

PAPER • OPEN ACCESS

Utilization of Surface Water Potential for Irrigation at Gona Village Bone Regency

To cite this article: A R A Syamsir *et al* 2023 *IOP Conf. Ser.: Earth Environ. Sci.* **1134** 012048

View the [article online](#) for updates and enhancements.

You may also like

- [Vegetation responses to climatic and geologic controls on water availability in southeastern Arizona](#)

Romy Sabathier, Michael Bliss Singer, John C Stella *et al.*

- [Water supply as a constraint on transmission expansion planning in the Western interconnection](#)

Vincent C Tidwell, Michael Bailey, Katie M Zemlick *et al.*

- [Drought and the water–energy nexus in Texas](#)

Bridget R Scanlon, Ian Duncan and Robert C Reedy



The Electrochemical Society
Advancing solid state & electrochemical science & technology

243rd Meeting with SOFC-XVIII

Boston, MA • May 28 – June 2, 2023

Accelerate scientific discovery!

Learn More & Register



Utilization of Surface Water Potential for Irrigation at Gona Village Bone Regency

A R A Syamsir¹, R T Lopa², and R Karamma²

¹ Postgraduate Program in The Department of Civil Engineering, Hasanuddin University, Makassar 90245, Indonesia

² The Department of Civil Engineering, Hasanuddin University, Makassar 90245, Indonesia

areskyamalias@gmail.com

Abstract. Availability of water is one of the important factors in determining the success of farmers in their harvest, especially during the dry season. Many efforts have been made by the government to meet the needs of the community, one of which is by paying attention to development in the agricultural sector, namely in terms of providing irrigation water with a pumping system that utilizes water sources from rivers, springs, lakes, and other water sources. To find out how large the area of rice fields that can be fed by the spring, it is necessary to analyze the amount of water availability and water requirement using the F.J. Mock Method and Cropwat 8.0 software developed by FAO. The results showed, the dependable flow (P) 80% is 0.0413 m³ /s or 41,3 lt / s with a rain catchment area of 0.493 km². The highest water requirement is December dec 3 as much as 2,191 lt/ha/sec and the lowest water requirement is December dec 1. It can be concluded that the water availability is more than the water need, so the surface water in Gona Village Springs can be utilized 4 ha in the first planting season, 20 ha in the second planting season. and 5 ha in the third season.

1. Introduction

Water is a very important element of life, because to carry out activities both in agriculture, animal husbandry, industry to energy generation, water is needed. Increasing population growth causes an increase in food needs, so that the development of irrigation networks for agricultural land is absolutely necessary to improve agricultural systems in the future [1]. In Indonesia, plantation or agriculture is the main source of meeting food needs. In the field of plantation/agriculture, water is a basic need in terms of plant growth. Without water, plants cannot grow and develop.

Many efforts have been made by the government to meet the needs of the local community. One of the efforts made by the government is to pay attention to development in the agricultural sector, namely in terms of providing irrigation water for technical irrigation systems, namely by pumping by utilizing water sources from rivers, springs, lakes, reservoirs and other water sources. Irrigation as one of the components supporting the success of agricultural development has a very important role. The provision of irrigation water for agriculture needs to be managed in a wise and sustainable manner so that its existence and function can be maintained. Management of irrigation water and its utilization must be carried out fairly and equitably so that it can provide benefits in the agricultural sector. As an effort to



increase food production, it can be done through proper and efficient management of irrigation water allocation. The distribution of irrigation water must be in accordance with the needs of the plant.

The quantity of water that is no longer able to meet the ever-increasing demand. Gona Village, Kajuara District, Bone Regency is a village that has water sources that are included in the category of springs but are not used properly by the government and local communities so that the use of surface water in the village is not effective and efficient. The use of pump irrigation can be done as a way of utilizing existing surface water. Agricultural water pumps are basically used for irrigation which aims to facilitate the agricultural process and maintenance of agricultural land. In this case, a water pump is used to move water from the water supply to a particular agricultural area. The way agricultural water pumps work is actually quite simple. The water pump draws water from a lower area, usually in the form of a well or groundwater, which is then sucked up to be transferred to a higher place, or in paddy fields or certain locations.

2. Methodology

2.1. Study Area

The location of this research will be in Gona Village Springs , Kajuara District, Bone Regency, South Sulawesi. (see Fugure 1)

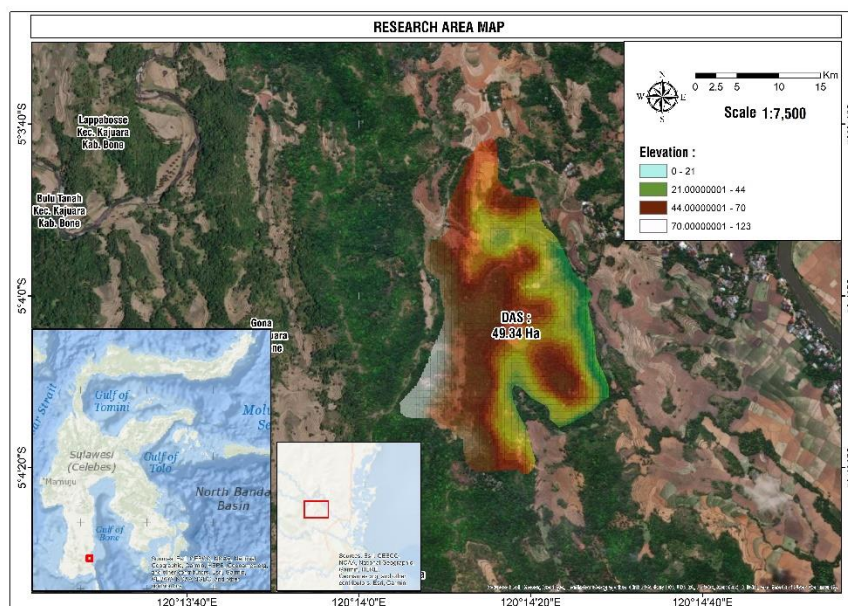


Figure 1. Gona Springs Catchment Area Map

2.2. Materials and Methods

The materials used in the research are; daily rainfall data from 2009 to 2018 obtained from the Pompengan Jeneberang Regional Office. The station is Salomekko station. Climatological data from 2009 to 2018 obtained from the Pompengan Jeneberang Regional Office. The station is Ujung Lamuru station.

In this study Google Earth and Arcgis is used to analyze the research point and the catchment area map, CropWat 8.0 and the Irrigation Planning Standards Criteria for Planning the Irrigation Network Section KP-01 used to calculate water requirement. The model is used to calculate water availability by applying the rainfall flow model approach using rainfall data, potential evapotranspiration, and hydrological characteristics to predict the amount of discharge with monthly time intervals. This model is known as the F.J. Mock model [2]. Soil type data is obtained from the RTRW document of Bone Regency. Agisoft Metashape for processing drone data. Epanet 2.0 is used to analyze water distribution.

3. Result and Discussion

3.1 Water Availability

Climatological data is taken from Ujung Lamuru Climatology Station. Existing climatological data include: data on average air temperature, data on average relative humidity, data on wind speed, and data on duration of sunlight. Potential evapotranspiration was calculated using by the FAO Modified Penman method.

FJ.Mock method is used to calculate, the average monthly discharge, which will be selected for the dependable flow. The dependable flow for irrigation water needs is planned with an 80% probability of occurrence, or with a failure of 20% [3]. After obtaining monthly water availability data in a certain year, it is continued by determining the mainstay discharge using the basic month planning method and the probability of each data being calculated by the Weibull formula [4]. It can be shown in the Table 1.

Table 1. Gona Springs Dependable Flow

Rangking (n)	Month												Max. (m ³ /s)	Min. (m ³ /s)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nop	Dec		
100	0,008	0,003	0,002	0,005	0,020	0,012	0,026	0,009	0,006	0,004	0,005	0,003	0,026	0,002
90	0,008	0,003	0,002	0,016	0,040	0,023	0,029	0,009	0,007	0,006	0,005	0,004	0,040	0,002
80	0,014	0,003	0,003	0,018	0,041	0,031	0,029	0,015	0,009	0,006	0,006	0,004	0,0413	0,003
70	0,015	0,003	0,007	0,018	0,046	0,038	0,029	0,015	0,009	0,008	0,007	0,004	0,046	0,003
60	0,015	0,003	0,012	0,019	0,058	0,057	0,059	0,017	0,011	0,008	0,007	0,004	0,059	0,003
50	0,015	0,006	0,013	0,024	0,063	0,059	0,061	0,019	0,012	0,008	0,008	0,007	0,063	0,006
40	0,016	0,006	0,014	0,026	0,081	0,059	0,062	0,021	0,013	0,010	0,010	0,008	0,081	0,006
30	0,017	0,007	0,014	0,026	0,092	0,098	0,071	0,024	0,017	0,010	0,011	0,008	0,098	0,007
20	0,017	0,020	0,019	0,038	0,092	0,104	0,084	0,036	0,017	0,018	0,014	0,016	0,104	0,014
10	0,019	0,049	0,020	0,052	0,108	0,106	0,092	0,077	0,079	0,038	0,020	0,023	0,108	0,019
Dependable Flow, Q ₈₀ (m ³ /s)	0,014	0,003	0,003	0,018	0,041	0,031	0,029	0,015	0,009	0,006	0,006	0,004		

3.2 Water Requirement

In terms of calculation, the calculation of irrigation water needs manually is guided by the Irrigation Planning Standards Criteria for Planning the Irrigation Network Section KP-01, 2010 while CROPWAT is guided by FAO because CROPWAT is software developed by FAO. The use of CROPWAT version 8.0 software is only limited to calculating irrigation water needs.

According to the Ministry of Public Works, 2010, the factors that determine water demand: Land Preparation (IR), Consumptive Use (Etc), Percolation And Seepage (P), Water Layer Replacement (WLR), Effective Rainfall (Re) and Analysis Of Irrigation Water Needs [5]. It can be shown in the Table 2 and Table 3.

Table 2. Comparison of Et_o using Planning Criteria KP-01 and using Cropwat 8.0

Month	Jan	Feb	March	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
ETo Crpwat (mm/day)	3,25	3,5	3,56	3,78	3,62	3,33	3,45	4,18	4,48	4,53	3,79	3,27
ETo KP 01 (mm/day)	3,27	3,57	3,64	3,86	3,64	3,41	3,52	4,28	4,67	4,67	3,86	3,33

Table 3. Comparison of water requirement using Planning Criteria KP-01 and using Cropwat 8.0

Month	Planting Season	Period	DR (lt/dtk/ha)	Planting Season	Period	DR (lt/dtk/ha)
Dec	I	1	0,000	I	1	0,478
		2	0,843			
		3	2,191		2	0,424
Jan		1	0,354		1	0,514
		2	0,366			
		3	0,410		2	0,563
Feb		1	0,370		1	0,887
		2	0,376			
		3	0,264		2	0,510
Mar	1	0,324	1	0,442		
	2	0,301				
	3	0,332	2	0,281		
April	1	0,000	1	0,464		
	2	0,946				
	3	2,044	2	0,388		
May	1	0,169	1	0,031		
	2	0,078				
	3	0,159	2	-0,002		
June	II	1	0,176	II	1	0,668
		2	0,203			
		3	0,193		2	0,041
July		1	0,155		1	-0,015
		2	0,139			
		3	0,178		2	0,225
Aug		1	0,021		1	0,037
		2	0,132			
		3	0,241		2	0,183
Sept	1	0,363	1	0,465		
	2	0,528				
	3	0,581	2	0,552		
Oct	III	1	0,583	III	1	0,752
		2	0,588			
		3	0,596		2	0,769
Nov		1	0,411		1	0,688
		2	0,260			
		3	0,086		2	0,538

3.3 Validation

Validation of data from the calculation of water requirement manually based on KP-01 guidelines and simulation results using Cropwat 8.0 software as shown in Table 4.

Table 4. Comparison of Calculation Results of KP-01 and Cropwat 8.0

Mouth	KP-01	Cropwat 8.0	MAPE
Jan	0,54	0,38	0,08
Feb	0,70	0,34	0,18
March	0,36	0,32	0,02
Apr	0,43	1,00	0,28
May	0,01	0,14	0,06
June	0,35	0,19	0,08
July	0,10	0,16	0,03
Aug	0,11	0,13	0,01
Sept	0,51	0,49	0,01
Oct	0,76	0,59	0,08
Nov	0,61	0,25	0,18
Dec	0,45	0,42	0,01
Percentage			8,64

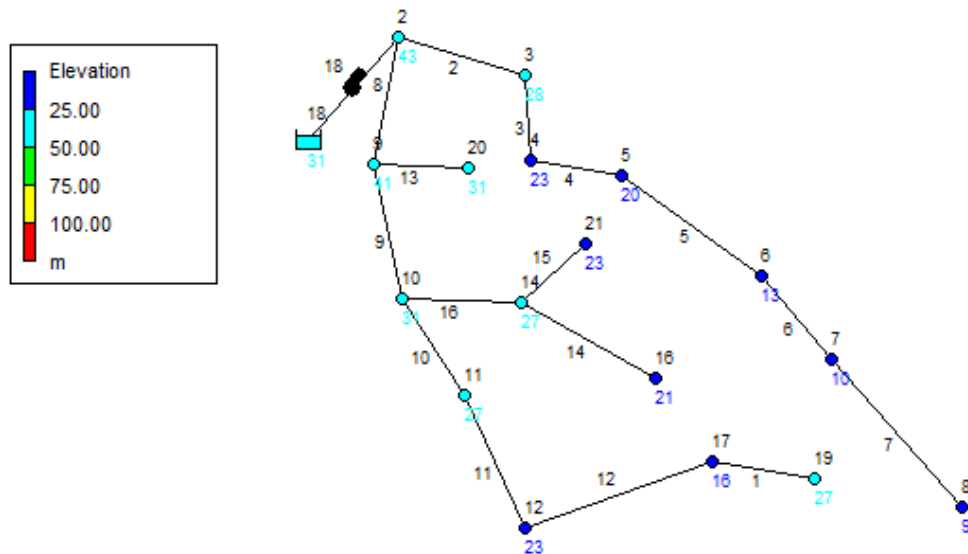
Based on the calculations performed using Cropwat 8.0 and manual calculation validation KP 01, the MAPE value (Mean Absolute Percentage Error) is 8.64 % or less than 10%.

3.4 Water Distribution Layout

The irrigation water requirement is estimated by multiplying the area of irrigated land with the irrigation water demand (lt/sec/ha) during the growing season. The area to be drained by the springs of Gona Village is 4 ha in the first planting season, 20 ha in the second planting season and 5 ha in the third planting season, as seen in Figure 2 and Figure 3



Figures 2. Water Distribution Layout in Google Earth



Figures 3. Water Distribution Layout in Epanet 2.0

4. Conclusion

The results showed, the dependable flow (P) 80% is $0.0413 \text{ m}^3/\text{s}$ or $41,3 \text{ lt/s}$ with a rain catchment area of 0.493 km^2 . The highest water requirement is December dec 3 as much as $2,191 \text{ lt/ha/sec}$ and the lowest water requirement is December dec 1. It can be concluded that the water availability is more than the water need, so the surface water in Gona Village Springs can be utilized 4 ha in the first planting season, 20 ha in the second planting season. and 5 ha in the third season.

5. References

- [1] Departemen Pekerjaan Umum. 2010 *Standar Perencanaan Irigasi KP-01*. Jakarta: Departemen Pekerjaan Umum.
- [2] Gustiana M, Azmeri, and Yulianur A 2014. Optimasi Parameter Model Dr.Mock Untuk Pengelolaan Daerah Aliran Sungai *J. Tek. Sipil Pascasarjana Universitas Syiah Kuala*.
- [3] Iqbal M T and Zulvyah F 2018 Tinjauan Kebutuhan Irigasi Saluran Sekunder Daerah Irigasi Kelara *Jurnal Penelitian* (Makassar : Politeknik Negeri Ujung Pandang)
- [4] Limantara L M 2010 *Hidrologi Praktis* (Bandung: CV. Lubuk Agung)
- [5] Sawun F L 2013 *Studi Perencanaan Irigasi Pompa pada Daerah Irigasi BKB. I Desa Bulu Kecamatan Pilangkeceng Kabupaten Madiun* (Malang : Universitas Tribhuwana Tungga Dewi)