JWC JOURNAL OF WORLD CONFERENCE
VOLUME 3 | NUMBER 3 | MAY 2021
Available online at http://proceedings.worldconference.id.
ISSN: 2656-1174 (online)

Calculation and Mapping of Water Demand Balance in Pacal Bojonegoro Irrigation Area

Agung Setya Budi
Faculty of Engineering Civil Engineering Study Program, Narotama University Surabaya
Jl. Arif Rahman Hakim 51 Surabaya
asetyabudi97@gmail.com

Abstract

This research describes the problems that exist in the Pacal Bojonegoro Irrigation Area, that in the dry season farmers often experience difficulties in irrigating their fields, therefore it is necessary to calculate a balance to know how much water is short. needed during the dry season. The water balance is calculated in a theoretical way, namely by calculating using the Global Planting Plan data as water demand data, while the existing water balance uses the existing discharge data. The research location is in the Bojonegoro Regency area using rainfall data at 3 stations for 10 years, discharge data for 7 years, climatological data for the last 1 year and crop data for the last 1 year. Rainfall data is calculated to be effective rainfall data, while discharge data is calculated using the weibul formula, for climatological data it is calculated to be evapotranspiration and percolation data, while plant data is used to calculate global cropping plans. Conclusions and suggestions for use as a reference are taken from the calculation results obtained and then forwarded as input to farmers using water and the Government of the Public Works Service. SDA Bojonegoro Regency to be used as an operational evaluation of the Irrigation Network.

Keywords:
Irrigation Area, Water balance, Bojonegoro Regency, Data Processing, Evaluation.

1. Introduction

1.1 Background

Water is one of the natural resources that has a very important function for human life because all the activities of living things cannot be separated from water. Not only that, because water can also be used to promote public welfare so that it is one of the basic assets and main factors in development that must be managed, preserved and maintained, especially river water.

In the concept of the hydrological cycle, the amount of water in a certain area on the earth's surface is influenced by the amount of water that enters (input) and leaves (output) at a certain time. The faster the hydrological cycle occurs, the more dynamic the water balance will be.

One of the problems that occur in Indonesia is the increasing need for basic foodstuffs caused by the very rapid population growth of Indonesia, so it is necessary to think about efforts to further increase agricultural output and prevent a high gap between the level of demand and the level of fulfillment of foodstuffs and also increase standard of living of farmers. (Satri Utama, SE, 1999)

Efforts are made to increase agricultural yields in each unit area, namely by meeting the needs of good irrigation water, so that the determination of the amount of water needed is known with certainty. Therefore, adequacy in meeting irrigation water needs should be carried out effectively and efficiently.

The use of irrigation water in East Java Province, especially Bojonegoro Regency, is still considered ineffective, this can be seen when there is a shortage of water during the dry season. Regulation of irrigation water needs has not been done accurately and optimally.

To increase agricultural yields in the Pacal Irrigation Network, Bojonegoro Regency, a mapping of the irrigation network is needed to be able to manage water use optimally. This is based on the so-called Global Planting Plan (RTTG). And it is hoped that farmers will be able to work on their fields throughout the year without the problem of water shortages.

Therefore, it is necessary to calculate and map the water balance. This aims to obtain data on the results of existing water needs to be used as a reference and can be used in the development and management of water resources for a certain period. Based on this explanation, it is necessary to conduct a study on "calculation and mapping of water balance in the Pacal Bojonegoro irrigation area".

1.2 Problem Formulation

Based on the above background, the formulation of the problem is as follows:

a. What method is used to calculate the balance of water demand in the Pacal Bojonegoro Irrigation Area.
b. What is the water demand during the dry season in the Pacal Bojonegoro Irrigation Area.
c. How to display the results of the water demand balance calculation on a map.

2. Literature Review

2.1 Previous Studies

In this study, the presentation of previous research relevant to the topics discussed, namely:

1. Analysis of the Das Renggung Surface Water Balance to Meet the Domestic and Irrigation Water Needs of the Population of Central Lombok Regency, was presented by Zulkipli, Widandi Soetopo and Hari Prasetijo, Universitas Brawijaya Malang, 2011. The steps of research activities begin with conducting surveys and observations as well as collecting the necessary data including a map of the research location, rainfall data at 5 stations, AWLR Renggung-Ponggong discharge data, Climatological data for Kupang Station, socio-economic data, population of sub-districts included in the Renggung watershed. Data analysis begins with calculating evapotranspiration using the modified Penman method. Calculation of water availability with discharge from AWLR. After obtaining data on monthly water availability in a certain year, it is continued by determining the mainstay discharge of 80% (Q80). The mainstay discharge (Q80) is used as the basis for determining water availability and is the potential water available in the Renggung watershed. (Cahyo Adi Wibowo, 2012)

2. Analysis of the Water Balance of the Upper Solo Watershed, Sub Das Bengawan Solo Hulu 3, Journal created by Julian Wahyu Purnomo Putro, student of Sebelas Maret University, Surakarta, in 2013. The availability of irrigation water is obtained from the intake discharge data of the weir that irrigates the irrigation network. The mainstay discharge is the amount of water available throughout the year with a calculated risk of failure. The reliability probability used is 80%, this means that there will be a risk of small debits from the mainstay discharge of 20% of the number of observations. In calculating the monthly land water balance, input data are required, namely monthly rainfall, monthly evapotranspiration, field capacity, and permanent wilt point. The values obtained from this land water balance analysis are the assumption prices of flat land covered with grass vegetation, land in the form of soil where the water that enters the land only comes from rainfall, only homogeneous soil conditions, homogeneous soil profile conditions so that the field capacity and the permanent wilt point represent the entire layer and stretch of land. Water balance in rivers and application of certain methods to analyze water availability, sometimes have different results. This is because each method has different assumptions, but the most important thing is to do the calibration for each method of water balance analysis so that the method can be used accurately.

3. Simulation of Water Balance at Das Rejoso Pasuruan, East Java Post-Umbulan Regional Spam Raw Water Intake, Journal made by Sheilla Barrina, Donny Harisuseno and Ery Suhartanto, Brawijaya University Malang, in 2016. In the water balance analysis method, there is a calculation of the raw water discharge for SPAM performed with 3 scenarios, namely,
   a. Scenario 1 (2500 liters / second)
   b. Scenario 2 (3000 liters / second)
   c. Scenario 3 (3500 liters / second)

   The analytical method used in determining the mainstay discharge is the Monthly-Based Charaacteristic Flow Method. and Annual Based Flow Characteristic Method. The area of the irrigation area in the Rejoso watershed used for this study is 2617 Ha. The calculation of irrigation water needs in this study uses the FPR / LPR method.

4. Analysis of the Ground Water Balance of the Center for Rice in Parigi Moutong Regency, Central Sulawesi Province, Journal made by Wenas Ganda Kurnia and Laura Prastika, Global Atmospheric Monitoring Station Lore Lindu Bariri Palu, 2016.The water balance can be calculated at a certain area and time period according to its needs general water balance equation is: Rainfall = Run off + Evapotranspiration ± KAT change. The water balance calculation procedure is based on the Thornwaite and Mather (1957) bookkeeping system with units of water height (mm or cm) for all elements and units of time daily, weekly, dasarian or monthly according to their needs. Groundwater availability is an estimate of surface groundwater conditions that can be explored by plant roots, information on groundwater availability aims to consider the suitability for rainfed land agriculture based on the availability of groundwater and adjust the planting schedule and harvest schedule and regulate the provision of irrigation water both in quantity and time. as needed. (Sheilla Barrina, 2016)

VOLUME 3 | NUMBER 3 | MAY 2021
Available online at http://proceedings.worldconference.id.
ISSN: 2656-1174 (online)

3. Research Methodology

3.1 Researchresearch

Locations Thelocations were in Pacal Irrigation Channel, Gondang Village, Sanganten Village, Sambongrejo Village, Jari Village, Pragelan Village, Krondonan Village, Pajeng Village, Kec. Gondang, Kab. Bojonegoro

3.2Flow Chart

In this research, all primary and secondary data that have been collected will be processed and analyzed to determine the amount of water availability in the Pacal Irrigation Area so that the right solution can be found if the calculation results are deficit.

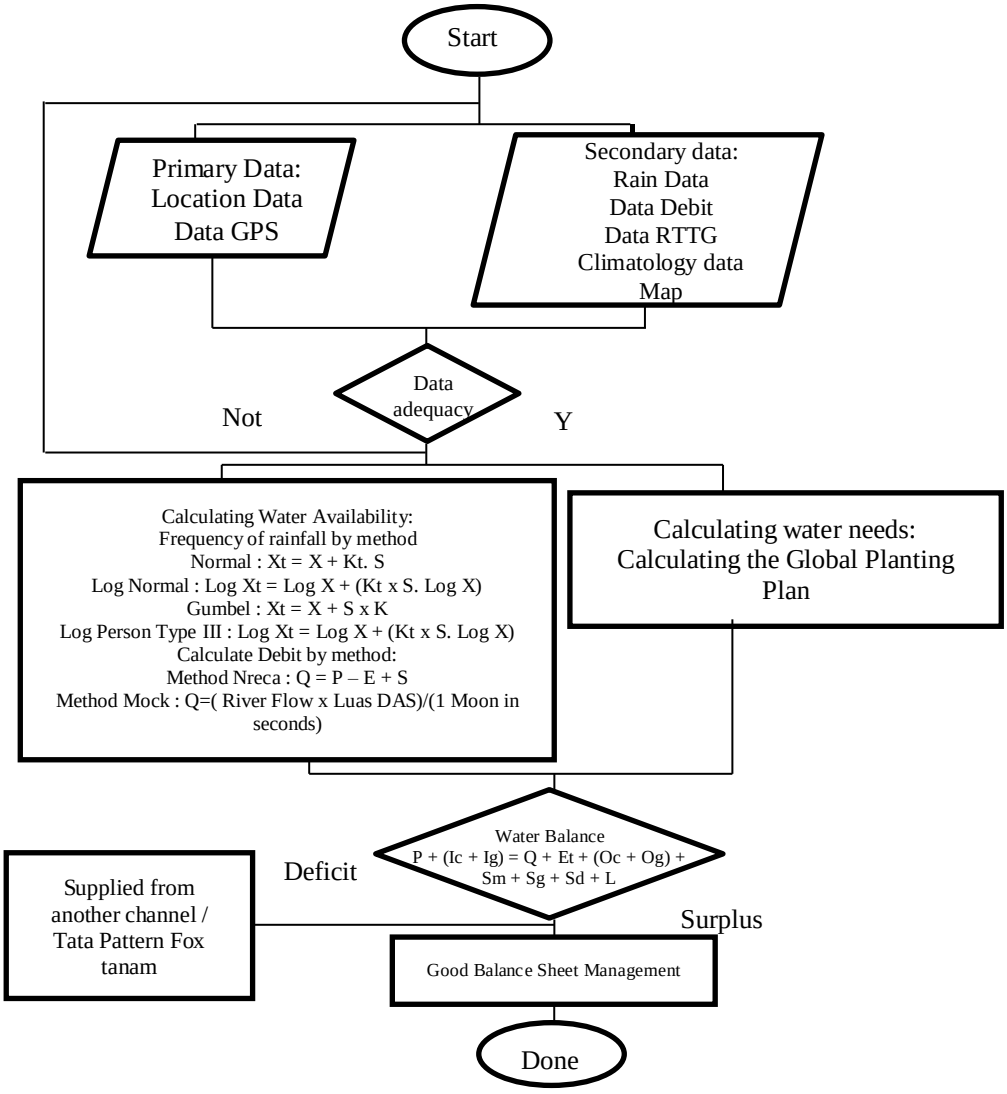

Figure 1: Flowchart

4.Analysis And Discussion

4.1 Data The

Data used in the analysis and discussion are rainfall data for 10 years from 2010 to 2019 from the 3 closest stations from the research object as initial data. Rainfall data were obtained from the Public Works Office for Water Resources of Bojonegoro Regency. This study uses data from Gondang Rain Station, Sukun Rain Station and Tretes Rain Station.

4.2. Processing Data The

Data that has been collected as above will be calculated one by one until it reaches the water balance.

4.2.1. Effective Rain

How to find effective rain by averaging the three rain stations over a period of 10 years of observational data then the data is sorted from largest to smallest. The 80 ranking sequence taken is then included in the effective rain count.

4.2.2. Mainstay Discharge

How to find a reliable debit, namely by averaging the debit data for seven years from 2013 to 2019, then the data is ranked from the largest data to the smallest data then ranked and ranked 80.

4.2.3. Evapotranspiration The

data required when calculating evapotranspiration is temperature, humidity, brightness and wind speed. The data was obtained from BMKG Karangploso Malang in 2018.

4.2.4. Water Needs in Paddy Fields (NFR)

Water needs in paddy fields include water needs for land processing, water needs for nurseries / nurseries, water needs for replacing water layers, and water needs for plants.

4.2.5 Water Balance

From the results of the above calculations, it can be directly used to calculate the balance of water demand in the Pacal Irrigation Area. These data, among others,

can be exemplified in November period I as follows:

Table 1. Water Balance Calculation Results

Moon	Period	Availability of Irrigation Water (Lt/Dt)	Availability of Irrigation Water (M^3/Dt)	Irrigation Water Needs (M^3/Dt)	Irrigation Water Needs (M^3/Dt)	Lack of Irrigation Water (M^3/Dt)	Information	Water Delivery System
November	1	188	0,188	0.583	-0.395	0.395	Not Fulfilling	Rotation
	2	180	0,180	0.680	-0.500	0.500	Not Fulfilling	Rotation
	3	266	0,266	0.569	-0.304	0.304	Not Fulfilling	Rotation
December	1	274	0,274	0.000	0.274	0.000	Fulfil	Continuously
	2	275	0,275	0.077	0.198	0.000	Fulfil	Continuously
	3	284	0,284	0.241	0.044	0.000	Fulfil	Continuously
January	1	742	0,742	0.169	0.573	0.000	Fulfil	Continuously
	2	949	0,949	0.091	0.859	0.000	Fulfil	Continuously
	3	1026	1,026	0.083	0.943	0.000	Fulfil	Continuously
February	1	1059	1,059	0.000	1.059	0.000	Fulfil	Continuously
	2	1045	1,045	0.000	1.045	0.000	Fulfil	Continuously
	3	1441	1,441	0.000	1.441	0.000	Fulfil	Continuously
March	1	1045	1,045	0.312	0.733	0.000	Fulfil	Continuously
	2	1045	1,045	0.367	0.677	0.000	Fulfil	Continuously
	3	1023	1,023	0.294	0.729	0.000	Fulfil	Continuously

April	1	882	0,882	0.402	0.480	0.000	Fulfil	Continuously
	2	946	0,946	0.221	0.726	0.000	Fulfil	Continuously
	3	986	0,986	0,305	0.680	0.000	Fulfil	Continuously
May	1	852	0,852	0.262	0.589	0.000	Fulfil	Continuously
	2	784	0,784	0.408	0.376	0.000	Fulfil	Continuously
	3	820	0,820	0.129	0.691	0.000	Fulfil	Continuously
June	1	722	0,722	0.310	0.411	0.000	Fulfil	Continuously
	2	710	0,710	0.192	0.518	0.000	Fulfil	Continuously
	3	710	0,710	0.284	0.426	0.000	Fulfil	Continuously
July	1	716	0,716	0.530	0.185	0.000	Fulfil	Continuously
	2	649	0,649	0.651	-0.001	0.001	Not Fulfilling	Rotation
	3	463	0,463	0.638	-0.174	0.174	Not Fulfilling	Rotation
August	1	346	0,346	0.613	-0.267	0.267	Not Fulfilling	Rotation
	2	355	0,355	0.396	-0.041	0.041	Not Fulfilling	Rotation
	3	287	0,287	0.450	-0.163	0.163	Not Fulfilling	Rotation
September	1	140	0,140	0.550	-0.410	0.410	Not Fulfilling	Rotation
	2	140	0,140	0.513	-0.373	0.373	Not Fulfilling	Rotation
	3	140	0,140	0.371	-0.231	0.231	Not Fulfilling	Rotation
October	1	140	0,140	0.415	-0.275	0.275	Not Fulfilling	Rotation
	2	140	0,140	0.567	-0.427	0.427	Not Fulfilling	Rotation
	3	140	0,140	0.308	-0.168	0.168	Not Fulfilling	Rotation

VOLUME 3 | NUMBER 3 | MAY 2021
Available online at http://proceedings.worldconference.id.
ISSN: 2656-1174 (online)

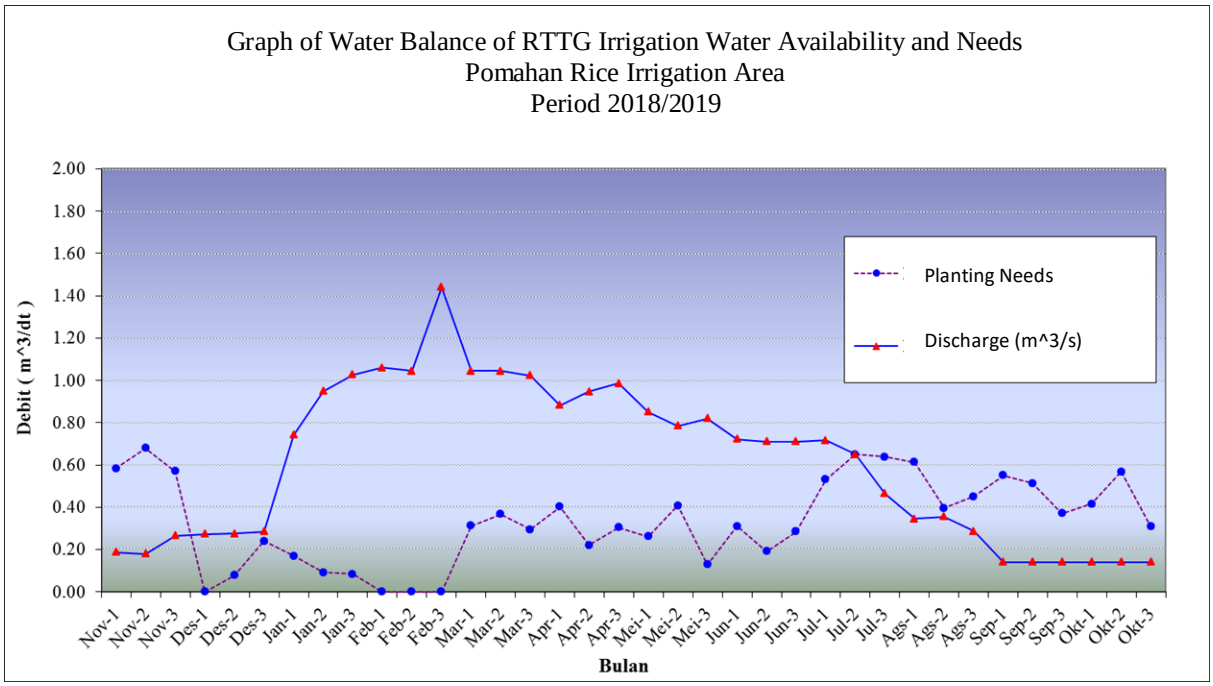

Figure 2. Water Supply Balance Graph

5. Conclusion and Recommendation

5.1. Conclusion

1. The method used in calculating the water balance:
   Rainfall using effective rainfall
   For Rice: 0.7 * R80
   For Polowijo: FD (1.25 x (Average2) 0.824 - 2.93) (100.0095 x Eto)
   FD = 0.53 + 0.0116.D - 8.94.10 ^ -5.D ^ 2 + 2.32.10 ^ -7.D ^ 3
   Discharge using reliable discharge
   - Q = Q80 min
   Evapotranspiration using the Penman method
   Eto = cx Eto *
   water balance
   Σ Availability - Σ needs ≥ 0
2. Results of water balance calculations indicate the dry season irrigation water demand in the area Pacal is 7304 m^3/ sec.
3. The basic map of the Bojonegoro Regency area that has entered the GIS application is added with the location of the irrigation building and rainfall station by adding information to the legend.

5.2. Suggestion

1. The results of the calculation of the balance of water needs in the Pacal Irrigation Area can be used by farmers to change cropping patterns because in the season there were plant pests when MK I switched to MK II, shortage of farmer labor, work aids in agriculture and the need for planting. land to match the acidity level of the land.
2. As input for the Public Works Agency. Water Resources in Bojonegoro Regency to always regulate the operation of the water distribution system so that farmers can get water.

References

Cahyo Adi Wibowo. (2012). Analysis of the Water Balance of the Irrigation Area of the Upper Bengawan Solo River, Sub Das Bengawan Solo Hulu 3. Sebelas Maret University, Surakarta.

Satri Utama, SE, B. P. S. B. P. (1999). The Interregional of Fiscal Decentralization in Indonesia: Inter Regional Social Accounting Matreix Model. Cornell Univercity.

Sheilla Barrina, D. H. and E. S. (2016). Simulation of Water Balance at Das Rejoso Pasuruan, East Java, Post Umbulan Regional Spam Raw Water Intake. In Brawijaya University Malang. Brawijaya University Malang.