Triangular Framework of Sustainability (TFS), which only measures sustainability from the economic, environmental, and social dimensions, we add the institutional dimension to conduct Sustainable Agriculture Land Management (SALM) assessment in Indonesia.

To carry out sustainable agriculture land management, the participation of farmers, governments, and other stakeholders is important, therefore, to target these stakeholders in the survey to be conducted. Perceptions of farmers and government officials were measured from four dimensions: environmental, social, economic, and institutional. This study answers two questions:

1) What are the perceptions of farmers and government officials regarding agriculture land management in terms of the factors in the Satoyama Agricultural Development Tools (SADT) framework plus the institutional dimension? In other words, is there gap between the perceptions of farmers and government officials in terms of current agriculture land management?

2) Which factors of the Satoyama Concept, specifically, environmental, social, economic, and institutional factors could be improved for sustainable management?

By understanding the perception gap among stakeholders, the government could implement outreach programs to increase the awareness, skills, and knowledge of local residents (especially farmers) with regard to sustainable land management. In addition, this study offers a new perspective by adding the institutional dimension to enable academics and practitioners to assess sustainability of agriculture land management more effectively. We provide suggestions regarding policies that reflect farmer demands/options and development priorities for sustainable agriculture land management.

2. Theoretical Background

2.1 Overview of Sustainable Development and Sustainable Agriculture Land Management

The idea of sustainable development emerged in the 1990s by the time development thought had reached an impasse (Dublin, 2015). Problems related to environmental protection and economic development were traditionally addressed independently, although it is now acknowledged that these crises are linked and have to be tackled in an integrated way in spite of the inevitably political challenge to do so (Adams, 2009).

"Our Common Future", also known as "The Brundtland Report", describes sustainable development as development that meets the needs of the present generation without compromising the needs of future generations (World Commission on Environment and Development [WCED], 1987; Dublin, 2015). The emergence of this definition of sustainable development is linked issues pertaining to economic improvement and long-term utilization of limited natural resources (Keiner, 2003; Emas, 2015). However, it was realized that social aspects such as equity, social justice, poverty alleviation, and community empowerment should also be at the core of sustainable development (Shen et al., 2009). Therefore, poverty alleviation, prosperity improvement, and community welfare have become the focus of attention in the new sustainable development agenda for 2030 (UNDP, 2016). Truly sustainable

development requires a holistic integration of environmental, economic, and social aspects through a decision-making process across sectors, administrative, and generational boundaries in the development policy (Emas, 2015).

Sustainable agriculture implies long term maintenance of natural systems, optimal production with minimum input, adequate income per farming unit, fulfillment of basic food needs, and provision for the demands and necessities of rural families and communities (Lynam & Herdt, 1989). Definitions of sustainable agriculture promote environmental, economic and social harmony in an effort to fully embrace sustainability (Zinck et al., 2002). Furthermore, sustainable agriculture land management can be defined as "a system of technologies and/or planning that aims to integrate ecological with socio-economic and political principles in the management of land for agricultural and other purposes to achieve intra- and intergenerational equity" (Hurni et al., 1996).

In most developing countries, agriculture remains as one of the main engines of economic growth. The process of harmonizing agriculture and food production in line with the often-conflicting interests of economics and the environment is integrated in the process of sustainable agricultural management. Assessments should consider the intricate, interdependent economic, social and environmental issues involved, as the practice of sustainability can be expected to change by location and over time, so solutions should be location- and time-specific (Maglinao, 1997).

2.2 Sustainability Concept: The Prism of Sustainability

Definitions and explanations related to sustainability in development as well as agriculture imply the need for the existence of an institution with the authority and ability to manage the environmental, social, and economic aspects of development in a comprehensive, harmonious, and balanced manner. In the absence of an institution capable of managing, mediating, and facilitating equal and balanced growth between environmental, social, and economic aspects, the conditions of sustainability in development are confined to the realm of theory (Valentin & Spangenberg, 2000; Spangenberg, 2002).

The model that is most frequently applied to account for the concept of sustainability is the Triangular Framework for Sustainability (TFS), which explains the concept of sustainability through environmental, economic, and social dimensions (Serageldin, 1996; Serageldin & Steer, 2000).

In the Prism of Sustainability (PoS) model depicted in Figure 1, the Economic Imperative is a condition in which human welfare is materially fulfilled on a macroeconomic scale through the availability of stable and competitive employment. The Environmental Imperative is defined as the reduction of pressure on the physical environment through a system that limits the use of natural resources to produce sustainable prosperity, and comprises all natural capital, which may in turn be classified as either non-renewable or renewable. The Social Imperative takes into account all the necessary resources and facilities that must be accessible to all individuals to ensure welfare, involvement in the decision-making processes and the organization of society. The Institutional Imperative concerns involvement of the institution in sustainability management (Valentin & Spangenberg, 2000).

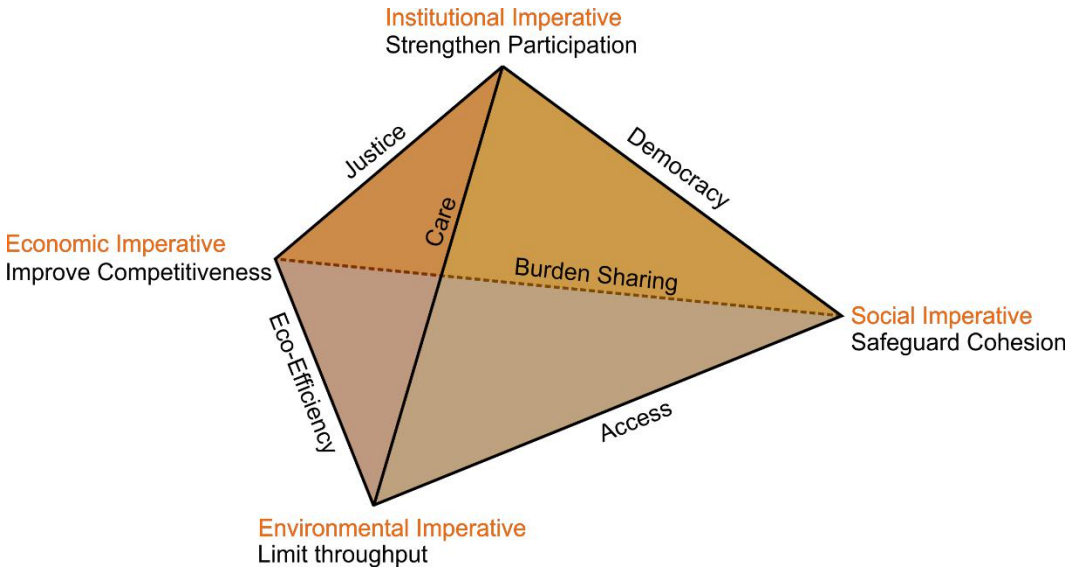

Figure 1. Prism of Sustainability

Source: Adapted from Valentin & Spangenberg (2000).

Furthermore, the study by Shen et al. (2009) about agritourism sustainability in the rural mountainous regions in China using the Prism of Sustainability shows that the institutional indicator has the highest scores of sustainability, followed by the social, economic, and environmental indicators. So, even if the institutional dimension is rarely mentioned in previous studies conducted in developing countries, this study shows that the most important factor to judge the overall agritourism sustainability is the institutional dimension (Shen et al., 2009). Cottrel and Eddins (2015) also added an institutional component based on the Prism of Sustainability to assess sustainable livelihoods in the context of volunteer tourism projects, revealing positive and negative effects of volunteer tourism in developing countries.

2.3 Sustainable Agriculture Perception Gap among Stakeholders

Van Den Ban and Hawkins (1988) define perception as the process by which information or stimuli are taken in from the environment and transformed into psychological awareness. They also indicate that people interpret their experiences differently when they receive similar impressions through their eyes and ears, and to a lesser extent through their senses of touch, taste and smell. The study by Sebeho (2016) on farmer perception and agricultural extension officials in South Africa and reveals that farmers are not just the recipients of the information and technology, but are also the ones who have the extensive knowledge about their farms in order to adapt the appropriate technologies. Therefore, the linkages between the extension officials, researchers, and farmers need to be strengthened to sustainably manage land based on modern technology and the traditional local situation. Findings suggest that it is imperative for governments to establish a national policy for the effective and efficient delivery of extension and advisory services to ensure the motivation of the officials involved. In addition, for the promotion of sustainable agriculture, a bottom-up approach is needed to identify

suitable agricultural projects (Sebeho, 2016).

Perceptions of sustainable agriculture practices may be seen from different points of view. Dunlap et al. (1992) study farmer and agricultural professional perceptions regarding sustainable agriculture from three dimensions (i.e., ecological, socioeconomic, and ethical sustainability). Their result shows that farmers are significantly more likely than agricultural professionals to see social and economic goals as important to improve the health and well-being of rural residents, revitalize rural areas, decrease the complexity of food systems, and increasing the number of farms. In contrast, agricultural professionals appear to believe that ecological factors (environment and wildlife habitat, increasing agricultural diversity, reducing agrichemical use, and reducing energy use) are necessary in sustainable agriculture. The survey indicates that farmers would rather seek economic and social sustainability than ecological sustainability (Dunlap et al., 1992). To the best of our knowledge, there has been no research on the understanding of farmer and government official perceptions in terms of sustainable agricultural land management using all four environmental, social, economic, and institutional dimensions.

2.4 Concept of SADT

In general, Satoyama representing landscapes that comprise a mosaic of different ecosystems is aimed at promoting a viable human-nature interaction and is a system where nature and people may co-exist with a material (nutrient) cycle where the natural capital is preserved. Osaki (2014) describes the Satoyama System as a sustainable land management system in East, Southeast, and South Asia, which maintained the independent long-term coexistence system of society (sato, in Japanese) and nature (yama, in Japanese).

Since the International Partnership for the Satoyama Initiative (IPSI) was established during the 10th Conference of the Parties to the Convention on Biological Diversity (CBD COP10) in Nagoya, Japan in 2010, the term “Socio-Ecological Production Landscapes and Seascapes (SEPLS)” has been widely recognized and used worldwide. Dublin (2015) developed a sustainability assessment tool for agriculture land management using the Satoyama concept. Known as Satoyama Agricultural Development Tool (SADT), this methodology includes five perspectives identified by the International Partnership for the Satoyama Initiative (IPSI): (1) resource use within the carrying capacity and resilience of the environment; (2) cyclic use of natural resources; (3) recognition of the value and importance of local traditions and cultures; (4) multi-stakeholder participation and collaboration; and (5) contribution to socio-economies (Dublin, 2015).

Satoyamas have been recognized by IPSI and GIAHS (Globally Important Agricultural Heritage System) as a successful and sustainable agriculture system with global value. Dublin (2015) developed the SADT to measure the success of a sustainable agricultural system by helping replicate the similar type of Satoyama systems in other parts of the world. To estimate the criteria involved in the SADT, Dublin (2015) used a series of indicators called Harmonized Questions, which was created and advocated by the UK Office of National Statistics (ONS). Dublin (2015) found that the SADT could provide appropriate indicators to show that development based on the Satoyama Concept is possible in some indigenous

communities of Guyana. However, in addition to Dublin (2015), there are only a few studies that have applied and tested the SADT and, moreover, no study has added the institutional dimension to measure the involvement of the institution in sustainability management.

3. Study Site and Method

Indonesia's population is more than 225 million people with an area of about 1.9 million square kilometers comprising approximately 17,000 islands. Sarangan Village, Magetan Regency, with total area of 23.44 km^2 and located in the southern part of Indonesia, was chosen as the study site to assess agriculture land management. Based on information from the Statistics Bureau of Magetan Regency (2018), the population in this village is 3,590 inhabitants (1,746 male and 1,844 female) while the total number of farmers is 432 people. Sarangan Village has a population density of 153 people/km^2 and is located in in the water catchment of Plaosan Sub-District. It is important to ensure that agricultural activities do not deteriorate the village environment. Moreover, Sarangan has become an important tourism destination in Magetan, thus leading to some land conversion to support tourism activities. The agriculture sector holds a special position in this region and contributes about 32% to the total of Gross Regional Domestic Product (GRDP), making it the highest contributor in the Magetan Regency. Sustainable agriculture land management is needed at the village level to ensure that the community can generate a sustainable income from agriculture. This area lies at an elevation of approximately 1,200 m above sea level and the location of Sarangan is at the base of Mount Lawu, with sloping land that is vulnerable to erosion and landslide. As mentioned earlier, Satoyama is a mosaic landscape of various ecosystems and several landscapes can be found in this village. Furthermore, Sarangan Village employs a farming practice called Integrated Farming System, which follows a pattern similar to the land use in the Satoyama, namely, cyclic use of natural resources, collaborative and sustainable management of natural resources, and so on.

This research was conducted using a deductive approach to describe the application of the Satoyama Concept using the Satoyama Agriculture Development Tools (SADT) to assess SALM in the context of land systems in Indonesia. Interviews and surveys were conducted to understand the perceptions of farmers and government officials using the Prism of Sustainability Theory (Valentin & Spangenberg, 2000). This theory states that the development sustainability should not only assessed from the environmental, social and economic aspects, but should also consider institutional aspects such as the presence of managers, mediators, and facilitators. The detailed questionnaire items are listed in Table 1.

Table 1. Questionnaire Items Used for Assessing Sustainability of Agriculture Land Management [5=Strongly agree, 4=Agree, 3=Neither agree nor disagree, 2=Disagree, 1=Strongly disagree] Questionnaire items 1-28 [Environmental, Social, and Economic Factors] were developed following Dublin (2015) while items 29-32 [Institutional Factor] were developed following Valentin & Spangenberg (2000)

	Environmental Factor: Cyclic Use of Natural Resources
1	Is there diversity in land use (grassland, forest, cropland, irrigation ponds, human settlements, etc.)?
2	Is there an absence of soil erosion?
3	Has the number of keystone species been maintained?
4	Are other types of farming practiced instead of mono-cropping?
5	Is the use of pesticides avoided or minimized?
6	Are bio-pesticides and biological pest controls being used?
	Environmental Factor: Resources Used based on Carrying Capacity and Resilience of Environment
7	Is the land size of the village to be legally demarcated?
8	Is there adequate water supply for the residents?
9	Is there adequate forest conservation and protection?
10	Is pollution at the village at a low level?
11	Is there adequate waste management in the village?
12	Is there an adequate disaster preparedness plan in the village?
	Social Factor: Recognition of the Importance and Value of Local Cultures and Traditions
13	Are there cultural landscapes and/or archeological sites that are recognized in the village?
14	Are there unique art, craft and/or objects that are recognized in the village?
15	Are there gastronomic practices that are typical and/or unique in the village?
16	Are there rituals/ceremonies that are typical and/or unique in the village?
17	Are there local skills and knowledge that are typical and/or unique to the village?
18	Are eco-tourism, agro-tourism and/or homestays promoted in the village?
	Social Factor: Collaborative Management of Natural Resources
19	Is the organizational structure of the community well defined with clear roles for all players?
20	Is there diversity and inclusiveness in the decision-making process?
21	Is there transparency in the decision-making process?
22	In the event of conflict, is there a good negotiation and mediation mechanism?
23	Is there good communication and dialogue among citizens?
	Economic Factor: Contribution to Local Socio-Economies
24	Is the infant mortality in low rate (less than 5 per 1000 births?)
25	Is the life expectancy at birth more than 80 years?

26	Is the literacy rate in Sarangan Village between 95 and 100%?
27	Is the crime rate less than 10 per 1000 persons in Sarangan Village?
28	Are most members of the community employed within Sarangan Village?
	Institutional Factor: Institutional Involvement
29	Are local governments involved in environmental protection and management?
30	Do local governments act as mediators in conflicts over agricultural land?
31	Do local governments provide assistance for the development of the agricultural sector?
32	Is there evidence-based long-term planning by the government in regard to the sustainability of agriculture?

4. Analysis

This study used both primary and secondary data obtained from questionnaires, field observations, semi-structured interviews, document reviews, and other related data from various sources. Firstly, questionnaires were distributed and answered by randomly sampled farmers (80 people) in Sarangan village and also purposive samples of government officials (20 people). In our survey, we defined farmers as those who grow crops and keep livestock. Most of the 80 farmers sampled grew vegetables and raised cows. As for government officials of Regional Government of Magetan Regency, seven people were from the Food Crops, Horticulture, Plantation and Food Security Office, three from the Culture and Tourism Office, three from the Environmental Agency, three from the Agricultural Extension Officers, two from Village Officers, one person from the Regional Development Planning Agency, and another person from the Forest Management Unit. The farmer survey took place at their homes, while government officials were surveyed at their offices. In addition, we conducted semi-structured interviews with the same government officials to obtain supporting materials and interpret the findings of the survey. For the questionnaire, we developed total of 32 items divided into four groups: environmental, social, economic, and institution factors (Table 1). Environmental, social, and economic factors comprising 28 items that were created following Dublin (2015), while institutional factors comprising 4 items were created following the study by Shen et al. (2009) on PoS (Prism of Sustainability). In this study, we define the social factor as a bottom-up process involving local residents and farmers. Therefore, items for the social factor are about decision making by local residents. On the other hand, the institutional factor in our study refers specifically to local government involvement.

Secondary data included information by the local government and the Statistics Bureau of Magetan Regency, such as land size, land cover, and population data. This data was obtained online and through document review.

The data obtained from the survey was analyzed quantitatively to understand the agricultural land management sustainability level in Sarangan village based on SADT. First, the mean of the perception scores for farmers and government officials were statistically compared through paired t-test analyses.

We set the significance level as the p-value of 0.05. The software package SPSS was used to conduct statistical analysis. For the Satoyama Points (SP) indicating sustainability of land management, we use the following equation:

$$SP=([SP_{01}/SP_{P1}]+[SP_{02}/SP_{P2}]+[SP_{03}/SP_{P3}]+[SP_{04}/SP_{P4}]+[SP_{05}/SP_{P5}]+[SP_{06}/SP_{P6}])/nP$$

where: SP_{01} … SP_{06}: Satoyama points obtained for Questions 1…6

SP_{P1} … SP_{P6}: Satoyama points possible for Questions 1…6

nP: the number of Questions

The calculated score for individual factors are evaluated as high (80-100%), medium (60-79%), and low (0-59%). The six factors (two Environmental, two Social, one Economic, and one Institutional) were considered of equal weight and, therefore, the average of the percentages obtained for them were then calculated to obtain the Total Satoyama Points (TSP). The results were determined to be SL=Satoyama Like if the score was 80.00-100.00, IT=In Transition if the score was 60.00-79.99, and NC=Non Compliant if the score was 0-59.99.

5. Results

5.1 Perceptions of Farmers and Government Officials of SADT

Among the six items for Cyclic Use of Natural Resources (Environmental Factor), four items showed significant differences in mean scores between farmers and government officials (Table 2). Government officials are more likely to agree than farmers with the statement that the number of keystone species are maintained ($p<0.01$) and bio-pesticides and biological pest controls are being use in this village ($p<0.01$). On the other hand, farmers are more likely to agree than government officials with the statement that the area is not affected by soil erosion ($p<0.01$) and multiple cropping is practiced in the farms ($p<0.05$).

Meanwhile, among the six items for Resources Used based on Carrying Capacity and Resilience of the Environment, three items showed significant differences in mean scores between farmers and government officials. Government officials are more likely to agree than farmers with the statement that water supply is adequate in this village ($p<0.01$) and waste management is well maintained ($p<0.05$). Farmers are more likely to agree than government officials with the statement that pollutants at the village are at a low level ($p<0.01$).

Table 2. Scores of Perceptions of Farmers and Government Officials Related to the Environmental Factor

Variables		Questions	Mean (Std dev)		t-value	Significance
			Farmers	Gov. Officials	of t-test	(2-tailed)
Resources Used based on Carrying Capacity and Resilience of Environment	Q1.	Is there diversity in land use?	4.62 (0.56)	4.75 (0.43)	-0.927	0.356
	Q2.	Is there an absence of soil erosion?	4.41 (0.61)	3.35 (0.96)	4.595	<0.001**
Cyclic Use of Natural Resources	Q3.	Has the number of keystone species been maintained?	3.39 (1.27)	4.40 (0.97)	-3.830	0.001**
	Q4.	Are there other types of farming practiced instead of mono-cropping?	4.94 (0.24)	4.75 (0.43)	1.820	0.012*
	Q5.	Is pesticide use avoided or minimized?	3.14 (0.97)	2.65 (1.15)	1.704	0.059
	Q6.	Are biopesticides and biological pest controls being used?	2.41 (0.68)	3.55 (0.97)	-4.816	<0.001**
	Q7.	Is the land size of the village to be legally demarcated?	4.77 (0.50)	4.65 (0.47)	1.000	0.320
	Q8.	Is there adequate water supply for the residents?	4.06 (0.43)	4.60 (0.49)	-4,395	<0.001**
	Q9.	Is there adequate forest conservation and protection?	3.71 (0.94)	3.75 (1.13)	-0.151	0.880
	Q10.	Is pollution at the village low?	4.72 (0.52)	3.50 (0.97)	5.297	<0.001**
	Q11.	Is there adequate waste management in the village?	3.04 (0.84)	3.60 (0.97)	-2.326	0.012*
	Q12.	Is there an adequate disaster preparedness plan in the village?	4.02 (0.76)	4.15 (0.48)	-0.697	0.488

Note. * Statistically significant at 5% (<0.05); ** Statistically significant at 1% (<0.01).

Among the six items for Recognition of the Importance and Value of Local Cultures and Traditions (Social Factor), five items showed significant differences in mean scores between farmers and government officials (Table 3). Government officials are more likely to agree than farmers with the statement that there is a unique cultural and archeological landscape ($p<0.01$), typical cuisine ($p<0.01$), local skill and knowledge ($p<0.01$), and agro-tourism is promoted ($p<0.01$). On the other hand, farmers are more likely to agree than government officials with the statement that that unique arts and crafts are recognized in the village ($p<0.01$).

There were no significant differences between the perceptions of farmers and government officials in terms of the Collaborative Management of Natural Resources.

Table 3. Scores of Perceptions of Farmers and Government Officials Related to the Social Factor

Variables		Questions	Mean (Std dev)		t-value	Significance
			Farmers	Gov. Officials	of t-test	(2-tailed)
Recognition of the Importance and Value of Local Cultures and Traditions	Q13.	Are there cultural landscapes and/or archeological sites that are recognized in the village?	3.45 (1.06)	4.35 (0.79)	-4.141	0.001**
	Q14.	Are there unique art, craft and/or objects that are recognized in the village?	4.62 (0.62)	4.05 (1.02)	2.347	0.002**
	Q15.	Are there gastronomic practices that are typical and/or unique in the village?	3.12 (0.58)	3.85 (0.91)	-3.317	<0.001**
	Q16.	Are there rituals/ceremonies that are typical and/or unique in the village?	4.81 (0.53)	4.70 (0.56)	0.836	0.405
	Q17.	Are there local skills and knowledge that are typical and/or unique to the village?	2.86 (0.61	3.75 (1.13)	-3.298	<0.001**
	Q18.	Are eco-tourism, agro-tourism and/or homestays promoted in the village?	3.11 (0.92)	4.25 (1.04)	-4.362	<0.001**

Collaborative Management of Natural Resources	Q19.	Is the organizational structure of the community well defined with clear roles for all players?	4.75 (0.54)	4.50 (0.50)	1.871	0.064
	Q20.	Is there diversity and inclusiveness in the decision-making process?	4.52 (0.76)	4.15 (0.91)	1.878	0.063
	Q21.	Is there transparency in the decision-making process?	4.29 (0.78)	4.30 (0.64)	-0.066	0.948
	Q22.	In the event of conflict is there a good negotiation and mediation mechanism?	4.32 (0.68)	4.40 (0.49)	-0.456	0.649
	Q23.	Is there good communication and dialogue among citizens?	4.69 (0.58)	4.45 (0.59)	1.610	0.111

Note. * Statistically significant at 5% (<0.05); ** Statistically significant at 1% (<0.01).

Among the five items related to Socio-Economic Contributions (Economic Factor), four items showed significant differences in mean scores between farmers and government officials (Table 4). Government officials more likely to agree than farmers with the statements that the village has a low mortality rate ($p<0.05$), high life expectancy ($p<0.01$), high literacy rate ($p<0.05$), and low crime rate ($p<0.01$).

Table 4. Scores of Perceptions of Farmers and Government Officials Related to the Economic Factor

Variables		Questions	Mean (Std dev)		t-value	Significance
			Farmers	Gov. Officials	of t-test	(2-tailed)
Contribution to Socio-Economies	Q24.	Is the infant mortality rate low (less than 5 per 1000 births)?	4.04 (0.73)	4.45 (0.59)	-2.605	0.023*
	Q25.	Is the life expectancy at birth more than 80 years?	3.46 (0.96)	4.30 (0.64)	-4.592	<0.001**
	Q26.	Is the literacy rate in the community between 95 and 100%	3.64 (0.64)	4.05 (0.67)	-2.435	0.013*
	Q27.	Is the crime rate less than 10 per 1000 persons in the community?	3.66 (0.77)	4.35 (0.65)	-3.964	<0.001**
	Q28.	Are most members of the community employed within the village?	4.64 (0.51)	4.40 (0.58)	1.800	0.075

Note. * Statistically significant at 5% (<0.05); ** Statistically significant at 1% (<0.01).

Among the four items related to Institutional involvement (Institutional Factor), two items showed significant differences in mean scores between farmers and government officials (Table 5). Government officials are more likely to agree than farmers with the statement that local governments are involved in environmental protection ($p<0.01$) and act as mediators in conflicts over agricultural land ($p<0.05$).

Table 5. Scores of Perceptions of Farmers and Government Officials Related to the Institutional Factor

Variables		Questions	Mean		t-value	Significance
			Farmers	Gov. Officials	of t-test	(2-tailed)
Involvement of Institution	Q29.	Are local governments involved in environmental protection and management?	3.59 (1.00)	4.65 (0.48)	-6.783	<0.001**
	Q30.	Do local governments act as mediators in conflicts over agricultural land?	3.85 (0.91)	4.40 (0.58)	3.265	0.012*

Q31.	Do the local governments provide assistance for the development of the agricultural sector?	4.37 (0.98)	4.70 (0.46)	-1.430	0.156
Q32.	Is there evidence long-term planning by the government in the sustainability of agriculture?	4.30 (1.04)	4.55 (0.59)	-1.022	0.309

Note. * Statistically significant at 5% (<0.05); ** Statistically significant at 1% (<0.01).

5.2 Satoyama Points Calculated Based on the Perceptions of Farmers and Government Officials

The results of the Satoyama Evaluation based on Satoyama Points demonstrate that Sarangan Village is Satoyama-Like from the perspective of government officials but appears to be In Transition from the perspective of farmers (Table 6). For the farmers, there were 3 variables with less than 80% in Satoyama Points, including "Cyclic Use of Natural Resources (Environmental Factor)" (76.38%), "Recognition of the Importance and Value of Local Cultures and Traditions (Social Factor)" (73.29%), and "Contribution to Local Socio-Economies (Economic Factor)" (77.75%). On the other hand, from the perspective of government officials, only "Cyclic Use of Natural Resources (Environmental Factor)" obtained less than 80% (78.17%) in Satoyama Points.

Table 6. Results of the Satoyama Evaluation of Sarangan Village Based on Satoyama Points

	Cyclic Use of Natural Resources		Resources Use based on Carrying Capacity and Resilience of Environment		Recognition of the Importance and Value of Local Cultures and Traditions		Collaborative Management of Natural Resources		Contribution to Local Socio-Economies		Involvement of Institutions in Agriculture Land Management		Final Evaluation	
	SP(%)	**R**	**SP(%)**	**R**	**SP(%)**	**R**	**SP(%)**	**R**	**SP(%)**	**R**	**SP(%)**	**R**	**TSP**	**R**
Farmers	76.38	M	81.13	H	73.29	M	90.30	H	77.75	M	80.56	H	79.90	IT
Government	78.17	M	80.83	H	83.17	H	87.20	H	86.20	H	91.50	H	84.51	SL

Key: SP(%)—Satoyama Points in percentage, R—Rating [H—High, M—Medium, L—Low], TSP—Total Satoyama Points, [SL—Satoyama Like, IT—In Transition, NC—Non Compliant].

Note. Satoyama Points of this table are based on perception scores of farmers and government officials.

6. Discussion

6.1 Perceptions of Farmers and Government Officials Regarding Sustainable Agriculture Land Management

The SADT and PoS were used as the underlying analytical framework for this study of sustainable agriculture land management (Dublin, 2015; Valentin & Spangenberg, 2000). Four sets of questions were developed to measure farmers and government officials' perceptions of aspects of sustainability: environmental, social, economic, and institutional.

6.1.1 Environmental Factor

There were significant differences for several items between farmers and government officials in environmental factors. In the village studied, government officials were more likely to agree with the statement that the number of keystone species has been maintained. However, interviews conducted with farmers revealed that conservation of keystone species is not important because some of those species occasionally damage their crops. Other significant differences in perceptions between farmers and government officials were about soil erosion. Farmers are more likely to agree with the statement that there is no soil erosion in the village than government officials. Based on laboratory data from the Environmental Agency (2018), the amount of erosion (soil loss) that occurs in this village ranges from 9.86-50.93 tons/ha/year, implying that erosion in the region is at a critical threshold. Meanwhile, bio-pesticides and biological pest controls are not well-used, and farmers still widely use pesticides. This condition can threaten the existence of natural enemies of pests and influence the quality of crop production. Furthermore, farmers thought pollution levels were low while government officials did not think this way.

In general, the land size in Sarangan Village is legally demarcated with adequate water supply for residents. In fact, Sarangan Village has a lake called Telaga Sarangan (Sarangan Lake), and besides being used as a water supply and irrigation, the lake is also used as a tourist destination. However, the survey revealed that farmers felt there was not much water supply and there is a gap with respect to government officials. This may indicate that although there is enough water for the whole region, water is not allocated effectively by farmer unit. Meanwhile, the scores for the waste management system for both farmers and government officials were low. The village does not have an adequate waste management system. Local residents including farmers generally dispose of their waste in inappropriate ways, and they do not separate waste according to type. From the context of the PoS, the environmental imperative is accounted for with the need to reduce pressure on the physical environment within ecological system limits. From this perspective, some items should be improved for sustainable agriculture land management.

6.1.2 Social Factor

Sarangan Village is considered a potential tourist attraction that could be incorporated into agro-tourism and eco-tourism initiatives in the region. According to interviews with farmers and government officials, the government has begun to build agro-tourism infrastructure in the village in

collaboration with local farmer groups. Homestays are considered as an extra source of income to supplement farmer primary income from agriculture. Some farmers started running homestays around Sarangan Lake, which could contribute to the economic sustainability of the local communities. Lastly, farmer perception about the recognition of the local skills and knowledge in the form of gastronomical practices is low. Based on interviews with the local government, however, there is a distinctive local cuisine in the area, including items such as rabbit satay and corn rice. However, farmers did not recognize their cuisine as distinctively local as they generally believe that their typical meals may also be found in other villages.

There were no significant differences in collaborative management of natural resources for individual items between the two groups, implying that both parties had similar perceptions in this broad area. Thus, it appears that natural resources have been collaboratively managed in the village and the roles of each party are clear. Several farmer groups have come together as a communication forum between farmers, meeting regularly to discuss common issues. In light of the PoS, social imperative calls for all individuals having access to the resources and facilities, allow transparency in the decision-making process and organization of society. These measures support decreasing social exclusion, which implies a non-discriminatory social fabric.

6.1.3 Economic Factor

Almost all items in economic factor show significant differences between farmers and government officials' perceptions. Generally, there is a midwife in the village who is in charge of improving maternal and child health and increasing the overall health status of the community. In addition, there are one doctor and one health nurse working in the village and collaborating with the midwife to handle community health. Based on the Statistics Bureau of the Magetan Regency (2018), life expectancy increased from 71.87 in 2013 to 72.16 years in 2017. Moreover, there are three elementary schools in the village where children receive quality education from early childhood. As a result, the infant mortality, life expectancy, and literacy rate has improved, while crime has decreased. Based on the PoS framework, the economic imperative was expressed as a means to satisfy human needs for material welfare and healthy living. In this sense, results infer that agriculture land management is sustainable in terms of the economic factor.

6.1.4 Institutional Factor

In this study site, the government is involved in the management of agricultural land in Sarangan Village. In general, local governments act as mediators in conflicts over agriculture land that occur in the village and are also involved in environmental protection and management. The government also provides assistance for the development of agriculture by conducting training and providing agricultural subsidies. Moreover, the government also develops long term plans in the form of spatial planning for the sustainability of agricultural land management in the village. Although total Satoyama Point scores were rated high from farmer perceptions, in terms of individual items, we find that farmers assigned significantly lower scores to government involvement in environmental protection and its

performance as mediator. According to PoS, institutional imperative concerns the involvement of the institution in sustainability management. From this perspective, conclusions indicate that agriculture land management is relatively sustainable within the institutional factor.

6.2 Factors That Could Be Improved for Sustainable Agriculture Land Management

According to the result of gap perception between farmers and government officials, each factor should be improved to achieve sustainable agriculture land management. First, for environmental factor, in order to maintain the number of keystone species in the future, the government should not only promote opportunities to educate and discuss with farmers the importance of conserving species but should develop procedures to teach farmers how to protect their crops from wildlife. Moreover, the government and researchers could promote biopesticides and biological pest control methods to farmers as a means to encourage more environmentally friendly agriculture. In addition, the government needs to conduct detailed on-site surveys to understand who lacks appropriate water supply and use this information to improve the irrigation system.

Second, for social factor, since recognition of the value of eco-tourism, agro-tourism and/or homestays is significantly lower for farmers than for government officials, the government should promote and support these tourism activities in the village in order to raise awareness about the potential of this activity. Third, for economic factor, the data indicate that farmers insights concerning the mortality rate, life expectancy, and literacy rate are far from accurate, implying that the government should increase its efforts at disseminating accurate socio-economic information and increase the effort to prevent the crime in the village. Lastly, for institutional factor, the government should increase its support of farmers in order to improve their performance so farmer perception reaches the same level as that of government officials for individual items.

By adding institutional factor, we are able to discover that the government still needs to make efforts to satisfy local residents and build trust relationships with them through strategies such as creating opportunities where farmers can freely discuss their concerns and the various stakeholders involved could collaborate toward sustainable agricultural management. Based on our findings, we suggest that future research regarding the evaluation of sustainable agriculture should include institutional factors.

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