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Strategies for Anticipating Drought And Flooding on Paddy Field to Maintain Food Security in Subak Area of Mengwi Sub-District, Badung Regency

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Abstract - In some Subak areas in Mengwi sub-district during the dry season there is often a lack of water (drought) and in the rainy season there is often excess of water (flooding). These events often disrupt plant growth and production and can have an impact on food security stability. The purpose of this study is to determine the total number and area of subak, the number and the area of subak which including normal water categories, water shortages (drought prone) and excess of water (flood prone). Besides, this study also aims at obtaining strategies to anticipate water shortages (drought) and excess of water (flood). This research was conducted through observation, survey, direct observation of paddy field plots. Group discussions with Subak, farmers, Mengwi Agricultural Extension Center as well as Deparment of Agriculture and Food of Badung Regency was also done. The result of the study show that in Mengwi Sub-District there are 48 Subaks with the area of 4,414 hectares, consisting of 3,865.85 hectares (87.92%) with normal water category, 527.01 hectares (11.94%) with drought prone category and the rest 6 hectares (0.14%) with flood prone category. The strategies to anticipate water shortage (drought) and excess of water (flood) are by improving the cultivation techniques, land management and repair irrigation facilities.

Keywords: Strategies, Drought, Flood, Rice, Food Security

I. INTRODUCTION

The government continues to strive to maintain rice food security, because rice food is the main staple food for the population in Indonesia. Indonesia's food security is still unstable, in 2017 there were still 311.52 thousand tons of rice imports (Ariyanti, 2018). To respond this, production must be increased.

In an effort to increase the production, paddy fields have a very important role. Paddy fields in Bali cover an area of 80,063 hectares (Bali BPS, 2015). Paddy cultivation in Bali is carried out directly by farmers who are members of Subak. Crops are generally cultivated are rice and secondary crops (non-rice). If the water supply is

sufficient, the cropping pattern in a year is usually twice rice and once non rice. The first rice is planted at the beginning of the rainy season, the second rice at the end of the rainy season and non rice is planted in the dry season. Most agricultural systems are still inorganic farming system.

Farmers in the subak area of Mengwi sub-district include advanced farmers, but there are still problems that need to be faced. The problems are that in some subak areas, there are water shortages (drought) and excess of water problems (flooding). Problems of lack of water (drought) often occur in the dry season, and the problem of excess water often occurs in the rainy season. Both of these problems interfere the growth and yield, and have the potential to crop failure.

According to Sujinah and Jamil (2016) drought stresses affect all growth factors of rice plants, starting from changes in physiology, morphology, growth patterns, and finally affect the yield. Conversely, in the rainy season rice plants are very susceptible to flooding, especially when the rice plants are 10 weeks and 12 weeks after planting, the percentage of high empty grain amounts reaches 77.62% and 66.08% (Triwidiyati *et al*. 2008). In the subak area of Mengwi Subdistrict no research has been conducted related to drought and flooding.

The purpose of this study is to determine the total number and the area of subak, the number and the area of subak which including normal water categories, water shortages (drought prone) and excess of water (flood). Besides, this study also aims at obtaining strategies to anticipate water shortages (drought) and excess of water (flood).

II. RESEARCH METHOD

This research was conducted in the subak area of Mengwi sub-district, Badung Regency, from April 2019 to October 2019. The materials and tools used were rice field plots, irrigation facilities in the Subak and Irrigation Areas, a list of questions (questionnaire), climatology equipment, laboratory equipment, chemicals, role meter, ropes, scissors and stationery.

The research was carried out using a field observation method, survey to farmers and subak leades, Agricultural Extension Office of Mengwi Sub-District and the Agriculture and Food Service Office of Badung Regency. Besides, also direct observations on paddy fields, soil sampling and record rainfall data. For subak areas in Mengwi sub-district, the data collected are the total number of subaks and their area, the number of subaks and their area which are categorized as normal water, and also for drought prone and flood prone area. In the paddy field plots, variable which observed are the water availability, water distribution among subaks or farmer, techniques to give water to the plants, soil moisture, the varieties of rice planted, cropping patterns, the percentage of green leaves, and the yield of harvest dry grain. Inundation height observations for each categories were carried out separately.

The collected data is tabulated and analyzed in a descriptive comparatively. The determination of strategies to anticipate water shortages (drought) and excess of water (flood) by synergizing the data variables in the paddy field plots with height inundation data.

II. RESULT AND DISCUSSION

Subak and Area

In Mengwi Sub-district area there are 48 subaks with the area 4,414 hectares. The number of subaks with normal water categories are 47 subaks which cover area 3.865,85 hectares (87,92%), the number of subaks with drought prone catagories are 21 subaks with have area 527.01 hectares (11,94%) and the number of subak with flood-prone categoriy is 1 (one) subak with the area 6 hectares (0.14%).

Actually farmers want to plant rice in all of their paddy fields area. However, due to insufficient water, especially in drought-prone areas, farmers reduced the area of rice planting and replaced it with non-rice crops. The effort that needs to be done is to conserve water resources. Water resources conservation strategies can be managed based on space, hydrological aspects, integrated water management. Conservation of water resources is a major factor to support sustainable water use, food security and poverty alleviation (Santosa, 2008).

Plant Condition in the Field

The result of observations is presented in Table 1.

Table 1. Variable Observed and Water Condition in the Paddy Field

Variables Observed	Water Condition in Area with :		
	Normal water catagory	Drought prone catagory	Flooding prone catagory
Water availability in the Paddy field	Enough	Enough and partly dry	Enough
Water application among subaks/farmers	Simultaneously	Simultaneously and in rotation	Simultaneously
Water application during rice growing period	Thin submergence and inundation	Thin submergence, inundation and partly dry	Thin submergence and inundation
Soil moisture in the plot	Saturated	Saturated and partly dry	Saturated
Percentation of rice green leaf (%)	95-100	95-100	95-100
Rice varieties planted	Ciherang and Cigelis	Ciherang, Cigelis, Non Rice : Flowers and Cassava etc	Ciherang and Cigelis
Cropping pattern	Rice - Rice	Rice – Rice; Rice-Non Rice; Non Rice – Non Rice	Rice - Rice
Harvested dry of unhulled rice yield (ton/ha)	6,78	6,31	6,33

In Table 1 above it can be seen that the water condition in the paddy fields for the three categories are almost the same. The difference is only in areas of subak that are prone to drought there is a turn of water and cropping patterns and types of plants are more varies. This turn is not necessary and only applies if the water supply is lacking. Farmers based on experience before planting have calculated the area to be planted with rice and it has been predicted that there will be no water shortages.

The remaining land that cannot be planted with rice is planted with non-rice. Here it is clear that in anticipation of water shortages, subaks / farmers undertake a strategy of reducing the planting of rice area, planting non rice, regulating planting time and cropping pattern. Efforts to overcome the drought of lowland rice carried out

in Lebak Regency are by optimizing all water pumps, carrying out canal cleaning and closing channel leaks, doing a turn system, coordinating with related agencies, sugest to farmers not to force to plant rice but replacing it with non rice crops (Lebak Regency Agriculture and Plantation Office, 2018).

In areas that are categorized as flood-prone areas, there is no problem, water supply in the dry season is always sufficient and flooding only occurs in the rainy season.

Inundation Height

The height level of inundation in paddy fields as shown in Table 3.

Table 3. Inundation Height in Normal Water Categories, Prone to Drought and Flood Prone (cm)

Water Aplication	Normal Water Catagory	Prone to Drought	Prone to Flooding
Thin inundation I (0-7 dap)*	2.00	1.80	1.00
Inundation I (0-30 dap)	5.00	3.80	2.83
Thin inundation II (31-35 dap)	2.44	2.00	0.00
Inundation II (36-80 dap)	5.66	4.40	3.00

Note : dap = days after planting

In subak areas with drought-prone conditions at each growth phase the conditions are almost the same as those in normal water conditions only the inundation height is slightly lower both during thin inundation and inundation. This is due to the limited availability of water due to various problems such as low flow of water entering the irrigation channel, crab pests, low rainfall and water distribution between subaks that are in the same water source channel. Based on these problems, the solutions implemented by farmers include setting planting time among farmers and between subaks, reducing the planting area of rice plants, regulating cropping patterns (Rice-Non Rice), borrowing water from subaks that have excess water and fixing any channels that leak. Even so, but water needs are always met throughout the growth because the soil is always in a saturated condition. In the subak area with normal water category, abundant water supply is balanced with good drainage.

For subak areas with flood-prone categories the conditions are the same as in normal water categories, except that there is a difference in the lower inundation height. The inundation is higher because there is naturally water flowing into the paddy fields. This is because the flow of water that enters the channel between paddy fields is sufficient, in addition to that the measurement of water level is carried out during the dry season, so that the amount of water available has no potential for flooding. But in the rainy season the quantity of water that enters the rice fields is very large and abundant.

Effort strategies which done by subak and farmers are by building drainage structures. This building is very important to regulate and drain excess of water enter paddy fields, so as to prevent water overflowing during the rainy season. Based on research in Kendal Regency and Demak Regency that floods that occur in paddy fields have

been partially overcome by building dykes, dams and waterways and also farmers have adapted by adjusting cropping patterns, setting of planting time, planting methods and selecting plant commodities (Hartini *et al*.2012).

V. CONCLUSION AND SUGGESTION

There are 48 Subaks in Mengwi sub-districts with the area 4,414 hectares. These consist of 47 subaks with the area of 3,865.85 hectares (87.92%) include normal water category, 21 subaks with the area of 527.01 hectares (11.94%) including drought prone category and there are 6 hectares (0.14%) which are prone to flooding an it is found only in 1 (one) subak.

Strategies to overcome water shortages (drought) are by adjusting planting time, regulating cropping patterns, planting dry-resistant rice varieties, reducing rice planting areas, planting non-rice crops, increasing water use efficiency, making water turns and improving irrigation networks that leak out. The strategies to deal with excess of water (flooding) are by raising the border of paddy fields at the upper part, planting inundation resistant rice varieties, closing irrigation channels, and improving drainage.

In subak areas that lack of water, it is necessary to continue the strategies that have been carried out by farmers coupled with harvesting rainwater in the rainy season for irrigation in the dry season, and in the areas of excess of water subak need to improve drainage. and plant cultivation techniques.

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