

RICE FARMING MANAGEMENT TOWARD CLIMATE CHANGE: CASE OF RICE FARMING DEVELOPMENT IN BALI PROVINCE- INDONESIA

Naori Miyazawa¹⁾, and Ni Made Intan Maulina²⁾

¹⁾ Waseda University, Japan

²⁾ Dwijendra University, Indonesia

e-mail: n.miyazawa@aoni.waseda.jp

ABSTRACT

Climate change, which is a global issue, has a significant impact on the management of rice farming, including in Indonesia. The productivity and quality of rice can decrease further if climate change is not addressed properly by farmers and the government. The decrease in production is caused by the availability of irrigation water which is uncertain and even very small or too large. In the case of Bali Province, Indonesia, rice farming management is carried out by farmer organizations which are locally called subak as a traditional irrigation system. This study aims to determine the management of irrigation and rice farming by subak, and to describe the efforts made by subak in overcoming irrigation problems as a result of climate change. This study was conducted in subaks in Bali with respondents who were subak administrators who were selected by purposive sampling. The results of the study showed that irrigation management is based on the philosophy of tri hita karana and is regulated through consensus and agreement among farmers which is stated in internal regulations called awig-awig. Some of the main activities of subak are water distribution and allocation, operation and maintenance of irrigation networks, conflict management, fund management and religious ceremonies. Efforts made to overcome irrigation water problems are mitigation and adaptation by regulating planting patterns, planting schedules, good agricultural practices (seeds, fertilizers).

Keywords: Climate change, subak, irrigation, religious ceremonies, mitigation and adaptation.

1. INTRODUCTION

Commonly, economic development is addressed to promote productivity of natural and human resources and to provide more opportunities for the economic actors at the every levels of producer and consumers. Agricultural development constitutes a main sector in economic development for the developing countries which generates food, employment and income especially for rural development (Acharya, 2006; Anríquez, and Kostas, 2007; Holcer, et al., 2013). Most of population's food is still dependent on the production from the small holder farmers in the developing countries (Stanton, 2000). Several researches have pointed out that the rural people in the developing countries are still poor due to low productivity (Ravallion et al., 2007; Eteng, 2005). They also have unskilled labor to work on agricultural works and unlimited access to information, technology, capital, and market (Anriquez and Lopez, 2007). In the rural areas, there are several categories of rural people income gained from crop production, livestock production, and other non-agricultural wage employment. it is very important for the government to make the improved approaches and rural and agricultural development to reduce rural poverty and unequal disparities of income. One of the disparities which should be overcome is a gap (inequality) of income among the rural people including urban people (Rao, 2009; Bezu, & Barrett, 2012). Inequality of income of rural people contributes to rural

poor and might hinder the rural economic development. The improvement of agricultural development might not be separated to industries developed in rural area and urban area, as well.

In the relation to agricultural development, Indonesia is one of the vulnerable countries to climate change in the relation to rice farming. This might influence to rice production and food security in the country. The availability of irrigation water is significantly very important for rice productivity as a main staple food for the people in Asia. Irrigation management should be technically and socially needed to control rice field cultivation along the year. In case of Bali province in Indonesia, the irrigation management along the river and at the farming level is run by government and local farmers groups called subak as a traditional irrigation system. The objectives of this study are to describe traditional irrigation system in the irrigation and rice farming development, and to explain the mitigation efforts conducted by subak to solve the irrigation water problem.

Implementation of agricultural development, particularly on rice farming has become increased in order to increase productivity of land and crop. Intensification on the rice field has been conducted through the application of new technologies or good agricultural practices. Selection of new high yield varieties has given significant impact on land and crop productivity. This has also been enriched by the uses of recommended fertilizers and irrigation water and the application of integrated pest and diseases management. In Bali province-Indonesia, management of rice field farming has been done under the farmers' organization called subak. It is a widely known that 'traditional' irrigation management institution for rice cultivation in Bali has been established since thousands ago (Roth, 2011; Sedana, 2012; and Roth and Sedana, 2015). The existence of subak(s), therefore, has still significantly played a great role in supporting agricultural development on rice field (Sedana, et al, 2013). Aside from this, cultural aspect on subak has become a buffer for Balinese culture as an interesting factor for supporting tourism development.

As an international tourism destination, the growth of economic development in Bali province has brought about some problems on the subak, such as competition of water uses, and land (rice field) conversion. Competition in using water has been felt by subak since the irrigation water source was also extracted by the other sectors for domestic water and industry uses. Water availability has become scarce for irrigation, thus cropping intensity is decreased. The consequence is production of rice becomes lower and being the threat on food security program of government. Land conversion is also difficult to control as the high need of land for housing, physical infrastructure and industry in line with economic development.

Aside from this, the youth in Bali seemingly might not have good interest any more to work on rice farming with some reasons, such as a relative low income, high risk, income gained after harvest (take relative long time) with the high risk of harvest failure. Cumulative reasons found in rice farming have pushed farmers and the youth strive to work on non-agriculture job in urban area as a daily worker and others. Even, some of farmers as members of subak should sell their own rice field since the income gained is relatively low, thus also make land conversion. This paper is addressed to describe farming system under subak management, and to formulate agribusiness works conducted by subak to sustain traditional irrigation system.

2. RESULTS AND DISCUSSION

Irrigation Management in the Subak System, Bali

2.1. Subak System

Subak is a traditional irrigation system in Bali that has been formed and grown since thousands of years ago (Roth and Sedana, 2025; Sedana, 2017). Subak has a socio-agrarian religious nature, all of its activities are based on a philosophy, namely *tri hita karana* (three causes for happiness). The three components of *tri hita karana*

are parhyangan (a harmonious relationship between humans and God); pawongan, which is a harmonious relationship between humans and humans; and palemahan which is a harmonious relationship between humans and their environment.

Subak as an autonomous organization of water-using farmers, where its activities are not controlled and managed by the village government but are only coordinative. In organizing irrigation and agricultural activities, the farmers who are members of the subak jointly agree on rules that are locally called awig-awig. In the awig-awig, everything that must be done and must not be done is regulated and is equipped with sanctions if a violation occurs. The main components as binding factors for farmers (subak members) are irrigation water and temples as places of their ritual worship, and are built within the subak area and other places believed to have a religious connection with subak activities. Several studies have shown that subaks in Bali have five main tasks, namely: (i) distributing and allocating irrigation water fairly to its members, (ii) operating and maintaining irrigation systems, (iii) managing finances; (iv) handling conflicts between farmers, and (v) organizing various religious ritual activities. In the subak system, religious ritual activities are carried out based on the phases of rice planting (starting from the water welcoming ceremony, seeding, land preparation, transplanting, plant maintenance, harvesting and post-harvest, such as storage and thanksgiving for the harvest).

The management of the subak is structurally very simple, where the subak is led by a chairman called the kelihan subak or pekaseh. The kelihan subak is elected by the members democratically through a social approach. In carrying out subak activities, the pekaseh is assisted by a deputy, secretary and treasurer and messenger. In subaks with relatively large rice fields and many members, the organizational structure of the subak can be supplemented with several sub-subak heads who are locally called kelihan tempek with the task of coordinating activities in each sub-subak. The organizational structure of the subak is shown in Figure 1.

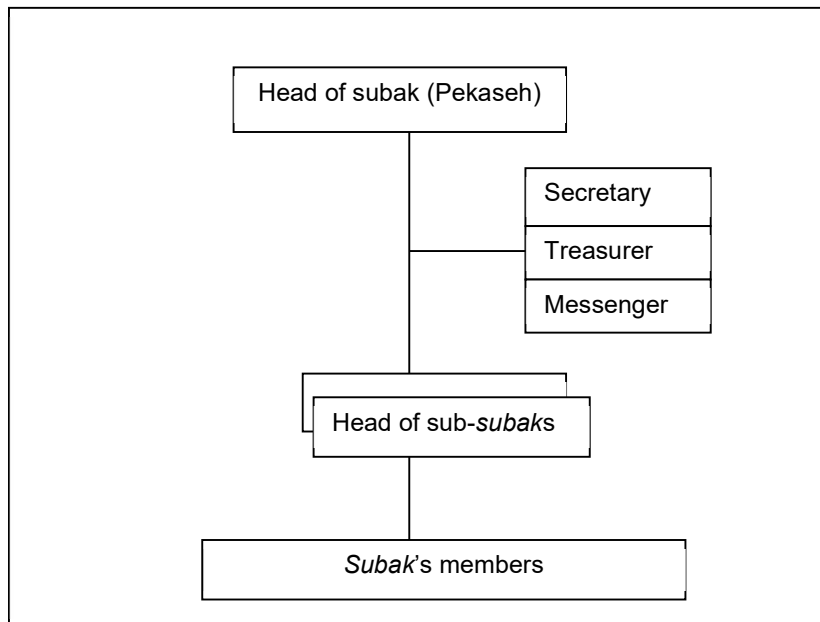


Figure 1. Subak organization structure

For the government, the existence of subak provides significant benefits in accelerating the dissemination of information and facilitating the application of technology at the farmer level. In relation to rice farming management, subak is a medium for farmers and government officers (agricultural extension workers) to determine planting patterns, planting schedules, choice of rice varieties, plant maintenance methods and so on. Agricultural extension workers encourage farmers through their subak to carry out good and correct farming practices in order to have higher productivity and product quality and increase their income. Increased income for farmers will be an incentive to further increase the intensity of farming better. This condition will be able to provide a positive impact, namely controlling the conversion of rice fields.

2.2 Subaks' Efforts to Overcome Irrigation Water Problems

The issue of climate change felt by the global community also has a direct impact on the agricultural sector, such as rice farming. Some problems that occur as a result of climate change are; (i) the availability of irrigation water is increasingly limited; (ii) competition for water use between users, such as subak, households, industry, government (iii) pests and diseases, and (iv) disrupted rice productivity; and (v) rice fields that change function. Subak takes mitigation and adaptation efforts to the increasingly limited water availability conditions. One of the actions taken is to change the planting pattern, such as rice-rice-secondary crops or rice-secondary crops-secondary crops, or rice-secondary crops-rice, or rice-secondary crops. The types of secondary crops planted by farmers are usually peanuts, corn, green beans, soybeans and horticultural crops, such as flowers and vegetables. Another alternative action taken is to regulate the use of irrigation water, such as rotation and staggering. To ensure the process of land cultivation and transplanting, farmers in the subak system also have a water borrowing pattern among farmers.

The pest and disease attacks have a high potential to reduce productivity and product quality, and even crop failure. The efforts taken were asking for technical recommendations from agricultural extension workers, such as integrated pest management control with the principle of environmentally friendly agricultural practices, namely using biopesticides. Subak must implement good agricultural practices such as choosing certified seeds, fertilizers, and proportional pesticides. In addition, subak also carries out religious ritual activities to overcome the problem of pest and disease attacks as a form of applying local wisdom. Subak can face major problems if industries require water from the same source through making coordination with the government and industries to have water allocation. Government should have an updated data or information about water allocation for the irrigation, water domestic, industries and other sectors.

3. CONCLUSION

Subak as a traditional irrigation system manages water under the local wisdom called *tri hita karana*. Subak has internal rules to manage the water distribution and allocation, operation and maintenance of irrigation facilities, fund raising and ritual activities. Subak has mitigation efforts to solve the problems by implementing a flexible planting schedule, rotation of cropping pattern, selecting of crops, improving of agricultural technologies, and performing of ritual activities. These were conducted simultaneously by farmers as subak members based on the climate information provided by government. Another effort is making coordination with the government and industries to have water allocation.

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