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Study of River Water Quality and Quantity Pangkajene for Irrigation Pangkep District - Indonesia

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ABSTRACT

Purpose of this research is the study of the quality and quantity of river water to match its usefulness, utilization of proper water and met at the River irrigation area Pangkajene Pangkep District of South Sulawesi province. The method used in this research that starts from data collection climatological, hydrological data, calculation of irrigation water requirements, calculate the quantity of discharge mainstay, analyzed the water balance, water sampling, laboratory testing of water samples, and then analyze the results obtained. River water quality testing results on the examination Pangkajene Biological Oxygen Demand (BOD) exceeds water quality standards with quality grade IV. Water Quality Standards Regulation No.69 2010 Governor of South Sulawesi, it describes the effects of pollution from human and industrial waste that are around the River Pangkajene so advised domestic wastewater should not be discharged directly into the river / water processed first and all manufacturers of industrial waste required to have a wastewater treatment plant (WWTP). based on the analysis of the quantity of discharge showed significant fluctuations of the river Pangkajene, water balance and water shortages occur in June I, II, July I, August I, II, and September I, II.dan recommended to plant crops in the coming months who have less discharge so as to reduce the occurrence of water shortages.

Keywords: *Water Quality, Water Quantity, Irrigation*

1. INTRODUCTION

Pangkajene and Islands District, South Sulawesi, Indonesia, there is a major river called the River Pangkajene a 32 km long with an area of 613.41 km2 watershed. The river is used as the main source of water for 8615 ha irrigated.

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The quality and quantity of water in the river is expected to be appropriate based on their utility as a source of irrigation water is Pangkep District. Is it still within the limits of tolerance of water quality criteria are still eligible to be used or not, and the quantity of water in which the level of demand of irrigation water can sometimes less streamflow conditions that result in water shortages. Therefore, there must be a way to reduce the impact on agriculture.

Based on this, the authors are interested to study the quality and quantity of river water for irrigation Pangkajene Pangkep District.

The next chapter presents the methods used in this study, then, Chapter 3 shows the results of the analysis, and the last chapter gives conclusions related to the research.

2. RESEARCH METHODOLOGY

2.1 Debit Curvature Method

In analyzing the mainstay discharge, based on the ways in which the selection of appropriate methods, generally based on these considerations, the data is available. Of these factors, the method of calculation used is a mainstay discharge Curvature Method Debit using linear regression.

Curved Debit method is used with reference to the recording data recording discharge high elevation (H) and discharge (Q) obtained from observational data the last 10 years starting from 2002 to 2011 on Front Air Station High Registrar (Staff Gauge) Tabo-Tabo, then the equation is the relationship between the Q-H by using the linear regression equation.

Data modeling is a common practice in the fields of science and engineering. This method is used to find the theoretical parameters that give the most appropriate relationship. The equation is expressed as follows (1):[Abdurrahman,2005]

$$Y_i = b_0 + b_1 X_i \quad (1)$$

Of equations derived from the relationship between the Q - H, plotted the value of recording water level into the equation above, and the value obtained discharge. In doing predictions / forecasts for the year 2013 conducted by the need to model (trend) with linear regression for each month.

2.2 Irrigation Water Needs

The rate of percolation is very dependent on the properties of the soil sfat. In clay soil with good processing characteristics, percolation rate of 1-3 mm / day. Evaporation is the event of change of water to steam. In determining the amount of evaporation is used Penman method, whereby evaporation (Ea), the saturated vapor pressure at the mean temperature (e), the actual vapor pressure (ea), Wind Speed (u). The relationship between the variables are shown as follows [2]:

$$Ea = 0{,}35(e-e_a)(0{,}5+0{,}54u) \quad (2)$$

Transpiration is a process event of water vapor leaving the plant body (Soenarto,1999). The water requirement of plants is influenced by factors percolation, evaporation, transpiration are then calculated as evapotranspiration. Free water evaporation (Epan), reference crop Evapotranspiration (Eto), crop Evapotranspiration (Etc), slope of the saturated vapor pressure curve (Δ), psychrometer coefficient (γ), corrected Penman (Kp), crop coefficient (Kc), latent heat evaporation (L), temperature (t). The relationship between variables is shown as follow (Seyhan,1995)

$$E_{pan} = \frac{10\left[\frac{R\Delta}{L}\right] + \gamma Ea}{\Delta + \gamma} \quad (3)$$

$$Et_o = K_p \,.\, E_{pan} \quad (4)$$

$$Et_c = K_c \,.\, Et_o \quad (5)$$

The amount of water requirements for land preparation depends on the amount of soil saturation, duration of treatment, evaporation and percolation. The amount of water requirement for paddy cultivation time can be calculated by using the method developed by Van de Goordan Zilstra, need water for processing (IR), a replacement water requirement of water loss due to evaporation and percolation in fields already saturated (M), magnitude wasted water evaporation (Eo), Percolation (P), Lama tillage (T), water requirement for saturation (S), and Numbers exponent (e = 2.7182). The relationship between the variables are shown as follows [6]:(Directorate General of Irrigation,1986)

$$IR = \frac{Me^k}{\left(e^4 - 1\right)} \quad (6)$$

The water requirement for crops is the need for saturation is not required because the flooding. Effective rainfall is the amount of rainfall that falls on an area of agriculture that can be only partially utilized / absorbed by the plants to meet the needs during infancy.

In determining the value of effective rainfall first determine the value of the mean rainfall using Thiessen Polygon Method, which Thiessen polygon average rainfall (R), the total area of influence of a station limited line polygons (A1.. An), and High rainfall station (R1.. Rn). The relationship between the variables are shown as follows [7] (Sunggono,1995):

$$R = \frac{A_1.R_1 + A_2.R_2 + ... + A_n.R_n}{A_{total}} \quad (7)$$

Replacement water layer performed 2 times, each 50 mm (3.3 mm / day for 15 days). Early in the first and second months of planting. Irrigation efficiency is the ratio of the discharge rate of irrigation water used to debit the amount of irrigation water that flowed and expressed in percent (%). Losing can be the evaporation of irrigation, seepage from drains or other purposes. In planning the total amount of irrigation efficiency from losing a primary to tertiary canal water by 65%.(Directorate General of Irrigation,1986).

Crop Water Requirement is the amount of water needs required by plants for growth. Where the crop water requirement (NFR), crop consumptive use (Etc), effective rainfall (Reff), Percolation (P), and the replacement of the water layer (WLR). The relationship between variables is shown as follows:

a) For Rice,

$$NFR = Et_c + P - R_{eff} + WLR \quad (8)$$

b) For Corps

$$NFR = Et_c + P - R_{eff} \quad (9)$$

The need for taking the required amount of water needs to door collection. Needs net (net) in the rice water (NFR), the overall irrigation efficiency (E), and the coefficient converting mm / day to l / sec / ha (8.64). The relationship between the variables are shown as follows [10]:

$$DR = \frac{NFR}{E \times 8{,}64} \quad (10)$$

Cropping pattern is a layout plan for the area irrigated cropping is useful to establish the pattern of utilization of

irrigation water is available for plant production gain as much as possible in agriculture. Planning cropping pattern done by calculating the value of evapotranspiration, percolation, donations effective rainfall, water demand as tillage, replacement of a layer of water, consumptive needs of plants, and the total efficiency of the irrigation canals. Of cropping patterns were obtained value of irrigation water requirement for each ha is used in planning the multiplier coefficients of the total area of land planted. Water balance is a balance between the availability of water to the water needs of all irrigated land. Through the water balance can be seen when the water shortage or excess water for one year, and can determine the ability of the service to the overall irrigation irrigated land available (Directorate General of Irrigation,1986)

2.3 Irrigation Water Quality

Pangkajene River water quality checks carried out by taking samples of the water in the irrigation weir Tabo-Tabo dated August 6, 2012 and then melakukam laboratory water quality testing at Environmental Health and Engineering Center for Disease Control (BTKLPP) Class 1 Makassar. Adjusted for the Investigation Air Quality Standards Regulations quality South Sulawesi Governor No. 69 of 2010 Class IV for use of irrigation.

3. ANALYSIS RESULTS

3.1 Quantity Dependable Flow

The results of calculation of the quantity of river discharge dependable flow Pangkajene using arc discharge method can be seen in Figure 1.

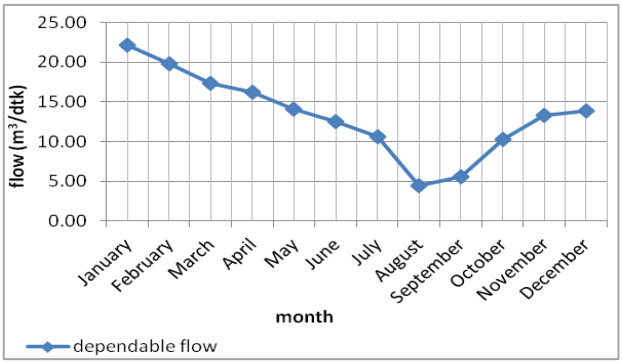

Figure 1. Quantity Dependable Flow

In Figure 1, the line above is the mainstay of river discharge quantity Pangkajene. Based on these lines can be seen that the fluctuation of the water in the river Pangkajene happens quite significant where the rainy season has a great flow, while in the dry season has a very small discharge.

3.2 Existing Cropping Pattern Water Balance

The calculation is done by comparing the water balance between the needs of irrigation water for the entire 8615 ha of irrigation water sourced from rivers Pangkajene services compared with river discharge mainstay Pangkajene available. Graph of water balance between the needs of existing irrigation cropping pattern Pangkep district with river discharge mainstay Pangkajene can be seen in Figure 2.

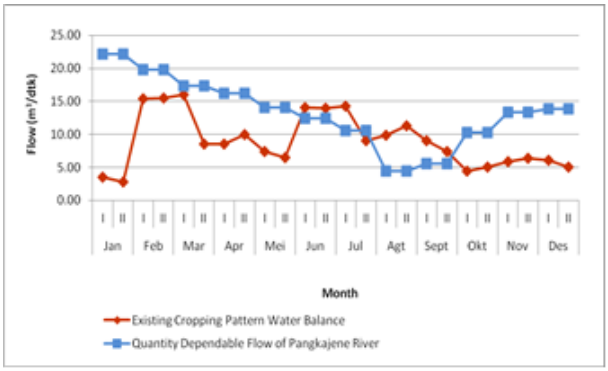

Figure 2. Existing Cropping Pattern Water Balance

Based on Figure 2 above, we can see the comparison between the line of the river discharge mainstay Pangkajene to outline the need for irrigation water Pangkep cropping districts. At discharge mainstay known that significant fluctuations in the debit debit Pangkajene river during the rainy season which tend to be large even far above the needs of irrigation water needed for irrigation, but in the dry season less debits. From the comparison of the discharge mainstay and major irrigation water demand on the chart will also be aware that there is a shortage of water as much as 7 times that in June I, II June, July I, August I, II August, September I, II and September.

3.3 Water balance Cropping Pattern Optimization

Water balance irrigation cropping pattern optimization is done by comparing the results between the water needs of the cropping pattern optimization results with discharge mainstay Pangkajene River. Optimization is an effort to water management plan to be used efficiently to identify the best solution in the decision of a problem. Optimization is applied on the basis of a solution to the shortage of water caused a significant fluctuation in the dry season. The parameters used to perform the optimization is to apply the Crop planting pattern in the shortage of water. Graph of water balance between irrigation needs cropping pattern optimization results with river discharge mainstay Pangkajene can be seen in Figure 3.

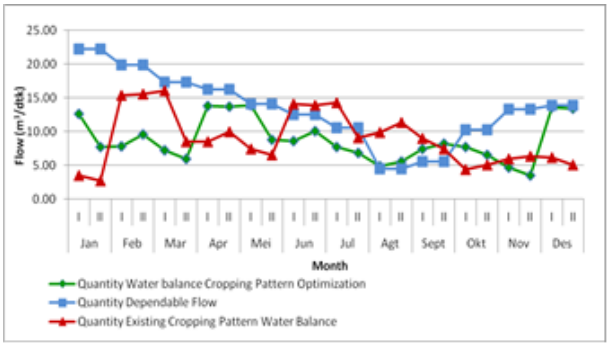

Figure 3. Water balance Cropping Pattern Optimization

Based on Figure 3, it can be seen that the results of the optimization of the Crop planting can reduce the need for irrigation water. So as to reduce the occurrence of water shortages that had a water shortage occurs 7 times (June I, II June, July I, August I, II August, September I, II, and September) to 4 times (August I, II August, September I, and September II). This is done with the schedule change cropping patterns, which accelerated the planting of rice in the first planting in July II then held in May II and the early planting crops in August that have less discharge. While for a long time is still a lack of water is recommended to apply the provision of water in rotation / rotation. The use of cropping pattern proved to optimize the use of water more effectively so that the water shortage can be reduced which can directly increase agricultural production Pangkep district.

3.4 Water Irrigation Quality

Based on the test results of water samples, there is an examination that does not qualify the criteria of water quality standard Class IV South Sulawesi Governor Regulation No. 69 of 2010 to meet the irrigation water source inspection Biological Oxygen Demand (BOD).Biological Oxygen Demand (BOD) or Biological Oxygen Needs an analysis of the amount of oxygen needed by aerobic bacteria to decompose (oxidize) almost all the dissolved organic substances and some organic substances suspended in water. The high values of BOD required limits illustrates the effects of pollution from sewage and industrial population to be around the River Pangkajene. Therefore, domestic wastewater should not be discharged into the river / water bodies and should be processed first and in all industries producing waste water is required to have a wastewater treatment plant.

4. CONCLUSION AND DISCUSSION

Pangkajene river discharge quantity based on the results of the analysis mainstay seen significant fluctuation of the water balance and water shortage in June I, II June, July I, August I, II August, September I, II and September and was advised to plant crops on months that have less discharge so as to reduce the occurrence of water shortages, while for the month which is still a lack of water made water delivery in rotation / rotation and perform optimization planting rice for two cropping periods are January, February, March and from May, June, July to increase the area of land planted.

Pangkajene River based on the results of water quality, the value of Biological Oxygen Demand (BOD) exceeds the threshold class IV water quality standards based Quality Standards Water Quality Regulation South Sulawesi Governor No.. 69 In 2010, it describes the effects of pollution from sewage and industrial people who are around the River Pangkajene so advised the domestic wastewater should not be discharged directly into the river / water bodies but processed first and all industrial wastewater producers are required to have an installation wastewater treatment plant.

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