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Research Article

Identification of Water Resources in the East Sumba Region for Land Irrigation Requirement

Raden Herdian Bayu Ash Siddiq[1]
Departement of Civil Engineering, Widyatama University, Indonesia
raden.herdian@widyatama.ac.id

Fuad Hasan[2]
Departement of Civil Engineering, Widyatama University, Indonesia

Bambang Eko Widyanto[3]
Departement of Civil Engineering, Widyatama University, Indonesia

Corresponding author: Departement of Civil Engineering, Widyatama University, Indonesia
Email: raden.herdian@widyatama.ac.id

Abstract

East Sumba Regency is one of the regencies in East Nusa Tenggara Province, where is an inseparable part of national development. The topography of East Sumba is generally in the coastal area, sloping to wavy lowland and hilly. Areas with elevations above 1,000 meters are only a few in hilly and mountain areas. One of the dominant and empowering sectors in East Sumba district is the agricultural sector, although the agricultural sector is the first place in regional income, the area of rice fields that can be cultivated is only 11% of the total district land area, it's because the water supply problem. The problem of water supply in East Nusa Tenggara Province is caused by many factors, namely rainfall, soil, vegetation, water sources, locations to utilize, reservoirs, air quality, supporting facilities and infrastructure, and the community. From the results of this study, it was found that there are several recommendations for the use of water sources: (1) Surface Water, there are 5 rivers namely Melolo, Rindi Majangga, Tatung, Mburukulu and Kaliongga rivers which are always available with water. The water from these rivers can be utilized by taking and flowing it to the location of artificial reservoirs in the riverside area. (2) Reservoirs and Irrigation Pipes: it is possible to build several dams in the upstream area of the land area next to the river. The irrigation combination system uses pipe, gravity, and pump. (3) Underground Water: water from underground has a small potential with a discharge of about 0.1 - 1 liter per second. However, there are indications that the water is used by local residents by using artesian wells. (4) Desalination: Very Possible with Seawater Reverse Osmosis System (SWRO) to irrigate concession lands near the coast.

Keywords
East Sumba, Water Resources, Irrigation

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Introduction

East Sumba Regency is one of the regencies in East Nusa Tenggara Province, where is an inseparable part of national development. East Sumba Regency is located in the economic area between Central Sumba, West Sumba and Southwest Sumba Regencies. Sumba Island, one of the islands in the NTT region, is an island with a drier climate than other islands, especially East Sumba Regency, which is even drier than Central Sumba and West Sumba. The topography of East Sumba is generally flat in the coastal areas, sloping to wavy in the lowlands <100 meters and hilly. Areas with elevations above 1,000 meters are only a few in hilly and mountain areas. Agricultural land is mainly found in the northern coastal plains which have sufficient water on the surface. Although the soil conditions in East Sumba are less fertile, more than half of the population of East Sumba Regency are farmers. Although the agricultural sector occupies the first place in regional income, the area of rice fields that can be cultivated is only 11% of the total land area of the district. Some locations where communities also grow rice have been assisted with irrigation infrastructure in certain locations, but the main food crop cultivated by the Sumbanese people is corn. In Southwest Sumba Regency, many people grow upland rice (Rengganis, 2016).
The dominant and competitive sectors in East Sumba district are agriculture, manufacturing and trade, hotels and restaurants. The non-dominant sectors are the mining and quarrying sector, the electricity, gas and water supply sector, the construction sector, the transportation and communication sector, the banking sector, financial and leasing institutions and the services sector (Mukhtar, 2020; Tehik, 2019).

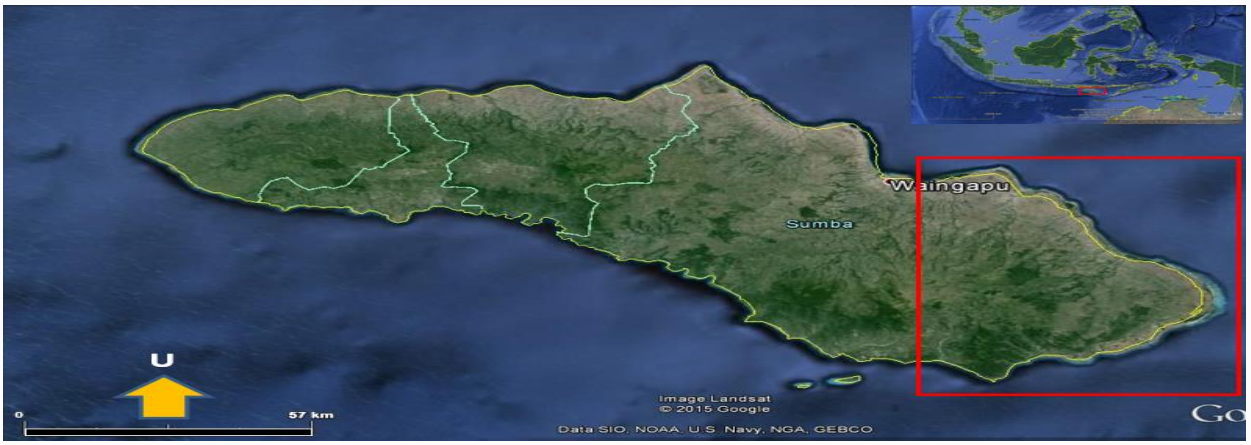


Figure 1: Research Location

The potential and opportunities for using groundwater for dryland irrigation in Nusa Tenggara are technically possible to implement. Therefore, it is necessary to identify water sources and their potential in detail so that the use of ground water can support each other with surface water. The government has started to pay attention to the use of ground water and surface water for irrigation (Soedireja, 2017).
The problem of water supply in East Nusa Tenggara Province is caused by many factors, but in general the components that influence the problem are mapped using the interrelationship model system, including rainfall, soil, vegetation, water sources, settlement locations, reservoirs, water quality, facilities and infrastructure. supporting infrastructure, and community (Wardiha et al., 2018).
Therefore, research is needed on the identification of potential water sources in the East Sumba region starting from surface water to groundwater potential.

Methodology

In this study, secondary data analysis and direct observation in the field were used. The secondary data used are as follows:

a. Climatological Data (Source: BMKG)

b. Geological Map Sheet Waikabubak and Waingapu, Nusa Tenggara, 1993, scale 1:250,000 (Geological Research and Development Center, 1993).
c. Hydrogeological Map 1:250,000 scale, 1965 (BGR, 2020).
d. DEM SRTM

Based on the climatological data, rainfall and evaporation were analyzed, while the river watershed in the study site were identified based on the Topographic Map and DEM SRTM. Then carried out an analysis of the potential for underground water based on Geological and Hydrogeological maps.

Result and Analysis

Based on the results of the Topographic Map analysis and direct field observations, there are 9 major rivers in East Sumba, 5 of which are Melolo, Rindi Majangga, Tatung, Mburulu and Kaliongga rivers which always available of water. While the other 4 rivers, namely the Patawang, Wera, Wanga and Kadumbul rivers, further observations must be made for the state of the water. The detailed area for each River Area as follows:

1. WS Kadumbul : 28501,413 ha
2. WS Wera : 3407,865 ha
3. WS Wanga : 6119,132 ha
4. WS Patawang : 7744,865 ha
5. WS Melolo : 22152,006 ha
6. WS Rindi : 27437,025 ha
7. WS Tatung : 5829,812 ha
8. WS Mburukulu : 3343,192 ha
9. WS Kaliongga : 9102,127 ha

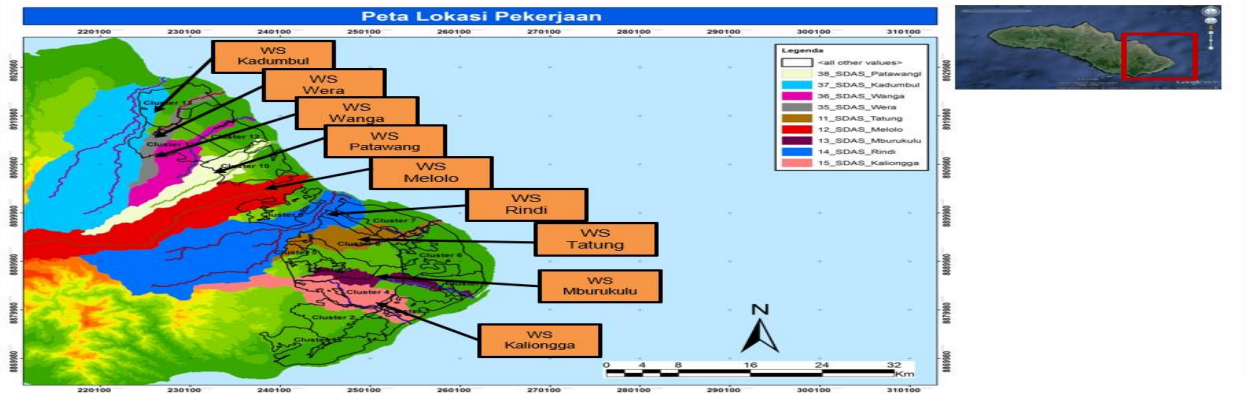


Figure 2: River Watersheds


Tatung


Melolo

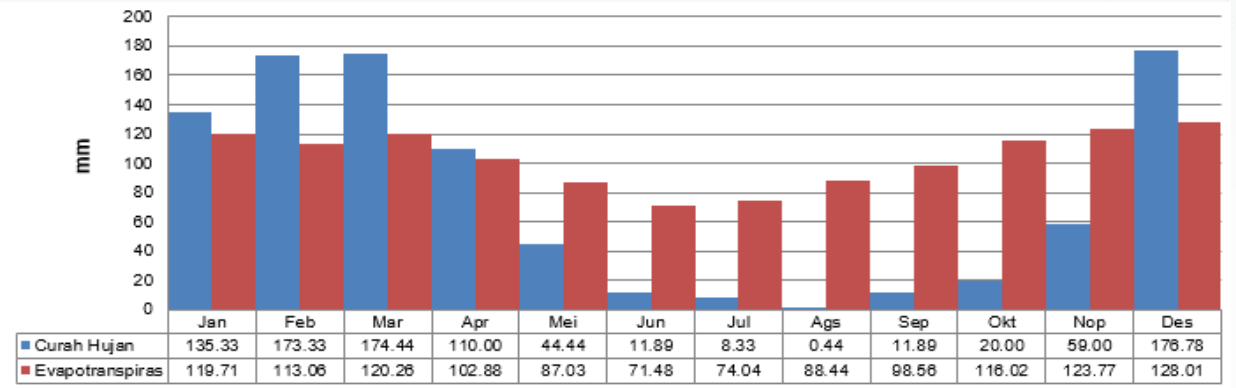

Rindi Majangga


Mburukulu

Kaliongga

Figure 3: River Condition

Based on the analysis of the amount of rainfall, it was found that in several years in the Waingapu area and its surroundings the maximum rainfall occurred in February with a value of 316 mm, while the minimum rainfall was in July to September where the rainfall in one month was below 10 mm. Meanwhile, based on air humidity and sunlight data above 80%, it shows that surface water evaporation is high from May to November. The following picture is a comparison of the amount of rainfall (blue) and evapotranspiration (red) at the study site.



	Jan	Feb	Mar	Apr	Mei	Jun	Jul	Ags	Sep	Okt	Nop	Des
Curah Hujan	135.33	173.33	174.44	110.00	44.44	11.89	8.33	0.44	11.89	20.00	59.00	176.78
Evapotranspiras	119.71	113.06	120.26	102.88	87.03	71.48	74.04	88.44	98.56	116.02	123.77	128.01

Figure 4: Comparison of the Amount of Rainfall and Evaporation

It can be seen that rainfall and evapotranspiration fluctuate throughout the year. From May to October, it appears that evapotranspiration is greater than rainfall, so it is estimated that surface water from rainwater will evaporate completely (from reservoirs) in the months between May and November, one reliable source is surface water that comes from springs flowing in rivers.
As for the potential for underground water sources based on the Hydrogeological Map, it was found that the East Sumba area has very small ABT potential between 0.1 liter/second to 1 liter/second, with the subgrade condition formed from permeable reef limestone. For the Central Sumba area, it has very small ABT potential (0.1 liter/second) with permeable subgrade of reef limestone. If there is rain, taking into account the high evaporation, it is very unlikely that surface water will be obtained that can be utilized unless using good technology.

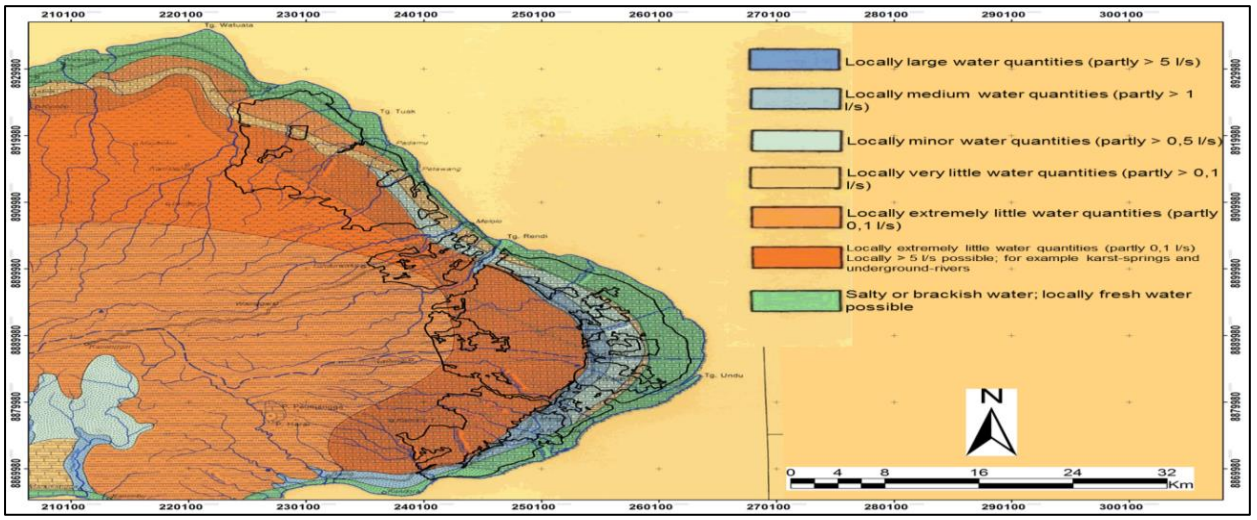


Figure 5: Hydrogeological Map of The East Sumba Area

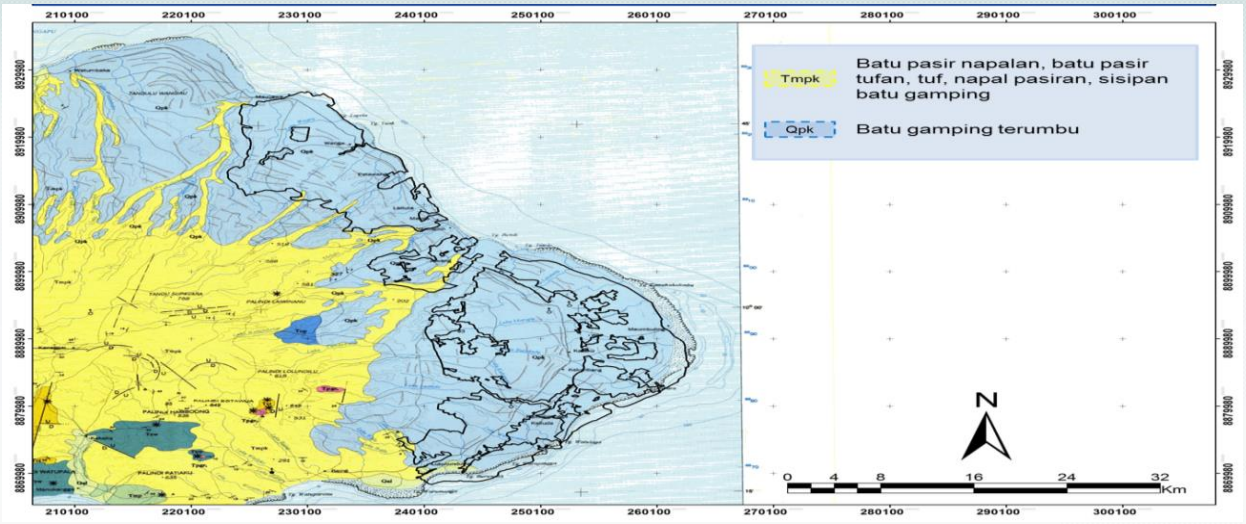


Figure 6: Geological Map of The East Sumba Area

Based on the topographical analysis of DEM SRTM and in several places, validation was carried out in the field with field visits on 11 to 13 March 2015, several examples of trough locations that can be used as water reservoirs can be seen. However, most of the trough locations in East Sumba have limestone subgrades which tend to be permeable. So that the water will be quickly absorbed to the bottom of the trough.

Figure 7: Trench Location Condition

In addition to water sources on land, sea water can also be used as a source of irrigation water, especially for land near the coast. Seawater distillation is the oldest and most commonly used seawater desalination method. Seawater distillation is a separation method by heating seawater to produce water vapor, which is then condensed to produce clean water. Desalination efforts with membranes are divided into two, namely reverse osmosis and electro dialysis. The Reverse Osmosis system is a common and economical system in use today.
The SWRO system installation consists of 4 (four) main processes, namely pretreatment, pressurization, membrane separation, and post-treatment stabilization. The advantage of SWRO technology is the speed of the processing process in producing clean water. This technology uses pump power so that it can force more water production.

Conclusion

Based on field observations, it can be estimated that the northern area is generally dry. This is indicated by several rivers in the northern area that are dry. Coupled with the basic soil layer which is dominated by young limestone which is permeable, so that the water that falls quickly seeps into the ground.
As for the southern area, the area is wetter, this is based on the results of observations in the field there are several rivers that flow quite fast and have quite a lot of discharge. In the southern part

there are also many natural dams, which indicates that the soil structure in the southern part is mostly impermeable.
There are several recommendations for the use of water sources at the study site, namely (1) Surface Water: there are 5 rivers namely Melolo, Rindi Majangga, Tatung, Mburuulu and Kaliongga rivers which are always available of water. The water from these rivers can be utilized by taking and flowing it to the location of artificial reservoirs in the riverside area. (2) Reservoirs and Irrigation Pipes: it is possible to build several reservoirs in the upstream area of the land area next to the river. The irrigation system uses combination between pipe, gravity, and pump. (3) Underground Water: water from underground has a small potential with a discharge of about 0.1 - 1 liter per second. However, there are indications that groundwater is used by local residents, namely by using artesian wells. (4) Desalination: It is possible with the Sea Water Reverse Osmosis (SWRO) system to irrigate concession lands near the coast.

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