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The Preparedness of Tunggak Community Dealing with Drought Disaster, Grobogan Regency

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ABSTRACT

Drought disaster is geosphere events that occur in a long period of time that giving impact of society in terms of social, economic and environmental aspects. Drought disaster that often occurs in the Village of Tunggak has made BPBD Grobogan Regency distributing clean water assistance in the last 6 years. Drought conditions require preparedness to respond to a situation of disaster preparedness precisely to minimize the impact of drought. This study goals to detect forecasts in the early months of the drought in station rain area of Toroh Sub-district and to determine the community's preparedness for dealing with drought in Tunggak Village, Grobogan Regency. Detect forecasts in the early months of the drought used data on rainfall monthly index calculated by method of Standardized Precipitation Index (SPI) in accordance with WMO (World Meteorological Organization) guidelines and analysis of preparedness index data referring to LIPI UNESCO/USDR, 2006. The results showed that in the early months of drought forecasts occurring in May with an SPI value of-2.10 which is included in the classification of Extreme Dry, so that when entering May, the community can prepare to face drought. Meanwhile, the preparedness of Tunggak community in facing drought disasters is classified as Less Ready based on knowledge indicators, emergency response plans and resource mobility. While the value of each indicator is 41.4% with the Less Ready classification for the knowledge indicator, 55% is classified as Nearly Ready for the emergency response plan indicator and 46.4% which is included in the Less Ready classification for the resource mobility indicator.

Keywords: SPI, Preparedness, Drought Disaster

INTRODUCTION

Drought is one of the geosphere phenomena that occur in the Earth's atmosphere which affects rainfall, low rainfall on a certain time scale resulting in a depletion of water in the community. The severity of drought triggered by rising global temperatures (global warming) that encourages the occurrence of climate change is characterized by increasing extreme climate events (Adib, 2014; S. Nugroho, 2019; Rasmikayati & Djuwendah, 2015). Extreme climate events around the world affect the intensity of ENSO *(El Nino-Southem Osicillation*) in the Pacific Ocean, so it can increasing the frequency and intensity of hydrometeorological disasters (Räsänen et al., 2016; Sudarma & As-syakur, 2018).

Drought is often defined as a rainfall deficit that occurs in a region lasting a period (Solh & Van Ginkel, 2014). Drought is classified into four types namely meteorological drought, hydrological drought, agricultural drought and socio-economic drought (UNISDR, 2009; Wilhite et al., 2014). Meteorological drought stems from climate activities that decrease rainfall intensity under normal conditions (Brito et al., 2018). Meteorological drought can be an early parameter of drought events in a region that will continue into hydrological droughts and agricultural droughts, if rainfall is below normal conditions continuously.

A phenomenon can be said to be a disaster when society or humans are affected by it (Aji, 2015). Drought of phenomena in a region makes people's wells dry up and water supplies in the soil are depleted, it is causing disruption of human life because water is one of the important components in human daily activities.

Water is used for various purposes, those are cooking, drinking, bathing, washing, up to agricultural, industrial, and service needs (Hardati, 2015). So, the role of water is very important in the joints of human life ranging from household activities, farming to industry is in desperate need of proper water supply so that the lack of water that lasts a long time can decrease the quality of human life.

Drought disasters that are repeated every year make themselves as the world's most expensive natural disasters (Hao et al., 2014). The prolonged drought has increased water demand on a huge scale, limited water availability and high distribution costs have made all demands unable to be fulfilled, which makes the impact and losses due to drought even worse.

Drought disaster based on the drought risk assessment, there are 10 provinces that are focus of drought disaster management activities, one of which is Central Java with a total number of people exposed to drought risk as much as 30,468,131 people (*BNPB*, 2019). Grobogan regency is a limestone mountainous region so it has a high potential to experience drought disasters every coming dry season (Yuwana et al., 2017). Grobogan District has 6 reservoirs, 32 rivers, 33 small dams and 91 water springs spread across 19 districts with maximum temperatures reaching 34°C in the dry season (*DLH* Grobogan Regency). Although having many water sources, it does not make Grobogan Regency escape from drought, in fact almost every year Grobogan Regency run into a drought disaster almost every year (Hardati et al., 2020; Purwanto & Supangat, 2017).

Toroh sub-district is a region that is often hit by drought. Based on the data from the Regional Disaster Management Agency (*BPBD*) Grobogan Regency 2019, it is known that drought disasters often occur so that it becomes the district that most often gets clean water supply assistance from *BPBD*. In this sub-district, Tunggak Village is the village that has the cleanest water supply in the last six years (2013-2019) in each dry season. Tunggak Village has received 72 tanks of clean water from *BPBD* Grobogan Regency, to help the community in meeting the needs of clean water.

The supply of clean water assistance by *BPBD* starts from July to November to drought-prone villages in Toroh Sub-district, including Tunggak Village. Based on information from *BPBD*, the dry season in Central Java each year on average starts in June or July which conveyed by *BMKG* through an official letter to *BPBD*. Information from the BMKG is distributed by *BPBD* throughout the sub-district in Grobogan, then from the sub-district informs all villages in the region about the month of the dry season.

The dry season is identical to the drought indicated by the rainfall deficit and the depletion of water supplies in the community, the first month of drought disaster varies by region. In addition, to the information from *BMKG*, the initial month of drought disaster can use rainfall data from Toroh Rain Station which is calculated temporally by using the standardized precipitation index (SPI) as a preventive measure to detect meteorological drought, of course the use of SPI will be more accurate to detect the early months of drought in the area of Toroh Rain Station and scheduling clean water assistance supplies in the Toroh region is also more accurate.

The community is the main party who feels the impact of an incident directly (Fahri et al., 2012). Drought does not only affects the economic sector but also affects social conditions through farmers' debt,

migration, malnutrition and disease, it is necessary to respond to emergency response (Gutiérrez et al., 2014). The impact of drought disasters is increasing while the people of Toroh are not ready to face disasters, so the community needs to take preventive measures to reduce the risk of disaster.

LIPI-UNESCO/ISDR (2006) risk reduction before disasters occur includes preparedness, mitigation and prevention. Preparedness is emphasized on preparing the ability to be able to carry out emergency response activities quickly and appropriately, under UNESCO's coordination of education for disaster risk reduction to be the initial cause for the ideals of making a strong society that is responsive and resilient to disasters. Aji (2015) highlighted the importance of studies on disaster management, especially disaster preparedness, which is needed to manage disasters in the future. With preparedness study, it is hoped that in the future the level of vulnerability can be gradually improve through various preparedness measures.

Based on the description above, where the drought always threatens every year in Grobogan Regency, especially in Taroh District, including Tunggak Village, it is necessary to detect an early prediction of the occurrence of drought. With the detection of drought forecasts, drought disaster mitigation can be carried out quickly and precisely. Therefore, research on drought is needed, especially early detection of drought. At the same time, research on community preparedness in dealing with drought disasters also needs to be carried out to reduce the risk of disasters experienced by local communities.

MATERIALS & METHODS

This research was conducted in Tunggak Village and Toroh Rain Station in Toroh District, Grobogan Regency. Tunggak Village was chosen as the research location because almost every year *BPBD* Grobogan District distributes clean water assistance to Tunggak Village to overcome the drought that often occurs almost every year. Toroh Rain Station was chosen because the observation area includes Tunggak Village and surrounding villages. Tunggak Village has an area of 1975.86 km^2 and is between the positions 110° 32'-111°15' East Longitude and 6°55'-7°16' South Latitude (see Figure 1)

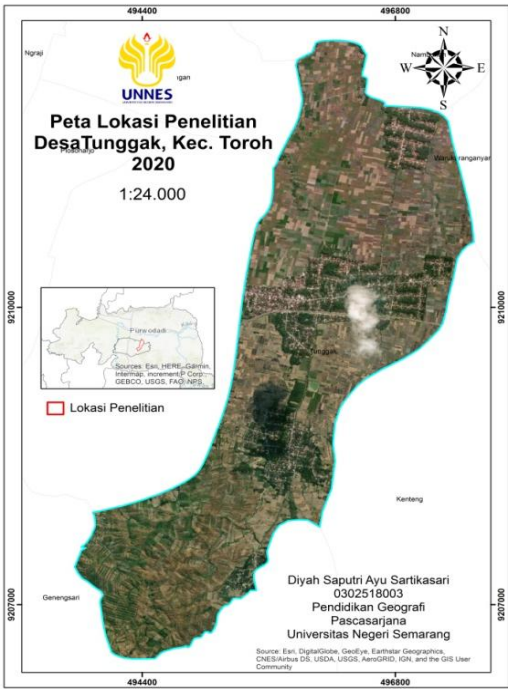

Figure 1: Research Location
Source: (Results of analysis, 2020)

This study uses quantitative approach in detecting the forecast of the early month of drought by using data on Toroh Rain Station. Analysis of rainfall data (empirical) collected at this station uses the SPI 3 data analysis method. SPI 3 was chosen because it can be used to determine seasonal rainfall deficits that are divided into positive and negative values. Consideration of the initial time determination of drought is based on the availability of data and its completeness for the period time in 2008-20018. Rainfall data obtained from the Central Statistics Agency or known as *BPS* of Grobogan Regency.

The matching formula for finding the SPI value is to use the gamma distribution. Thom as cited in Khan & Gadiwala (2013) time series precipitation is calculated by the probability density fuction of the gamma spread.

$$G(x)=\int_0^x g(x)dx \frac{1}{\beta^{\alpha}\Gamma(\alpha)} \int_0^x x^{\alpha-1} e^{-x/\beta} dx \quad (1)$$

Description

$\alpha(>0)$ is a form parameter,
$\beta(>0)$ is the scale parameter and
$x>0$ is the total monthly rainfall
The Z (SPI) value for $0<H(x)\leq 0,5$ is:

$$Z=SPI=-\left(t - \frac{C_0+C_1t+C_2t^2}{1-d_1+d_2t^2+d_3t^3}\right), \quad (2)$$

$$\text{with } t=\sqrt{In\left(\frac{1}{(H(x))^2}\right)} \quad (3)$$

Z (SPI) value for $0,5<H\leq 1,5$ is :

$$Z=SPI=+\left(t - \frac{C_0+C_1t+C_2t^2}{1-d_1+d_2t^2+d_3t^3}\right) \quad (2)$$

$$\text{Where } t=\sqrt{In\left(\frac{1}{(1-H(x))^2}\right)} \quad (3)$$

Known value

C_0=2.515517, C_1=0.802853, C_2=0.010328, d_1=1.432788, d_2=0.189269, d_3=0.001308

After the SPI value is found, it is then configurable (Table 1)

Table 1: SPI Index Value Classification

SPI Value	Classification
≥2.0	Extremely Wet
1.50-1.99	Very Wet
1.0-1.49	Moderately Wet
(0.99) - (-0.99)	Near Normal
(-1.0) - (-1.49)	Moderately Dry
(-1.5)- (-1.99)	Very Dry
≤ -2.0	Extremely Dry

Source: (World Meteorological Organization, 2012)

Community preparedness to deal with drought disasters in Tunggak Village has an indicator which includes knowledge, emergency response plan and resource mobility in LIPI-UNESCO/ISDR year of 2006 (table 2). Data analysis used is descriptive analysis, percentage and classification.

Table 2: Classification of preparedness Tunggak community in facing drought disaster

Indeks Value	Classification
80-100	Very Ready
65-79	Ready
55-64	Almost Ready
40-54	Less Ready
<40	Not Ready

Source: (LIPI-UNESCO/ISDR, 2006)

RESULT & DISCUSSION

1. Drought Disaster Early Month Forecast

Initial forecast of drought disaster using SPI 3 with a recording period of 11 years, SPI 3 provides and overview of drought with seasonal rain type (McKee et al., 1993; A. A. S. Nugroho et al., 2019). The results of the analysis with a time period of 11 years showed that the beginning of drought is predicted to occur when entering March (Table 3).

Table 3: Analysis of the forecast for initial month of the drought

Years	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008			-0,24	-1,36	-0,28	-1,25	-1,44	-1,47	0,16	0,94	0,76	-0,08
2009	-0,88	-0,96	-0,82	0,95	0,24	0,82	-0,29	-0,36	-0,85	-0,31	-1,27	-2,52
2010	-0,42	0,25	2,05	2,24	1,65	1,01	1,16	0,57	0,96	1,34	1,26	0,70
2011	-0,26	-0,39	0,38	0,16	0,25	0,24	0,35	0,75	-0,06	-0,09	0,36	1,13
2012	1,51	1,58	0,58	-0,96	-2,10	-1,85	-1,94	-1,05	-1,09	-0,39	-0,93	0,44
2013	0,40	-0,08	-0,68	0,90	1,02	1,26	0,09	0,22	-0,30	0,29	0,33	1,27
2014	0,60	-0,05	-0,49	0,23	0,51	0,63	0,16	0,34	0,22	-0,14	-0,37	-0,32
2015	-0,87	-0,97	-2,00	-0,68	0,83	1,02	-0,05	-1,35	-1,53	-2,13	-1,26	0,38
2016	1,17	1,27	0,07	-0,82	-0,88	-0,71	-0,15	0,30	1,15	0,97	1,33	-0,23
2017	0,05	0,19	0,23	-0,50	-0,88	-0,71	1,88	2,15	1,90	0,97	1,02	-0,87
2018	0,02	0,44	0,91	-0,16	-0,35	-0,44	0,24	-0,16	-0,87	-1,30	-1,25	0,10

Source: (Results of Analysis, 2019)

The red color in Table 3 shows Extremely Dry, the brown color indicates Very Dry, the yellow color indicates Moderately Dry and the green color indicates Near Normal conditions. The results of analysis with SPI 3 in a period of 11 years showed that drought is expected to occur when entering May although the conditions change every year, but can be a marker to prepare for drought disasters for the community and government when entering May.

In May in the period of 11 years the average entry in the Near Normal classification but the Near Normal classification in May has a value that is almost included in the classification Moderately Dry, so there is a slight deficit

of rainwater. The condition of the early months that have a rainfall deficit can affect the next month because of the condition of the rainfall deficit accompanied by the absence of clean water supply, so in the following months there will be a growing shortage of clean water in the community.

The lowest SPI value is Extremely Dry classification with a value of <-2 that occurred in December of 2009, in February of 2012 and in May of 2012, in 2015 in March and October. While the classification Very Dry occurred in 2012 and 2015 with an index value of SPI <1,5. Moderately Dry classification spread in 2008, 2009, 2012, 2015, and 2018 with an index SPI <-1. The drought in Toroh area of Grobogan Regency was influenced by the increasing strength of ENSO in the Pacific Ocean as described by Safril & Ulfiana (2020) when ENSO occurred, the water vapor content changed slightly and had the impact of a long drought in Java.

Preparedness of Tunggak Community in Facing Drought Disaster

According to Carter (as cited in LIPI/UNESCO-ISDR, 2006) preparedness is an action to be able to respond to a disaster situation quickly and appropriately. Preparedness is carried out before a disaster that is part of a proactive disaster management process. Based on the results of analysis, it is known that the level of preparedness of the community in dealing drought is included in the classification of Not Ready with an average score 49.4% (Table 4).

Table 4: Level of preparedness in dealing drought disasters

Indeks Value	Classification	*f*	Score %
80-100	Very Ready	0	0
65-79	Ready	3	9,37
55-64	Almost Ready	7	21,87
40-54	Less Ready	14	43,75
<40	Not Ready	8	25
Average score %			49,40
Average score in classification			Less Ready

Source: (Results of analysis, 2019)

Furthermore, to be easy to understand the data is presented in the form of pie diagrams as follows:

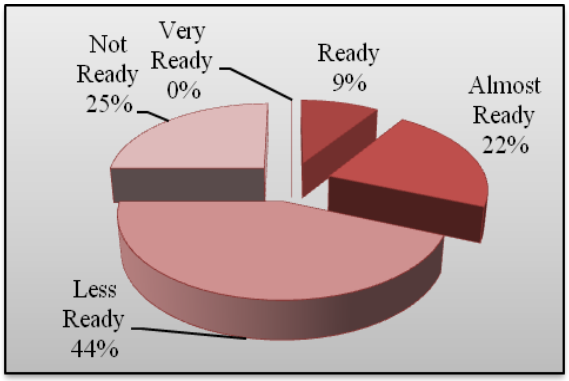

Figure 2: The level of preparedness of Tunggak community in facing drought disaster

Source: (Results of Analysis, 2019)

The results of analysis explained that only 9% of people are ready to face the drought disaster, 22% are almost ready, 25% are not ready and 44% are Less Ready. Here are the results of the analysis of the drought indicator:

Knowledge

Society is the main character of an event should have knowledge of a phenomenon that is around them. Public knowledge in dealing with drought disasters is included in the classification of Less Ready with a score of 41.4% (Table 5)

Table 5: Knowledge of drought disaster Tunggak community

Indeks Value	Classification	*f*	Score %
80-100	Very Ready	1	3,12
65-79	Ready	5	15,60
55-64	Almost Ready	0	0
40-54	Less Ready	9	28,12
<40	Not Ready	17	53,12
Average score %			41,40
Average score in classification			Less Ready

Source: (Results of analysis, 2019)

Knowledge of drought disasters Tunggak community is included in the classification of Less Ready, this is due to low public knowledge about the impact of drought disasters, do not understand the environmental conditions of the house that increases the frequency of drought disasters, do not understand the condition of buildings and do not know the cause of drought disasters.

Knowledge of disasters can be indicated by understanding the surrounding environmental conditions (Setyaningrum & Rumagutawan, 2018). The most of Tunggak community do not know about the

environmental conditions of friendly houses to deal with drought disasters but in the yard of people's homes there have been perishable plants and the availability of open land for water absorption in the hope that water can seep perfectly then stored in the soil that can be used as a reserve of clean water, the environmental condition of which there are still many trees must be immediately carried out conservation in order to preserve the greenness of the village. Tunggak community also do not know about the conditions of suitable house buildings to deal with drought, most of the house buildings do not have a tub for rainwater storage that can be used in the event of a drought disaster.

Public knowledge about the causes of drought disasters can be due to the lack of socialization about disasters from local governments. Disaster socialization is necessary for educational purposes that are useful in eliminating the impact of a disaster or at least reducing the risk of a disaster (Pahleviannur, 2019). Drought in Tunggak Village is caused by a rainfall deficit followed by the absence of clean water supply and supported by the presence of grumusol soil. It has a high ability to absorb water, but the ability to provide water is low (Prasetyo et al., 2018) so that when there is a deficit of rainfall grumusol soil will dry up, cracks and cannot provide enough water for the use by the community when drought is coming.

Tunggak community have known when the drought and *titen* disasters against the signs of drought disaster. It can hit Tunggak Village during the dry season, the occurrence of drought disaster in Tunggak Village is characterized by the drying of well water, *nelo-nelo* soil, grass and leaves that dry up by itself and do not rain for a long time.

Emergency Response Plan

The community emergency response plan in dealing drought in Tunggak Village is classified in the Almost Ready classification with an average score of 55% (Table 6).

Table 6: Tunggak community emergency response plan

Indeks Value	Classification	*f*	Score %
80-100	Very Ready	1	3,12
65-79	Ready	10	31,20
55-64	Almost Ready	10	31,25
40-54	Less Ready	7	21,87
<40	Not Ready	4	12,50
Average score %			55,55
Average score in classification			Almost Ready

Source: (Results of analysis, 2019)

Plans that have been prepared to deal with disaster emergencies can minimize the impact of a disaster (Murbawan et al., 2017). The emergency response plan that has been carried out by the people of Tunggak Village is classified as Almost Ready; this is because most people already know when drought has occurred in Tunggak Village so that they can prepare themselves by planning emergency response measures that will be carried out when drought begins.

The emergency response plan in Tunggak Village that has been carried out by the community is in the form of planning the use of water wisely, preparing personal equipment such a jerry can or *gembes* or plastic barrel that will be used to collect aid water from *BPBD* Grobogan Regency. Clean water assistance that has been distributed by *BPBD* Grobogan Regency to Tunggak Village has reached 72 tanks from 2014-2019, although clean water assistance for 6 years has reached 72 tanks, the community still feels that this assistance has not been able to solve the problem maximally due to the drought.

The next emergency response plan is the availability of important facilities in the form if a clean water taking post from the village government, the clean water collection post in the form of a location for parking the water tank car, assisted by *BPBD* Grobogan Regency, so that people can queue up for supplies of clean water. After receiving the clean water that can be used for drought emergencies and water storage from purchasing tank water privately which is collected and stored in the well. The well in Tunggak Village has a

dual role, namely as a provider of clean water during normal conditions and rainy conditions as well as a place to collect clean water from private tank water purchases, clean water purchased from the tank is directly fed into the well through a hose provided by the seller.

Source Mobility Power

Mobility of community resources Tunggak Village only amounted to 46.4% which included in the classification of Less Ready (Table 7). This value is lower than the value of the emergency response plan that is 55.5% (Table 6), this is inseparable from government's role in supplying clean water to Tunggak Village.

Table 7: Resource mobility of Tunggak community in dealing with drought

Indeks Value	Classification	*f*	Score %
80-100	Very Ready	0	0
65-79	Ready	0	0
55-64	Almost Ready	9	28,12
40-54	Less Ready	9	28,12
<40	Not Ready	14	43,75
Average score %			46,48
Average score in classification			Less Ready

Source: (Results of analysis, 2019)

The mobility of resources is in the Less Ready classification with an average score of 46% being an indication of did not maximum for community of Tunggak Village in mobilizing resources to deal with drought, inadequate resources mobility due to lack of access to information, absence of family members who attend training and the absence of special allocation funds or savings to deal with drought disasters.

Purchase of tank water comes from spending funds or impromptu funds. The drought that recurs every year places itself as the most expensive natural disaster in the world (Hao et al., 2014), in line with this opinion, the purchase of clean water by the Tunggak community requires a cost between Rp 80,000-Rp 100,000 for tanks with a volume only 5000 K that can be used for 7-12 days depending on usage and the number of families in 1 house. However, if it is not possible to buy tank water, most families choose to save significantly on the well water use or sometime use social networks. Most people have a good social network, namely in the form of kinship, family, friends who will help when they need water, such as bathing and washing clothes or sometimes even channeling their well water using a family hose that requires clean water. The habit of helping can reduce the burden on households in dealing with drought in Tunggak Village, but there must still be efforts to increase resource mobility.

The state of mutual help cannot be applied throughout the dry season because when the dry season for long term occurred, there will be water deficit increasingly in the case of the need for water, sometimes there are owners of wells that reprimand or complaining because the source of their well water is low that want to use it personal so there is a feeling of discomfort to take water from neighbors and relatives' wells. The same problem also occurs in Pamor Village, as expressed by Baharinawati et al. (2020) when the wells start to dry up, usually there are well owners who warn people do not take their well water anymore because they want to use it personally.

CONCLUSION

The results of research on drought and the preparedness of Tunggak community can be concluded as follows. First, the results of the SPI analysis showed that the drought is predicted when it enters in May every year. Second, based on the results of the LIPI-UNESCO/USRD analysis, it shows that Tunggak community is less prepared to deal with drought. Third, suggested to the management of Rain Stations throughout Indonesia, especially prone areas to drought disaster, to perform longitudinal rainfall data processing by using SPI to produce information about the early forecasts of drought in the region of each observation. Fourth, with the Rain Station as the hub, it needs to be equipped with an analysis of community preparedness in the face of a drought based on LIPI-UNESCO/USRD. Fifth, disseminating the results of the analysis of the information to the local community and the local

community in order to enhance the practical knowledge society as the basic part of disaster risk reduction strategy (DRR).

The level of preparedness in the face of drought carried out by the community is included in the classification of Less Ready, the community has tried their best to prepare themselves to deal with dryness in a simple way, those are: *titen* or marking signs of entering a drought disaster, preparing a jerry can or tank of liquids, and asking for help from family or relatives

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