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Analysis of Precipitation, Runoff and Tides of Water Level in Lebak Swamp Ogan Keramasan

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Abstract: ***Problems encountered in the production of rice in swamp land, namely the existence of climate change, the el Niño (drought) and la Nina (flooded), so that during the dry season drought, it is because the floodgates unused in the drain water. When it is rainy season, the water exceeded the sluice. This leads to stagnant water, water level further high then the water fluctuations cannot be controlled. And also water management system of macro and micro poorly, channels were damaged and less irrigation planning. These issues can reduce the productivity of rice and led to the failure of agriculture in lebak swamp. Thus, this study aims to clarify he relationship between rainfall, runoff, tidal rivers and water level in the lebak swamp especially in Ogan Keramasan. The method used was observation, experiment and inventory data. This study was conducted at Ogan Keramasan, Ogan Ilir District in March 2014 to October 2014. The conclusions obtained were: 1) the trend of rainfall more fluctuative than the trend of evapotranspiration. Beside that, evaporanspiration value was higher than rainfall. This often causes dry conditions during drought. The value of evapotranspiration is not affected by rainfall, but affected by the area of land cover, 2) the water level is strongly influenced by rainfall, tides River and runoff. Thus, a mathematical model of the relationship between rainfall, runoff and tides water level is required.***

Keywords: evapotranspiration, precipitation, tides river, water level fluctuations

1. Introduction

Lebak swamp is a land that water regime influenced by rain, both local and in the surrounding area. Puddle in the lebak swamp can be more than 6 months due to the deep basin. Based on the height and length of the puddles, the lebak swamp can be grouped into shallow lebak swamp, middle lebak swamp, and deep lebak swamp.Each of these lebak swamp has different natural characteristics that require different utilization technology as well. According to Suriadikarta and Sutriadi (2007) lebak swamp characterized always flooded during dry season.

Therefore, based on hydrotopography, the lebak swamp can be categorized into three type, they are: 1) shallow lebak swamp, it is waterlogged during rainy season with depth <50 cm for <3 months, 2) middle lebak swamp, the depth of puddle is 50 -100 cm during 3-6 months, and 3) deep lebak swamp is puddle > 100 cm for> 6 months. Shallow lebak swamp generally has better soil fertility than the others, due to the enrichment of the mud deposits that are overflowed by river water.

Lebak swamp that has been cultivated for rice farming almost 91 percent with once time rice planting patterns in a year. While the cultivated two times a year just about 9 percent. Thus, the intensification opportunities in lebak swamp are still possible to do. This intensification can be done through increased productivity per unit area, or by increasing the cropping index (IP) from once plant to twice plant (Sudana, 2005).

Problems encountered in the production of rice in lebak swamp, namely the existence of climate change, the el nino (drought) and la nina (flooded), so that during the dry season drought, it is because the floodgates unused in the drain water. When it is rainy season, the water exceeded the sluice. This leads to stagnant water, water level further high then the water fluctuations can not be controlled. And also water management system of macro and micro poorly, channels were damaged and less irrigation planning. These issues can reduce the productivity of rice and led to the failure of agriculture in lebak swamp.

If lebak swamp is managed properly and in accordance with the characteristics of the landc through the correct science and technology, it can be used as productive agricultural areas (Ismail, *et al.*1993). Activities and operations at lebak swamp are highly dependent on the water system. The key to success in the wetlands is water management (Susanto, 2010). There have been many models to predict the groundwater level (Ngudiantoro, 2010), hydrological modeling by Handayani *et al.* (2010) and water balance approach (Puspitahati, 2013), but they have not been able to link rainfall, tides, and water runoff to fluctuations in the lebak swamp. So, this study aims to explain the relationship of rain events, runoff, tides rivers and high water levels in the lebak swamp especially in Ogan Keramasan.

2. Material and Method

The research was conducted in Ogan Ilir District, and also Soil and Water Engineering Laboratory, Department of Agricultural Technology, Faculty of Agriculture, Sriwijaya University since March 2014 to October 2014. This study was after research by Puspitahati (2013). This study focuses factors affecting water levels, namely precipitation, run off and tides rivers in Ogan Keramasan.

The data required were the data of rainfall the last 5 years, the data tides last 5 years, as well as data existing condition such as land cover maps on Ogan Ilir. The method used was observation and experiment, and inventory data. This research conducted by observation and experimentation that direct observation to the field that was in Ogan Keramasan. Water level measurement with sensors measuring water level (TMA). While Inventory data was done by collecting climatic data such as rainfall, humidity, rainfall from BMKG. Then, collect tides data from Sea Force (Lanal). Processing data of rainfall and water level carried tabulations and charts. In addition, processing data was also performed using methods MOCK (Nassaruddin, 2004) to calculate water balance. Water balance was used to get the value of evapotranspiration and runoff.

The steps to calculate water runoff were calculation of rainfall; it is used Thiessen method, calculations of potential and actual evapotranspiration and also water surplus. Calculation Run off is all water flowing through a river moving away from the catchment area regardless of origin / path taken before reaching the channel. To calculate runoff, previously, it should be calculated the amount of infiltration. After the top layer is saturated, the excess water flows to the deeper ground as a result of the earth's gravitational force known as percolation process (Asdak, 2002). While, the data analysis was done by linking the occurrence of rainfall, water runoff, the water level in the lebak swamp.

3. Result and Discussion

3.1. Rainfall Fluctuations.

The results of rainfall fluctuations in Ogan Ilir and rivers from 2009-2013 obtained from rainfall data per year (BMKG) can be seen in Figure 1 below:

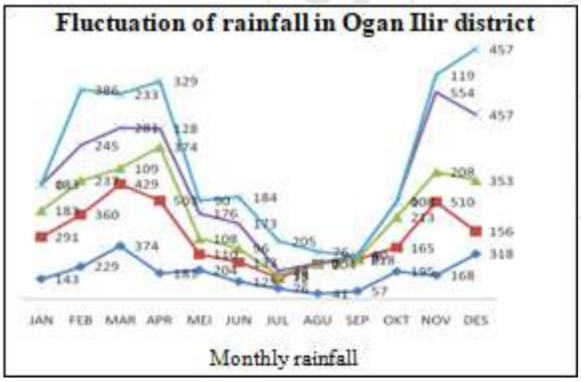

Figure 1. Fluctuation of rainfall in Ogan Ilir district

Effective rainfall. To calculate evapotranspiration, effective rainfall data is required. Effective rainfall was obtained from the calculation of 80% mainstay. Calculation of the mainstay debit aims to determine the area of irrigated rice fields. The water balance was used with analysis of Dr. F.J. Mock based on monthly rainfall data, number of rainy days, evapotranspiration and hydrological characteristics of the drainage area. The principle of this calculation was the rain falling on the ground (precipitation) will partially be lost due to evaporation, some will be lost to direct run off and some will enter the soil (infiltration). Infiltration initially saturated the surface (top soil) which then becomes percolation and finally out to the river as base flow.

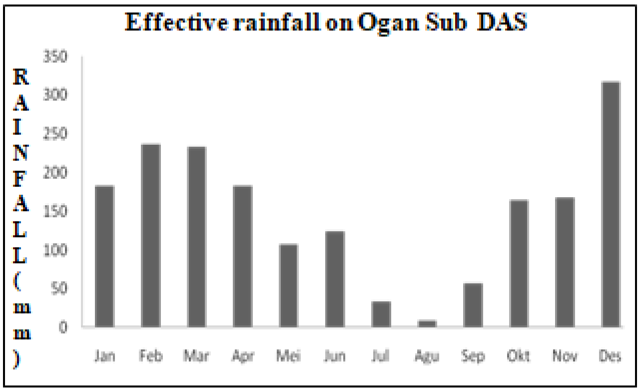

Figure 2: Effective rainfall on Ogan Sub DAS

Figure 2 can be seen that for 5 years from 2009 to 2013 at Ogan Sub Watershed. It occured the rainfall pattern from October to December and January to April was the wet seasons. Otherwise, Mei to September was the dry seasons. The highest effective rainfall was in December, while the lowest rainfall was in August.

The calculation results of the effective rainfall from January to April and October to December was the highest effective rainfall that reached 318 mm in December. Effective rainfall greatly affects the amount of runoff coefficient. the higher rainfall the higher runoff. However, this can be controlled by the value of evapotranspiration.

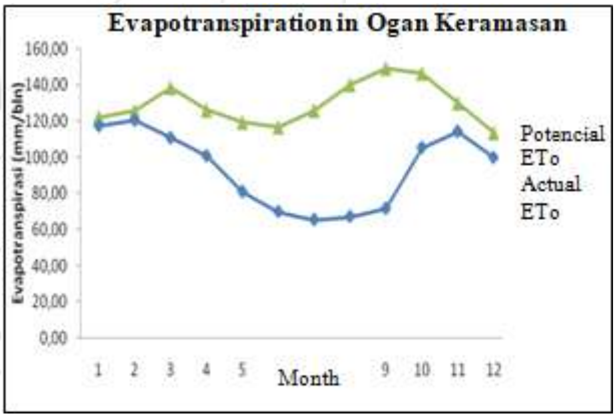

Figure 3: Evapotranspiration in Ogan Keramasan

From Figure 3, the potential evapotranspiration value was higher than the actual evapotranspiration. During the transpiration process, potential evapotranspiration of water was available to the needs of the plant, whereas actual evapotranspiration was occurred under very limited water conditions.

Actual evapotranspiration was affected by land cover. It is covered by plants or not in the dry season. The condition is called expose surface (m). The highest evapotranspiration produced in September was 149.32 mm/month and the lowest was in December of 113.49 mm/month.

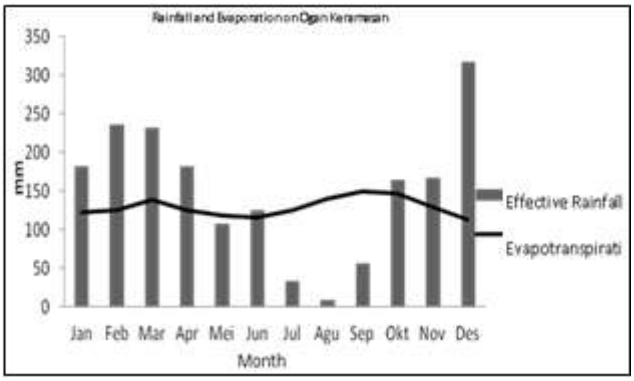

Figure 4: Comparison of effective rainfall and evapotranspiration on Ogan Keramasan

Figure 4, the trend of rainfall and evapotranspiration was not in line. Where, rainfall is higher in wet months than in dry months. However, the evapotranspiration trend was almost flat. It was not so fluctuating from January to December. This is what causes the weather is very dry in the dry season. this is due to the rain falling slightly and the evapotranspiration is very high. Thus, the evapotranspiration is not affected by rainfall, but affected by land cover. Meanwhile, to know the pattern of water surplus and Runoff can be seen in Figure 5.

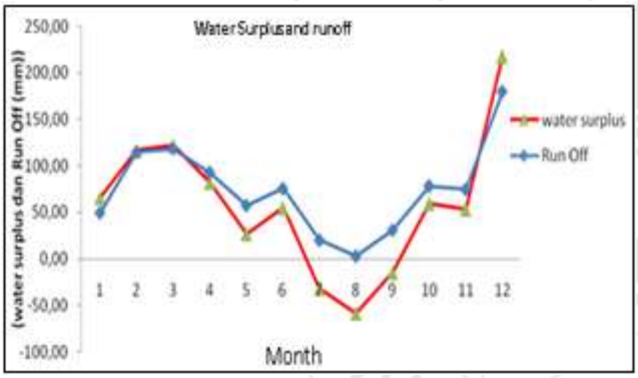

Figure 5: Water Surplus and Run Off on Ogan Keramasan I Ogan Ilir

Water surplus greatly affects the amount of infiltration. The coefficient of infiltration was highly determined by geological conditions, topography and crop conditions. If the cover conditions were deforested, the infiltration becomes less.

In Figure 5 showed that the pattern of surplus water movement in line with the movement pattern of Runoff. This was because when Runoff on the ground surface is small, the water surplus will also be smaller as well as infiltration. On the other hand, the more increase runoff the more increase the surplus water. In August, surplus water and Runoff values were lowest. It was because low rainfall and surplus water and runoff has increased in December. The average tides of the Musi river can be seen from the last 5 years. Trends generated each year were almost identical, can be seen as follows:

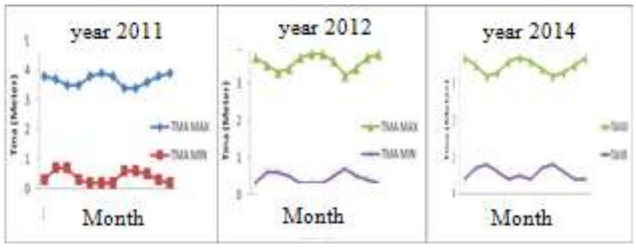

Figure 6. Fluctuations Tides of Musi river Year 2011-2014

In figure 6 seen the trend of high tide and low tide was almost the same every year. So it can make it easier to predict the fluctuations of the years to come.

3.2. Water level

Measurement of the water level tool was used by the sensor. This tool was installed in paddy fields. This tool is very cheap and efficient. But this sensor tool required replacement battery and the addition of pulse so as not to stop the recording. The installation of equipment was done in the field by using 2.5-inch diameter pipe. The height of the pipe from the ground surface was 2 m, and the height of the pipe from ground level to the ground was 1 m. The sensor deviced records according to the height of the water from 1 m from the ground to 2 m above the ground. Sensor deviced count every 1 hour once a day and directly sent via message to handphone.

Figure 7: Sensor Equipment Water level

The relationship between rainfall, runoff and tides with fluctuations in the water level in the lebak swamp can be seen in Figure 8.

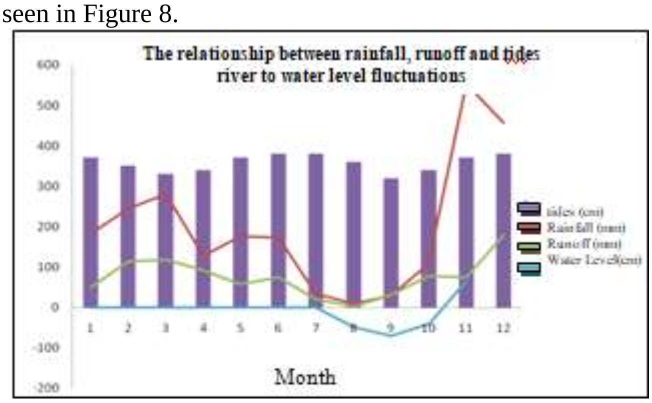

Figure 8: The relationship between rainfall, runoff and tides river to water level fluctuations

Figure 8 showed that trend of rainfall and Runoff was very significant with the trend of water level. So it can be concluded that the water level can be influenced by rainfall and Runoff. While, in dry Season, rainfall and Runoff decreased along with lower water level, otherwise, rainfall and runoff increased during the rainy season.

4. Conclusion and Recommendations

4.1. Conclusion

1) Rainfall trends were more fluctuating than evapotranspiration trends. however, the evapotranspiration was higher than rainfall. This is often causes the dry season when the situation was very dry. The value of evapotranspiration is not affected by rainfall, but affected by land cover
2) Water level was strongly influenced by rainfall, river tides and runoff.

4.2. Suggestion

Mathematical model of the relationship between rainfall, runoff and tides to the water level is needed, so that it can be known how much water in and out on a land

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