

Community Adaptive Capacity of Changes in The Social-Ecological System of Sub Das Amprong In The Village of GubukKlakah, Malang

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Abstract - Rural areas are currently faced a spectrum of changes that vary from changes in ecosystem conditions to their socioeconomic impacts. Each rural condition has different resilience in accordance with the respective social ecological conditions. The purpose of this research are: (1) Describing the social ecological conditions of the Amprong Sub-watershed community in GubukKlakah Village; and (2) Identifying the adaptive capacity of the community for changing socio-ecological conditions. This research uses qualitative approach. Research informants were determined by snow ball sampling and data collection was done through in-depth interviews. Data analysis was performed using the interactive model of Miles and Huberman while the validity data was carried out by triangulation of sources and methods. The results showed that the social ecological conditions of the community including suitable climate, thick top soil which is more than 50 m, and agricultural products' quality. The vulnerability could be caused by both ecological and economic factors. Ecological factors included topographic contoured soil could cause erosion, decreasing in soil fertility, and drought. Thus, fluctuated commodity prices could also generate the vulnerability. The adaptive capacity of the community in responding to this vulnerability is demonstrated by organic fertilization, intercropping planting systems, and rejuvenation arrangements to regulate harvest time.

Keywords: Adaptive capacity, social-ecological system, and ecological social vulnerability.

I. INTRODUCTION

The Upper Brantas River Basin (DAS) plays important role in providing stable water resources for productive lands. If the upstream Brantas watershed condition is disturbed, it is possible that the surrounding agricultural land is threatened due to natural and socio-economic factors. Agricultural lands that are categorized as highlands with a diversity of topography and natural resource potentials as well as a diversity of socio-economic conditions of the people also dominate the upstream Brantas watershed.

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This watershed was included in critical watershed category, because it was related to environmental issues, namely (a) the phenomenon of land conversion from forest to agricultural land, (b) a decrease in the quantity and quality of water, and (c) a high rate of soil erosion resulting in degradation land, (d) high population density and (e) land productivity or low farmer income and community awareness of relatively low conservation efforts [1].

Due to pressure from internal and external factors, changes happen in the villages of the Brantas upstream watershed in the last few decades. Internal factors include the population that continues to increase and the rate of land use change is quite fast. While for the external factors include the monetary and economic crisis experienced in 1997/1998 until the year of 2004, globalization and government policies in the agriculture sector, road infrastructure development, housing, and so on. These various ecological vulnerabilities will have an impact on watershed functions sustainability resulting in ecological vulnerability.

To overcome the ecological, economic and social vulnerability inherent in any change as the effort to achieve sustainability in the future, it is important to understand the level of rural resilience (social-ecologies) in this region. The intended rural (socio-ecological) resilience is the capacity of rural areas to adapt to changes in both internal and external conditions such as living standards including satisfactory environmental conditions can be maintained. Socio-ecological systems emerge from close interactions in society, between socioeconomic systems and natural systems [2].

Governance in anticipating natural disasters threat that is still often ineffective in dealing with drought, landslides, floods and disease pests. The need for governance of social-ecological systems that can help overcome change and facilitate reorganization, innovation and crisis disruption [3].

Dependence on innovation programs that tend to burden farmers forever will not survive. Appropriate strategy is needed to prevent farmers from exploiting resources. Strategies are classified into reactive and anticipatory adaptations[4]. Reactive adaptation helps households to overcome the effects of drought, but does not reduce the vulnerability of drought households in the future.

Vulnerability often occurs because subjective thoughts emerge that are realized in reality. To overcome this, social representation has a role in creating shared reality in the content of their thoughts[5]. Knowledge about society is

about understanding the objective reality, and continuously producing reality. In order to solve various natural problems, symbolic phenomena can be captured in full reality.

Based on this background, this research aims: (1) Describing the social ecological conditions of the Amprong Sub-watershed community in GubugKlakah Village and (2) Identifying the adaptive capacity of the community for changing socio-ecological conditions.

II. METHOD

This study was located in the village of GubugKlakah, Poncokusumo District, Malang Regency. The site selection was determined purposively, because it was one part of the Upper Brantas watershed. The approach used in this study was qualitative. Research respondents were determined by using snowball sampling. Data collection was conducted by observation, in-depth interviews, and secondary data from BPS and village monographs. Data analysis was performed by using the interactive model of Miles and Huberman, and the validity of the data was carried out by triangulation of sources and methods.

III. RESULTS AND DISCUSSIONS

A. Description of Research Locations

The Brantas Hulu watershed included three streams, namely: Das Amprong Sub, Lesti Sub Watershed, and Metro Sub Watershed.

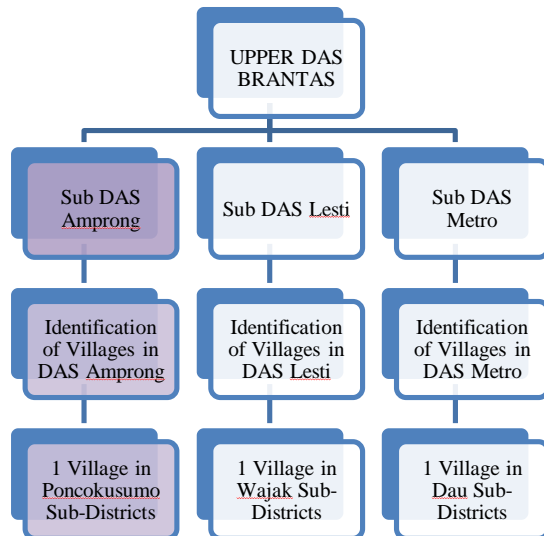


Figure 1. Upper DAS Brantas Classification

Based on Figure 1 above, the GubugKlakah Village was one of the villages in the Amprong Sub-watershed which was part of the Upper Brantas River Basin. Gubugklakah Village was one of the villages located in Poncokusumo District, Malang Regency, East Java Province. Based on secondary data from village profile data, GubugKlakah Village had an area of 384 hectares. GubugKlakah Village was at an altitude of 900-1000 meters above sea level with the average 20 - 22 ° C temperature and 1500 - 2000 mm rainfall (BPS Kabupaten Malang, 2017). The area of KlakahGubuk Village + 384 Ha, which was divided into: Tegal / 332 Ha fields, 12 Ha

settlements, 1 Ha offices, and others covering 39 Ha. The proportion of land use was shown in Figure 2 below.

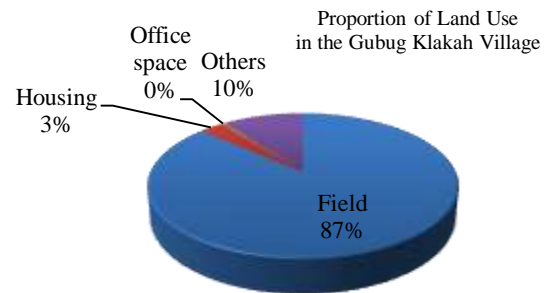


Figure 2. Proportion of Land Use in GubugKlakah Village
 Source: Statistics Indonesia, 2017

Based on these pictures it could be explained that the existing land used in the village of Gubugklakah was dominated by dry land. There was no use of paddy land due to sloping and hilly land conditions. These conditions made farmers did farming on dry land with apple crops and horticultural cultivation.

The total population of GubugKlakah Village was 6648 people, with a total of 1848 people for men, and 1797 for women. Based on BPS[6], the proportion of the population in the GubugKlakah Village was 49% female and 51% male. Based on this information, it could be assumed that the labor required for land management in agriculture, which were usually men, could be solved from within the village itself (the family's work needs). Counting the number of images based on table 1 below.

TABLE 1. PROPORTION OF POPULATION OF GUBUG KLAKAH BY TYPE OF WORK

No.	Type of Work	Amount
1	Farmer	1.352
2	Farm workers	960
3	Entrepreneur	285
4	PNS	8
5	TNI	3
6	Tailor	5
7	Driver	10
8	Carpenter	25
9	Bricklayer	30
10	Private Teacher	17
11	Pensionary	3
12	Others	1.001
	Total	3.699

Source: Statistics Indonesia, 2017

Based on Figure 3, the proportion of type of occupations in the GubugKlakah Village was dominated by farmers. This was based on natural conditions that were suitable for farming. GubugKlakah had a suitable climate for horticultural crops, so the majority of the population used land for agriculture. In addition, this also showed that

the farming sustainability would continue, so that policies were needed to support sustainable agriculture that synchronized ecological, social and economic aspects based on internal and external forces of the community.

The crops cultivated by farmers in the village of GubugKlakah were horticultural crops. Based on BPS[6], apples were a superior commodity planted by farmers in the village. However, the history of 2014 apple production had decreased. In 2014, apple production amounted to 545,268 tons, while in 2015, apple production amounted to 416,134. This could be caused by the decrease of farmers' interest in apple farming due to the expensive maintenance costs of apples.

In addition, based on in-depth interviews and field observations, many farmers were currently working on horticulture of vegetables such as potatoes, leeks, garlic, chilies, cabbage, and so forth. The choice of these various commodities adjusted the prices that they felt are beneficial.

B. Description of the social ecological conditions of the Amprong Sub-watershed community in GubugKlakah Village

The social ecological conditions of the GubugKlakah Community were characterized by:

1) Climate suitable.

The climate in the village of GubugKlakah was suitable for agricultural cultivation. The area had an altitude between 900-1000 meters above sea level, an average temperature of 20-22 ° C and rainfall 1500 - 2000 mm. The main commodity in this area was apple plant which could grow well at temperatures around 16-27OC.

2) A thick top soil layer (solum soil).

Agricultural land in the Tengger region, including the GubugKlakah area, had a rather thick soil solum, estimated to reach depths of \pm 50 meters. This condition enabled farmers to have high nutrient reserved in their agricultural land.

3) Various agricultural production

Most of GubugKlakah Village people worked as farmers. This was supported by the village land proportion that was still large enough to be used in farming activities. Besides the apple commodity that had become an "icon" of the GubugKlakah and Poncokusumo District, there were several other commodities cultivated by farmers, such as: potatoes, leeks, oranges, and so on. Often, however, agricultural production was not followed by a suitable market price and profitable for farmers.

4) Contoured topography (tends to be sloping).

Agricultural land in GubugKlakah Village had a slope of between 40-70°. The land was intensively planted by communities with high economic value crops. As a result, conservation plants that could withstand landslides were rarely found. In addition, the culture of using chemical pesticides still occurred in farming practices by farmers. Thus causing land degradation in the Village of GubugKlakah.

The condition of intensively controlled sloping land and lack of conservation plants was very risky to decrease soil fertility. This was further exacerbated by

the use of chemical pesticides which were still carried out until now. Moreover, when farmers were harvested, they faced the price of their commodities that were not stable on the market, so that they often harm farmers. Such different conditions eventually led to the vulnerability experienced by the GubugKlakah Community.

C. The adaptive capacity identification of the community for changing socio-ecological conditions.

The vulnerability condition experienced by the community in GubugKlakah Village was responded by various responses to adapt the changes in ecological conditions that occurred. The adaptabilities were important in order to allow the community to survive the changes and be economically profitable. The adaptabilities were:

1) The application of soil and water conservation techniques

A form of farmers' adaptation to the topography of agricultural land with a slope of 40-50% was the making of terraces on their agricultural land. On land planted with apples, farmers made bench terraces, so soil erosion or landslides did not occur. Their choice of soil conservation techniques was the bench terrace. The terrace was planted with grass (*gajah or setria*) on the lips and cliffs to make the terrace building solid. While prevention soil erosion or landslides, they also made bench terraces and protected their investment in apple crops. Because by making a bench terrace, soil would be prevented from planting eroded apples. If eroded, then the apple plant would fall and eventually it would be damaged. Making bench terraces on land planted with apples, completed with creating water drainage (SPA). This was particularly important during the rainy season, so that the surface water flow on the top of the land did not erode the soil either on the bottom of the land or the canal itself.



Figure 3. Agricultural Land Condition with Guluds

While on land planted with vegetables without apples, the terrace chosen by farmers was the gulud terrace. This is done so that the surface water ran smoothly in the rainy season and the soil dried quickly, so that this condition did not interfere with the cultivated vegetable crop being. Actually, this ridge terrace was not really perfect for soil erosion prevention. But in this village, the soil solum was dense, so the farmers did not feel the impact of soil erosion. The condition of agricultural land with mounds was shown in Figure 3.

2) The organic fertilization.

In the beginning, the village farmers used fertilizers in apple plants to balance the use of organic and chemical fertilizers. However, the presence of apple farmer tenants from outside the village since 1990s had contributed to agricultural land degradation on this leased land. It turned out that these tenant farmers had different behaviors in the use of fertilizers on apple crops compared to local farmers. Tenants preferred to use chemical fertilizers above the current levels without the use of organic fertilizers being compensated. This was done to maximize the profits obtained during the lease period. The result was the soil degradation, which was shown by the dropped of apples productivity significantly, the quality of the apples produced is not good, and even found many dead apples. Faced with these conditions, the farm's owner moved the old apple plant after the land returned and replaced with a new one. In addition, as an effort to improve soil fertility, farmers increased the use of organic fertilizer from livestock manure, especially goat manure. People used organic fertilizer produced from livestock manure (manure). This livestock manure came from cows, goats and chickens that they breed. Typically the dung was received from neighbors who raised livestock if they did not have livestock.

3) Planting with intercropping system.

Pest and plant disease were the disadvantage faced and experienced by farmers. The value of farm products earned by farmers was often unpredictable from the economic side. The efforts made by farmers to face these circumstances were implementing multiple cropping systems and patterns. The community used intercropping systems to overcome the unstable market price so that some plant crops commodities were harvested

and expected that if one commodity price fell, the others would still able to raise the price. Intercropping by farmers included:

- a. Apple - Leeks - Potato
- b. Apple - Leeks - Cayenne pepper
- c. Orange - Corn - Leeks
- d. Orange - Apple
- e. Apple - Cabbage

The figure 4 below showed the farmers' land condition that carried out intercropping planting system.

4) Rejuvenation (*perompesan*) to adjust harvest time.

After harvest, composting was cutting leaves and twigs after harvest to allow new shoots grew immediately. This was done sequentially (not simultaneously) on apple plants. The aim was to set the harvest time, so that harvest did not occur together which had a downward price trend and was detrimental to farmers. Composting conditions of apple plants as shown in Figure 5 below.

5) Doing work non agriculture

People of GubugKlakah Village mostly worked as farmers, but off-farm work was also done if it was not suitable for planting. The majority of rain-fed agricultural lands were not planted during the dry season, so farmers had no income. Becoming a construction worker was their strategy.



Figure 4. Intercropping system applied by GubugKlakah Farmers were: (1) Intercropping of Apple-Leeks-Cabbage; and (2) Intercropping of Orange-Corn-Leeks



Figure 5. Apple plants that have been harvested and are growing new shoots

IV. CONCLUSIONS AND SUGGESTIONS

The social ecological conditions of the community of GubugKlakah Village consist of climate sustainability which is owned for horticultural crop cultivation, sufficiently deep soil solum, land topography which tends to be skewed, and diverse horticultural agricultural production.

The adaptive capacity possessed by the GubugKlakah community in responding to changes in social and ecological conditions is by conducting organic fertilization to improve soil fertility. Meanwhile, intercropping can be used to deal with unstable agricultural production prices and *rompes* to regulate harvest time.

Some suggestions can be submitted in this study are:

1. Efforts should be made to improve the ability to provide organic fertilizer in a sustainable manner for farmers and the selection of intercropping commodities suitable for land conservation.
2. Coordination between stakeholders is needed so that agricultural products are well absorbed in the market.

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