

# **DROUGHT RISK ASSESSMENT FOR RESOURCE MANAGEMENT TOWARDS RESILIENT DEVELOPMENT IN EROMOKO DISTRICT, WONOGIRI REGENCY, CENTRAL JAVA**

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## **ABSTRACT**

Eromoko is a drought-prone district in Wonogiri Regency, Central Java, thanks to the karst landform and steep topography that dominate almost half of district's area. Drought usually hits the district during the dry season and harms many sectors, especially agriculture, household, and health. However, the level of drought risk is different in each part of the district. It depends on the hazard, vulnerability, and adaptive capacity aspects of each region. This research aims to generate drought risk map based on those aspects then identify the high-risk zone where resources urgently need to be managed towards resilient development. All information analyzed in this research were obtained from secondary data. Combination between qualitative and quantitative analyses, as well as rank method were then applied to it. Drought hazard map was generated from geological, soil, and elevation data. Social vulnerability map was generated from population density, disability ratio, and sex ratio data. Economic vulnerability map generated from paddy field ratio and dry field ratio data. Adaptive capacity map was generated from educated people ratio. Social vulnerability, economic vulnerability, and adaptive capacity maps were then overlaid and resulting a drought vulnerability map. Drought risk map was obtained by integrating hazard and vulnerability maps using rank method. Suitable resource management for high-risk area was then analyzed by considering the entire risk factors. The drought risk assessment result successfully identified Basuhan, Pucung, Ngandong, Tempur Harjo, Panekan, and the southwest part of Pasekan as the high-drought risk zones. The risk in Basuhan and Pucung is mainly controlled by geological, soil, and topographical conditions; low educational level; as well as the high dependency on agricultural sector. Topographical conditions and high dependency on agricultural sector are the main risk factors in Ngandong and Tempur Harjo Villages. Risk level in Panekan is mainly controlled by high dependency on agricultural sector, as well as high ratio of disability and sex ratio. As for the case of Pasekan, geological and soil conditions are the main factors. Finally, different resource management based on critical risk factors in each area is recommended by this reasearch in order to achieve resilient development in Eromoko District.

**Keywords:** drought, risk assessment, DRR, resource management, resilient development

## **INTRODUCTION**

### ***Background***

Eromoko is a drought-prone district in Wonogiri Regency mainly due to the existence of karst landform and steep topography, which is worsened by the low precipitation during the dry season. The karst landform is manifested in the type of rocks and soils in the area, which dominated by limestone (Surono *et al.*, 1992) as well as regosol and grumusol (Soil Research Institute, 1966). The low precipitation during the dry season in 2015 even reached 0 mm/month in 2015 during the period of Juli-October (BPS of Wonogiri Regency, 2016).

Drought could harm various sectors in Eromoko District, especially agriculture, household, and health. Agriculture sector could suffer crop failure that might reduce the income of the farmers (Cennachi, 2014; Takama *et al.*, 2014). Reducing income of farmers means a threat to farmer prosperity. This factor is considered play a big role in the reasons behind the other problems, such as low education level and sex ratio. The shortage of water supply could disrupt the household sector, since the families will difficult to obtain water, especially for drinking, washing, bathing, and cooking (Makoka, 2008). Such difficulty will make the people tend to use any kind of water for their needs without considering the quality, thus health conditions of the people could degrade (Yusa *et al.*, 2015).

Disaster risk reduction (DRR)-based resource management measures is one of the solutions in order to achieve resilient development in Eromoko District. Such kind of resource management needs to identify the risk factors behind drought in the district. This research attempts to identify the risk factors by doing drought risk assessment in order to determine suitable resource management measures for the district. Hopefully, the result of this research could be followed up with more detailed research that could help in managing the resource for achieving resilient development.

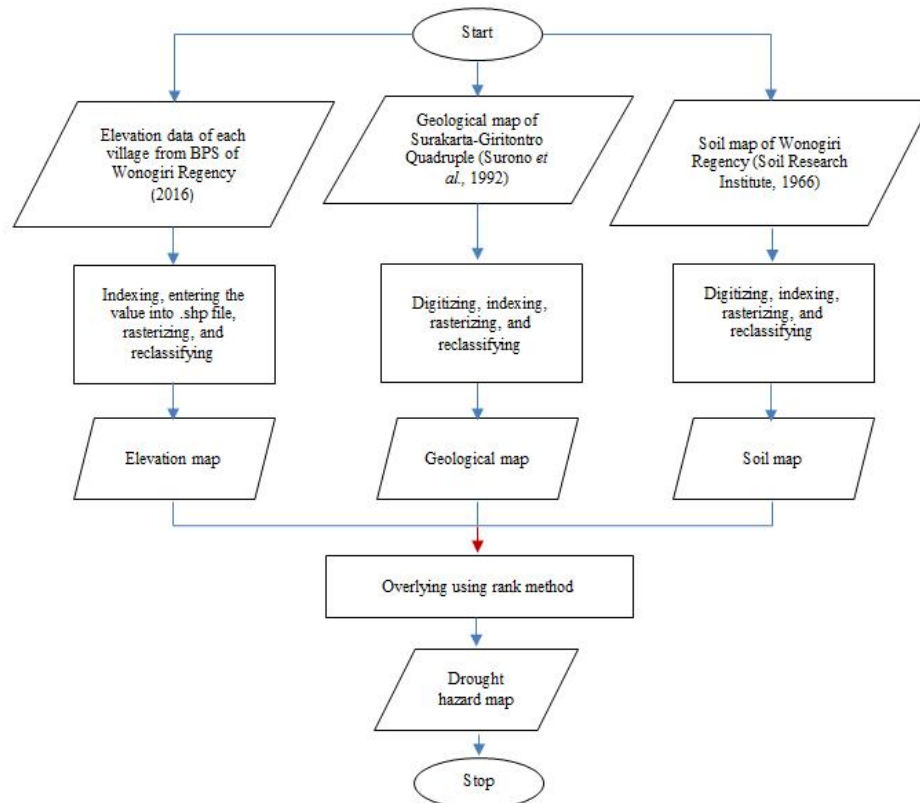


Figure 1. Flowchart for generating drought hazard map of Eromoko District

### Objectives

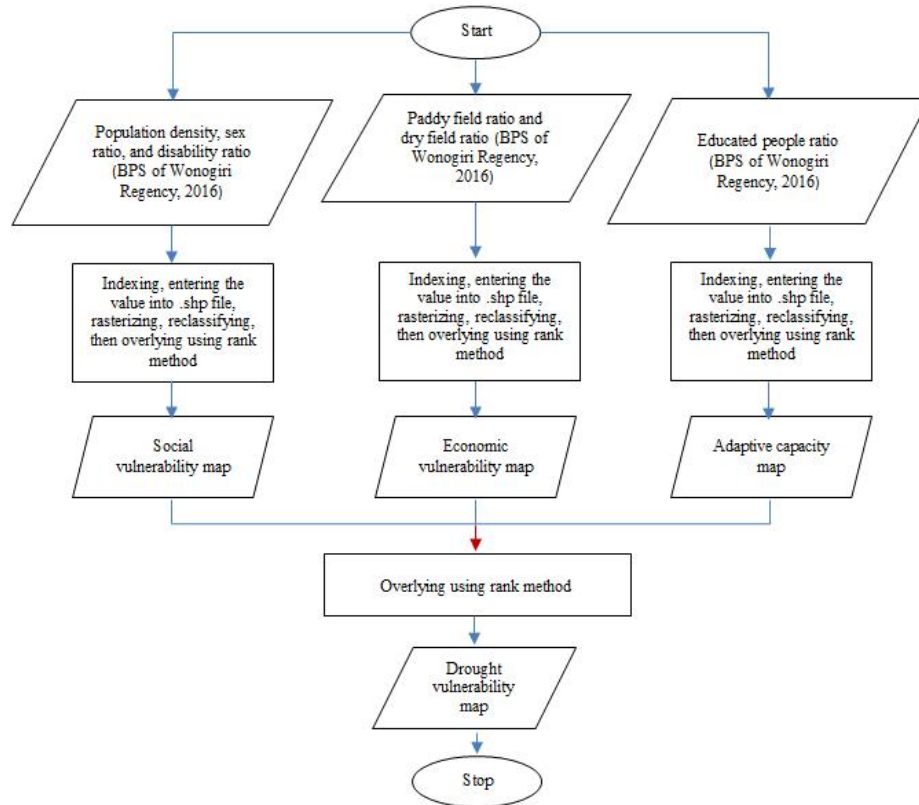
This research mainly aims to identify suitable resource management measures for Eromoko District based on the result of drought risk assessment in order to achieve resilient development. The main purpose of this research could be broken down into 3 special purposes, which are: (1) mapping drought risk potential of the study area; (2) identifying high-drought risk zones and their underlying risk factors; as well as (3) determining suitable measures of DRR-based resource management that support resilient development in the study area.

### METHODOLOGY

#### Data Collection

All information for this research was collected from secondary data. Geological information was obtained through digitization on “Geological Map of Surakarta-Giritontro Quadruples” with a scale of 1:100000 (Surono *et al.*, 1992). Soil information was also obtained through digitization on “Peta Tanah Kabupaten Wonogiri, Jawa Tengah” (Soil Research Institute, 1966). As for the remaining information, including topographical conditions, population density, sex ratio, disability ratio, paddy field ratio, dry field ratio, and ratio of educated people, were collected and derived from a report titled “Eromoko District in Figures 2016” (BPS of Wonogiri Regency, 2016). Topographical information was

derived from elevation data of each village. Population density and sex ratio were directly obtained from the report. Disability ratio was obtained by dividing the number of disable people of a village with the total population of the village. Paddy field ratio was generated by dividing the total paddy field area of a village (Ha) with the total area of the village (Ha). The same method was used for generating dry field ratio. As for the ratio of educated people, it was obtained by dividing the total number of people in a village who graduated from high school and higher education with the total population of the village.

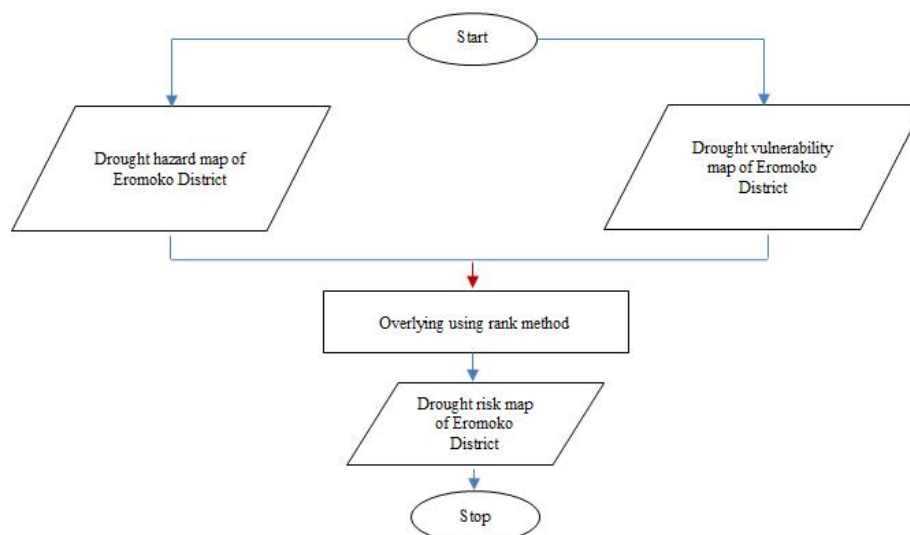


**Figure 2.** Flowchart for generating drought vulnerability map of Eromoko District

**Data Processing and Analysis**

Qualitative-quantitative analyses and rank method were applied to the data in order to generate drought risk map of Eromoko District and identify the priority zones for resilient resource management. The flow of data processing could be seen in Fig. 1, 2, and 3. Drought hazard map was generated from geological, soil, and elevation data. Social vulnerability map was generated from population density, disability ratio, and sex ratio data. Economic vulnerability map generated from paddy field ratio and dry field ratio data. Adaptive capacity map was generated from educated people ratio. Social vulnerability, economic vulnerability, and adaptive capacity maps were then overlaid and resulting a drought vulnerability map. Drought risk map was obtained by integrating hazard and vulnerability maps using rank method. The drought risk map was then

analyzed to identify the high-drought risk zones that will be prioritized for resource management that supports resilient development in Eromoko District.



**Figure 3.** Flowchart for generating drought risk map of Eromoko District

### ***Discussion of the Results and Formulation of Conclusions***

Discussion of the results was done by analyzing each underlying risk factors and its consequences in order to formulate resource management solutions in each high-drought risk zone. The analysis of risk factors and its possible consequences was based on the components of hazard and vulnerability aspects of each zone. As for the formulation of resource management solutions, it was conducted by considering the underlying risk factors and potential local resource of Eromoko District. Lastly, conclusions were formulated by emphasizing the main results of the research that in accordance with the objectives.

### **RESULTS AND DISCUSSIONS**

High-drought hazard zones are identified in Basuhan, most of Pucung, northwestern part of Pasekan, as well as southeastern part and a little area in the northeastern part of Tempur Harjo (Fig. 4). Hazard level of those areas is mainly controlled by the combination of geological, soil, and topographical factors that appears as karst landform. The karst landform, which has a steep topography, is geologically part of Wonosari Formation that mainly consists of limestone. Regosol and grumusol dominate the soil composition of the area. The high porosity characteristic of karst landform makes it difficult to preserve surface water and shallow aquifer. The drought susceptibility of karst landform is worsened by the steep topography of the area. Water flows from the higher regions to lower regions, thus the steep topography makes the higher regions drier, while the lower regions remain obtaining sufficient water supply.

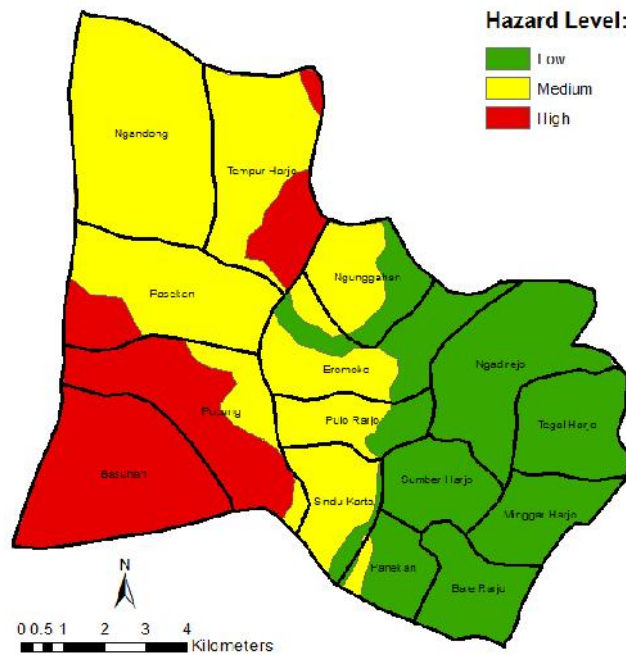


Figure 4. Drought hazard map of Eromoko District

High-drought vulnerability zones are identified in Basuhan and Panekan (Fig. 5). Vulnerability level in Basuhan is mainly controlled by the combination of high dependency on dry field agriculture, high sex ratio, small number of educated people, as well as high disability ratio. As for vulnerability factors in Panekan are high sex ratio and high disability ratio.

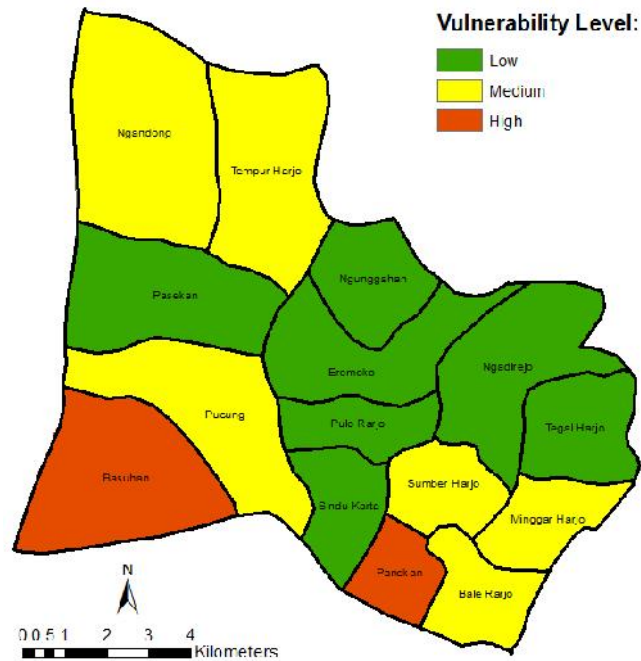


Figure 5. Drought vulnerability map of Eromoko District



## CONCLUSIONS

According to the drought risk assessment result, the high-drought risk zones in Eromoko District are identified in Basuhan, Pucung, Ngandong, Tempur Harjo, Panekan, and the southwest part of Pasekan. Resource management measures in Eromoko District should be formulated according to the underlying risk factors of each high-drought risk zones in order to achieve drought-resilient development. Three first resource management measures that recommended by this research are: (1) educating the people on drought hazard potential and simple methods to reduce the risk; (2) encouraging drought-resistant local food cultivation and consumption; as well as (3) the provision of health counselor and psychologist to treat and help disable people in exploring their ability and skills to live independently.

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