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# Analysis of potential water availability of the Baumata spring protected area in Baumata Village, Taebenu District, Kupang Regency, Indonesia

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**ABSTRACT**

Baumata water resources are subsurface water resources that come out as springs naturally, which are continuously used to meet the needs of clean water/raw water, industry/companies, and food crop agriculture. Changes in land use of protected areas are one of the factors that affect the discharge conditions of the availability of natural available Baumata spring water resources. This research uses the existing Water Balance Hydrological Model package for the rain to surface run off and subsurface flows (springs). The Hydrological Model Package used in the research to be carried out is the Mock Hydrological Model. The research variable is the availability of water resources for the land use of the Baumata spring protected area. Variables of availability of water resources include data: climate, rain. Baumata spring discharge and characteristics of protected areas to evaluate the potential availability of existing water resources. The results showed that the availability of Baumata spring is continuous because the flow is steady. Utilization of Baumata spring for the raw water needs of the local community AURI PDAM Mineral water, for agriculture/plantation, for PT Semen and Shipping. The continuity of availability is strongly supported by the potential of natural protected areas that exist in response to rain events/events on the natural protected areas.

***Key words :*** *Water resources, Water availability, Hydrological model*

## Introduction

Protected Forest Area is a forest area that has distinctive characteristics that are able to provide protection to the surrounding area and its subordinates as a regulator of water management, preventing flooding and erosion and maintaining soil fertility (Presidential Decree of the Republic of Indonesia Number 32 of 1990 concerning Management of Protected Areas.

Baumata water resources are subsurface water resources that come out as springs naturally, which are continuously used to meet the needs of clean water and raw water, industry/company, and food crop agriculture. Changes in land use in the protected area of the Baumata spring is one of the factors that affect the decrease in the flow of the availability of natural available Baumata water resources. Joleha, *et al.* (2017) stated that changes in land use patterns disrupt the hydrological function because it is a water transmission vessel, a buffer function and a gradual water release function. Changes in land use that are not properly controlled will cause a disturbance in the hydrological balance, which is characterized by a very high difference in river water discharge between the rainy and dry seasons, and

affects the availability of water. Joleha, *et al.* (2017) stated that an analysis of water availability and demand is needed to support better management planning, determine activities that can balance water supply and demand, and are even expected to increase water reserves.

## Materials and Methods

### The Study Area

The Study area is located in Baumata Village, Taebenu District Kupang Regency.

Spring water Baumata area is located around 211-263 mpdl, with a wavy and hilly topography with alluvial or clay soil conditions.

### Research Methods

This research uses watter balance hydrology package for diverting rain into surface and subsurface flows, the hydrological package used in the research mock hydrologycal research.

### Data Analysis Model

$Q = P - Eta \pm \Delta S$ ……

where:
Q = water flow rate (mm)
P = rain (mm)
Eta = actual evapotranspiration (mm)
ΔS = change in soil moisture reserves.

### Model Structure

The structure model of the mock model can be describe as follows:

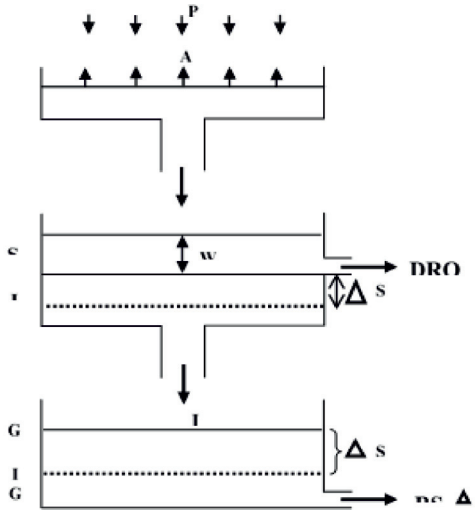


**Fig. 1.** Mock Model Structur (Hadisusanto, 2010)

Where :
P = *rainfall* (mm)
AET = actual evapotranspiration (mm)
ER = *excess rainfall* (mm)
DRO = *direct runoff* (mm)
WS = *water storage* (mm)
ΔSM = *change of soil moisture* (mm)
SMC = *soil moisture capacity* (mm)
ISM = *initial soil moisture* (mm)
ΔS = *change of water storage*
IGWS = *initial ground water storage*
GWS = *ground water storage*
BSF = *base flow*
CF = plant coefficient
Eto = potential evapotranspiration
AET = CF x Eto ER =P - AET
WS = ER - ΔSM ISM = $SM_{i-1}$
$ISM_{Feb} = SM_{jan}$ IGWS = $GWS_{i-1}$
$IGWS_{feb} = GWS_{jan}$ $I=C_w$ x WS $=C_d$ x WS
GWS = 0,5 x (1+k) x I + k x IGWS
$Q_{BSF}$ = I-ΔS =I – (GWS – IGWS)
$Q_{TOT}$ = DRO + $Q_{BSF}$

## Results and Discussion

### Description Research Site

Spring water Baumata area is located around 211-263 mpdl, with a wavy and hilly topography with alluvial or clay soil conditions. Based on the Geological map of the Transmigration Area Physical Planning Project (RePPProT) 1989, Taebenu Regency is included in the Noele.

Formation and the Coral Limestone Formation with a soil solum layer between 30-60 cm.Water originating from the protected area of the Baumata forest has a large discharge and continues to flow throughout the year. Agricultural land and plantations around the Baumata area are highly dependent on this water.

This spring is also used as a source of raw water for PDAM Kupang Regency, PT. Aguamor Timorindo Baumata is a bottled drinking water company that utilizes water from the Baumata protected area with the trademark Aquamor.

This bottled water is enjoyed by the general public, especially Kupang. The swimming pool which is managed by the Kupang Regency Tourism Office in supplying water needs comes from the Baumata spring. PT Angkasapura and the Air Force also took advantage of the services of this area.

**Protected Area Potential**

The potential of the area of approximately 36 ha, whose beauty is always maintained until now and is under good supervision from the NTT Provincial Forestry Service and the Kupang District Forestry Service. The protected area from the beginning was designated as a protected area marked by a number of piles of natural bricks in the form of primaids, as many as 85 pieces along the boundaries of the area. In the latest developments, this natural boundary has been installed by the Forestry Service, pillars have been installed, to keep the community from breaking through. The Baumata spring protected area has a natural cave point in a protected forest/ protected area. From the results of the interview, information was obtained that this natural cave was the starting point for the emergence of the Baumata spring. While the second point is the place where the current PDAM reservoir has been built. The protected area of Baumata springs is overgrown with various plants, consisting of shrubs, teak, tamarind, white and red banyan, tamarind, gamalia, johar. Its distribution varies and evenly throughout the region. This is possible because of the natural distribution of these plants or the presence of forest intervention is not carried out.

**Water Availability Analysis**

Analysis of water availability uses the Mock model method by inputting rain and climatological data as well as secondary and primary data for Baumata spring discharge. The results of the analysis show that the Baumata spring discharge is available throughout the year, with high fluctuations in the discharge during the rainy season (wet month) and tends to decrease in the dry season (dry month). Graphically, the availability of Baumata springs is based on the results of calibration, verification and simulation.

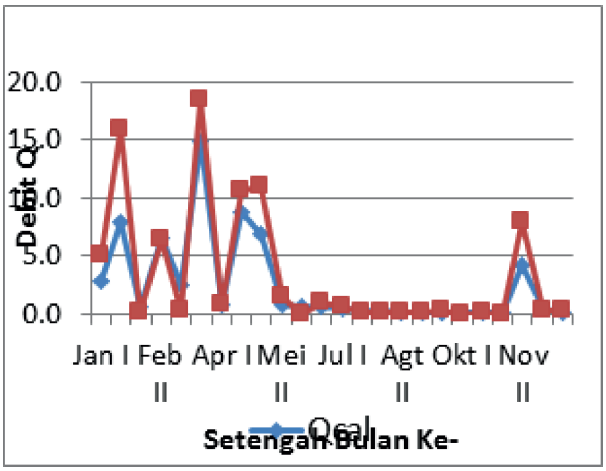


**Fig. 2.** Grafik Discharge Calibration 2021 Baumata Spring Water

The calibration results for the measured and calculated discharges show the same trend between the calculated and measured discharges. After estimation and optimization, it is concluded that the model is reliable/can be used.

Based on the picture above, it shows that the highest Baumata spring discharge falls in March, both observation discharge and calculation discharge. Similarly, the lowest discharge in the hot months. The results of the verification of the Baumata spring discharge are carried out to ensure that the parameter values of the model calibration results are appropriate. The graph shows the closeness of the observed and predicted discharge values. This closeness is due to the optimum value of the model parameters used. Based on the results of the verification carried out, it is known that both the measured discharge and the measured discharge of the Baumata spring tend to follow the amount of rainfall that occurs in the protected area of the Baumata spring.

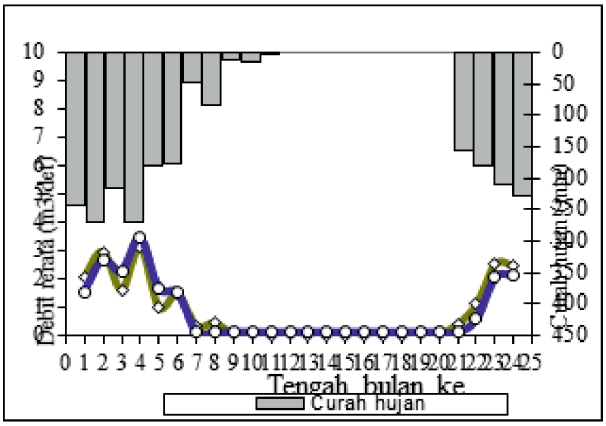


**Fig. 3.** Baumata Spring Water Verification results graph for 2021

The simulation results of the Baumata spring discharge on the rainfall that falls in the area, show that the Baumata spring discharge increases in the rainy season and decreases in the summer. Based on the characteristics of the protected forest area of the Baumata Springs which is rocky/coral, it is very possible that during the rainy season most of the

rainwater that falls in the protected area will infiltrate and fill the ground water which will further increase the discharge of the Baumata spring. The more rainfall in the protected area, the more available the Baumata spring discharge Statistically in the scatter diagram, it shows that there is a strong relationship between available discharge, rainfall and the existing protected forest area. Forest areas provide an opportunity for rainwater to escape into Baumata spring discharge. This answer is measured by the magnitude of the correlation coefficient reaching 0.877 (87.7%), the increase in linear discharge to rainfall and forest protected areas that are sustainable.

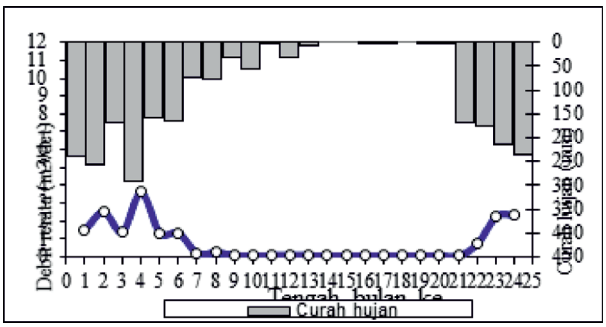


**Fig. 4.** Graph of the Result of the 2021 Baumata Spring Waterng Discharge Simulation

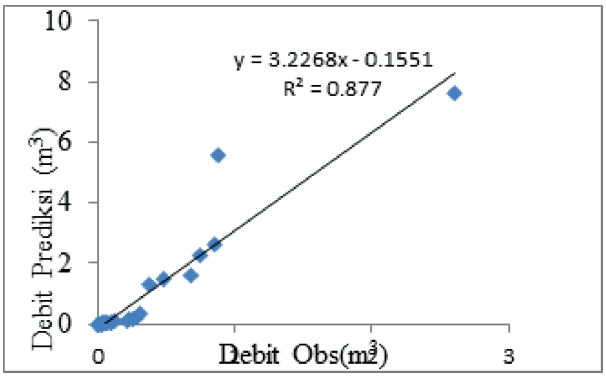


**Fig. 5.** Scatter diagram of Baumata Spring Water discharge simulation results in 2021

## Conclusion

1. Availability of Baumata spring is highly dependent on the amount of rainfall and the condition of the existing protected forest area
2. The availability of Baumata spring tends to follow the high and low rainfall that occurs, where the discharge will increase in the rainy season and decrease in the summer.

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