Drought Disaster Risk and Community Adaptation in facing Drought in Bringin Sub-district, Semarang Regency

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Abstract

The frequency of drought disaster in Central Java in 2017-2022 is quite high. Semarang Regency has a high level of drought vulnerability. Data from BPBD Semarang Regency shows that in 2022, there were 31 villages experiencing drought. The most severe drought is in Bringin Subdistrict. The high incidence of drought, followed by large losses, certainly requires more serious attention. Communities not only face threats before a disaster occurs, but also have to bear the risk of loss or property loss due to disasters, so that efforts are needed to minimize disaster risk through adaptation or adaptation innovation to drought. The design of this research is observational research that is analyzed descriptively quantitative. The data collected were primary and secondary data. Data on drought threat, vulnerability, and community capacity to drought will be analyzed by scoring, AHP analysis and map overlay analysis with ArcGIS technology.

Based on the data analysis, variations in the level of drought threat, the level of terrain vulnerability to drought, the level of community capacity, and the level of drought disaster risk will be generated. Meanwhile, the draft of "community adaptation innovation" in facing drought was discussed in a Focus Group Discussion with community representatives, BPBD officers, and stake holders to become an "adaptation innovation strategy" that must be carried out in facing drought.

Keywords: Drought, Adaptation innovation, Bringin sub-district.

Introduction

The frequency of drought in Central Java in 2017-2022 is quite high. Semarang Regency has a high level of drought vulnerability. Data from the BPBD of Semarang Regency shows that in 2022, there were 31 villages in Semarang Regency that experienced drought. The most severe drought is located in Bringin district. Based on this data, the BPBD of Semarang Regency asked the community to be able to manage the risk of drought, so that losses can be minimized[5]. The existence of a relatively high incidence of drought followed by large losses, requires more serious attention with research.

According to Law number 24 of 2007[20] on disaster management, a disaster is an event or series of events that threaten and disrupt people's lives and livelihoods caused by natural factors, non-natural factors and human factors, resulting in environmental damage, property loss, and psychological impact. The World Meteorological Organization (WMO) in 1992 defined drought as a period of abnormally dry weather and occurs in a long enough period of time due to lack of rainfall to cause serious hydrological imbalances[19].

The reality that has occurred so far is that there are still many losses due to disasters, which means that people's attention to disasters needs to be addressed, and people living in disaster environments need to make adaptations and innovations to adapt to disasters[8]. Adaptation is a way, a step from the population / community in adjusting to its environment in order to deal with drought[9]. While innovation is a creative process in selecting, organizing, and utilizing human and material resources in new and unique ways that will result in higher achievements for predetermined goals and objectives[15]. The community not only faces threats before the disaster, but also bears the risk of loss of life and property due to disasters, even they still have to face the state of recovery both physically and mentally after the disaster. Therefore, there needs to be an effort to improve community adaptation to reduce losses incurred due to disasters[11].

BNPB (National Disaster Management Agency) through the Indonesian Disaster Risk book defines drought as one type of natural disaster that occurs slowly (*slow on-set*), with a duration until the rainy season arrives, and has a very broad and cross-sectoral impact (economic, social, health, and education)[2].

In general, droughts can be classified into 4 main types: (a) meteorological drought, as a result of reduced rainfall (b) agricultural drought, a partial lack of moisture in the soil (c) hydrological drought, relating to shortages of surface and groundwater supplies and (d) socioeconomic drought in the use of water by human activities[22]. Drought is the relationship between the availability of water that is far below the need for water both for living, agriculture,

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economic activities, and the environment[4]. Drought is also a natural disaster event caused by a deficit of rainfall in a certain period of time which causes insufficient water availability for human activities and the environment[21].

Disaster risk is basically determining the magnitude and management of the 3 risk components. The National Disaster Management Agency (BNPB) has made guidelines for disaster risk mitigation planning[17], with the basic formula in calculating risk as follows:

R = H x V/C

where R is *Disaster risk*, H is *Hazard*, V is *Vulnerability* and C is *Capacity*.

Risk is the potential loss caused by a disaster in a certain area and period of time which can be in the form of death, injury, illness, threatened life, loss of security, displacement, damage or loss of property, and disruption of community activities[13]. Disaster risk that occurs, is related to human capacity in dealing with disasters, in the sense that community adaptation that leads to disaster risk reduction can reduce disaster risk. In connection with this, community adaptation in disaster-prone areas needs to be studied to be developed in the direction of reducing disaster risk to be as small as possible[3,6,7,12,18].

There are several studies on drought disaster, generally only examining the factors that cause drought as an effort in overcoming drought hazards[10, 23]. There are still very few researchers who focus on drought risk reduction by the community, even though the community is the most disadvantaged party in the event of a disaster[1,16].

The objectives of this study are:
(1) Analyzing the level of drought hazard in Bringin Subdistrict, Semarang Regency (2) Analyzing the level of terrain vulnerability to drought (3) Describing the level of community capacity in facing drought (4) Analyzing the level of drought disaster risk in Bringin Subdistrict (5) Analyzing community adaptation to drought disaster currently carried out by the community and (6) Developing a model/strategy of community adaptation innovation in facing drought disaster to reduce disaster risk in Bringin subdistrict, Semarang Regency.

Material and Methods

This research is an observational study that was analyzed descriptively quantitatively[14]. The population of this study is the physical condition of the terrain unit and people/communities living in drought-prone areas. Sampling of the terrain unit was done by purposive area sampling, which is choosing the terrain unit that has the largest area among others. The number of terrain unit samples was calculated based on interpolation calculations with sources from BIG (Geospatial Information Agency) as follows: BIG regulation of scale 1:50,000 has a total minimum sample of 30. BIG regulation of scale 1:250,000 has a total minimum sample of 20. Therefore, the minimum sample of scale 1:65,000 is 27 terrain unit samples.

The community sample was taken using purposive sampling technique, by considering people affected by drought, represented by heads of households (HH). The criteria for HHs were heads of households who had experienced the impact of drought. The number of samples for each sub-district was determined based on the Slovin formula with a 90% confidence level. After calculating, 36 samples were needed.

The variables to be studied include several variables.

(1) Drought threat variables include indicators of: (a) rainfall, (b) water source, (c) soil type, (d) groundwater depth, and (e) vegetation index (NDVI) from Landsat images. The formula used to determine the level of drought threat is as follows:

$$BK = (0.33CH) + (0.27KAT) + (0.20T) + (0.13SA) + (0.06NDDI)$$

where BK is Drought Hazard, CH is Rainfall score, KAT is Groundwater depth score, T is Soil texture score, SA is Water source score and NDDI is Crop Drought Index Value.

(2) Community vulnerability variables include sub-variables (a) social vulnerability, (b) physical vulnerability, (c) economic vulnerability, and (d) environmental vulnerability. The calculation of drought vulnerability is calculated using the formula from Perka BNPB No 02 of 2012 as follows:

$$IKK = (IKS \times 50\%) + (IKE \times 40\%) + (IKL \times 10\%)$$

where IKK is Drought Vulnerability Index, IKS is Social Vulnerability Index, IKE is Economic Vulnerability Index and IKL is Environmental Vulnerability Index.

(3) Community Capacity variables include sub-variables (a) disaster risk reduction becomes a national and local priority with a strong institutional basis, (b) the availability of a Regional Disaster Risk Assessment based on hazard and vulnerability data, (c) the realization of the use of knowledge, innovation and education to build capacity, (d) reduce basic risk factors, (e) strengthen disaster preparedness;

(4) Drought disaster risk is obtained through overlaying hazard maps, vulnerability maps, and community capacity maps:

R = H x V/C

where R is *Disaster risk*, H is *Hazard*, V is *Vulnerability* and C is *Capacity*.

(5) Community adaptation innovation variables include (a) structural strategies, (b) economic strategies, (c) social strategies (d) cultural strategies, (e) change agent activities in the form of promoting, informing, demonstrating, training, assisting and accompanying, (f) resident activities in the form of awareness, interest, assessing, trying, adopting and integrating. Community adaptation innovation is based on Havelock's innovation theory.

Data analysis was conducted using BNPB's drought risk analysis, AHP (Analysis Hierarchy Process) analysis, scoring analysis, and map overlay analysis with the help of ArcGIS technology.

Results

Overview of the Research Area: Bringin sub-district is one of the sub-districts located in Semarang Regency. It has an area of 6,189.10 hectares or 6.9% of Semarang Regency and has 16 villages divided into 74 RW, 321 RT and 87hamlet. Bringin sub-district borders Tuntang sub-district to the west, Bancak sub-district to the east, Grobogan regency to the north, and Pringapus sub-district, Pabelan sub-district and Grobogan regency to the south. Gogodalem village is the largest village in Bringin sub-district, covering 10.30 percent of the total area of Bringin sub-district. Meanwhile, the village with the smallest area is Popongan village, which only accounts for 3.00 percent of the total area of Bringin sub-district. The detailed administrative area of Bringin sub-district can be seen in table 1.

Drought Threat Level: Based on the calculation, the lowest drought hazard value is 0.99 and the highest is 4.55. Based on the classification of drought hazard class intervals, the following classification of drought hazard class is obtained (table 2). Fig. 2 is a map made based on the parameters and weighting described (table 2). The results illustrate that Bringin sub-district has an area with a high drought threat level of 11%. Details can be seen in table 3.

Level of Vulnerability to Drought

Social Vulnerability: Social vulnerability is obtained from secondary data provided by BPS, social vulnerability itself consists of several separate vulnerability factors or parameters. Each parameter is calculated using a scoring method in accordance with BNPB regulation no. 2/2012. The value of social vulnerability can be calculated using the social vulnerability formula as follows:

$$Social\ Vulnerability = \left(0,6 \times \frac{log\ log\ \left(\frac{population\ density}{0,001}\right)}{\frac{100}{0.01})}\right) + (0,1 \times sex\ ratio) + (0,1 \times ratio\ of\ poor\ population) + (0,1 \times disabled\ population\ ration) + (0,1 \times vulnerable\ age\ population\ ratio)$$

The above calculations were carried out for all villages in Bringin sub-district so that the value of the social vulnerability score in Bringin Sub-district can be found in table 4. Based on the results of data tabulation in table 4, it can be explained that Sendang Village is a village with a high level of social vulnerability with a population density of 11 people/Ha with a sex ratio of 104, a vulnerable age group ratio of 15.15%, a poor population ratio of 57.33%, and a disabled population ratio of 0.44%. Meanwhile, Tempuran village is the village with the lowest vulnerability with a population density of 4 people/Ha, a sex ratio of 103, a vulnerable age group ratio of 23.01%, a poor population ratio of 26.68% and a disabled population ratio of 0.67%.

Table 1
Administrative area of Bringin sub-district

S.N.	Village	Area (Ha)	Area (%)
1	Bringin	562,42	8,25
2	Popongan	204,40	3,00
3	Fern	333,09	4,89
4	Trap	271,06	3,98
5	Appeal	514,22	7,54
6	Truko	529,84	7,77
7	Nyemoh	302.72	4,44
8	Tempuran	556,26	8,16
9	Wiru	391,71	5,74
10	Sendang	288,37	4,23
11	Gogodalem	702,52	10,30
12	Rembes	511,08	7,50
13	Kalikurmo	555,65	8,15
14	Sambirejo	366,22	5,37
15	Kalijambe	476,03	6,98
16	Cape	252,79	3,71
Total		6818,39	100

Source: Bringin Sub-district in Figures 2023

Table 2
Classification of Drought Hazard Classes

S.N.	Drought Threat Class Interval	Drought Threat Class
1	0,99 - 2,17	Low
2	2,18 - 3,36	Medium
3	3,37 - 4,55	High

Source: Research Data Analysis, 2024

Table 3
Distribution of Drought Threats/Hazards Bringin Sub-district

S.N.	Threat/Danger	Area (Ha)	Percentage
1	Low Threat	403,738	5%
2	Medium Threat	6446,114	84%
3	High Threat	837.638	11%
Total		7.687,490	100%

Source: Research Data Analysis, 2024

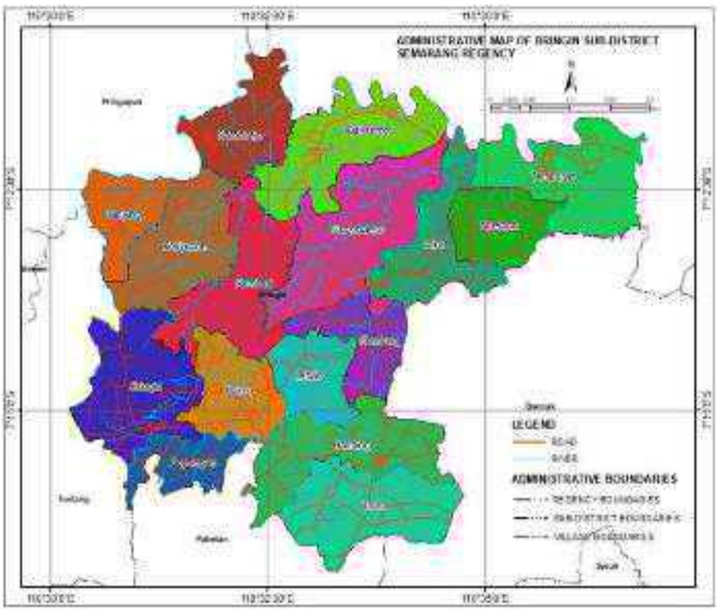

Figure 1: Research Location Map

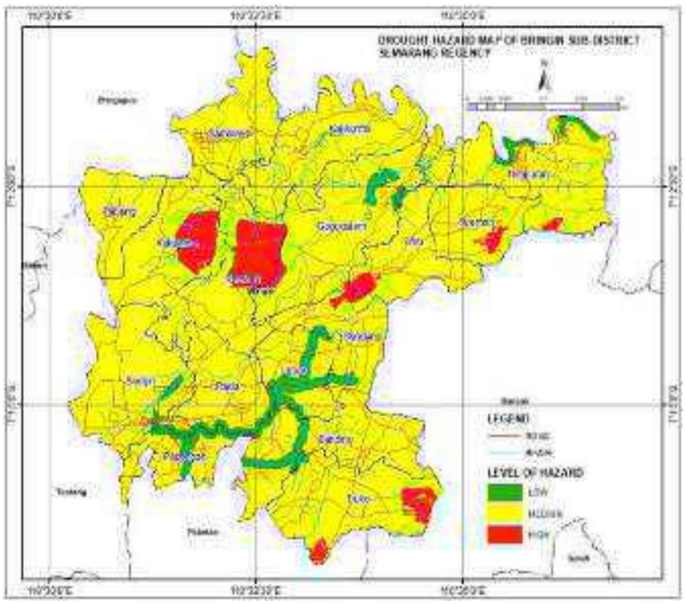

Figure 2: Drought Hazard Map of Bringin Sub-district

Economic Vulnerability: Economic vulnerability is obtained based on the results of the contribution of GRDP *(Gross Domestic Regional Product)* and productive land. Based on data from BPS Semarang Regency in 2023, the total GRDP value is Rp39,651,854,000,000, while the constant price GRDP in the agricultural sector in Semarang Regency is Rp3,834,881,000,000. The area of Bringin Sub-district is 6818.39 Ha and the total area with the agricultural sector based on the RBI map is 5620.82 Ha, so from these data, the contribution of GRDP and productive land of villages in Bringin subdistrict can be calculated.

To find out the results of the contribution of GRDP and productive land, an equation is used with the formula:

$$RLP_{\mathrm{i}} = \frac{PLP\ tot -_{\mathrm{i}}}{LLP\ tot -_{\mathrm{i}}} \times LLP\ villages -_{\mathrm{i}}$$

$$RPP\ villages = \frac{RPPKK}{Lkk} \times LD_{\mathrm{i}}$$

Meanwhile, the economic vulnerability score is calculated using the following formula:

$$(0{,}6\ \times Productive\ Land\ Score) + (0{,}4 \times Skor\ PDRB)$$

The results of the calculation of economic vulnerability in Bringin sub-district are presented in table 5.

Based on table 5, it is known that the distribution of all areas in Bringin sub-district has the same economic vulnerability value of 0.5. However, despite having the same economic vulnerability value, the contribution value of GRDP and productive land of each village in Bringin Sub-district is different. Based on the data, the highest GRDP contribution value is Gogodalem village with a GRDP value of Rp4,955,932,291,343.75, while the village with the lowest GRDP value is Popongan village with a GRDP value Rp1,441,946,196,784.63.

Environmental Vulnerability: Environmental vulnerability was assessed based on BNPB regulation no. 02/2012, which consists of protected forests, natural forests, forests and shrubs. Forest data was obtained from the Ministry of Environment and Forestry website and sourced from BIG. Environmental vulnerability was assessed based on the area of protected forest, natural forest and shrubs.

The environmental vulnerability index was formulated as follows:

Environmental Vulnerability = (0.35 × Protected Forest Score)+(0.35 × Natural Forest Score)+(0.2 × Shrub Score) +(0.1 × Mangrove Forest Score).

The calculation data for the calculation of environmental vulnerability of Bringin sub-district is presented in table 6. The highest environmental vulnerability score is 0.235 and the lowest is 0.2. The villages with the highest environmental vulnerability score are Banding, Tempuran, and Kalikurmo.

Drought Vulnerability: The calculation of drought vulnerability is calculated using the formula from Perka BNPB No. 02 of 2012. After the calculation, the next step is to classify the drought vulnerability using the jerking break method with three classes: low, medium, and high. The results of the calculation and classification of drought vulnerability of Bringin sub-district in detail are presented in table 7.

Table 4
Social Vulnerability of Bringin Sub-district

S.N.	Village	Population Density		Sex Ratio		Vulnerable Age Population Ratio		Disabled Population Ratio		Ratio of Poor Population		Social Vulnerability Score
		Soul/Ha	Score	%	Score	%	Score	%	Score	%	Score	
1	Bringin	10	0,3	96	0,2	8,58	0.2	0.25	0.2	22.63	0.3	0.46
2	Popongan	10	0,3	97	0,2	22,66	0.3	0.66	0.2	33.15	0.3	0.47
3	Fern	11	0,5	103	0,2	13,18	0.2	0.38	0.2	32.75	0.3	0.49
4	Trap	6	0,3	95	0,2	28.71	0.3	0.83	0.2	45.97	0.5	0.49
5	Appeal	7	0,3	101	0,2	13.47	0.2	0.39	0.2	41.45	0.5	0.48
6	Truko	7	0,3	100	0,2	13.43	0.2	0.39	0.2	29.89	0.3	0.46
7	Nyemoh	7	0,3	101	0,2	24.52	0.3	0.71	0.2	44.68	0.5	0.49
8	Tempuran	4	0,2	103	0,2	23.01	0.3	0.67	0.2	26.68	0.3	0.45
9	Wiru	8	0,3	97	0,2	15.41	0.2	0.45	0.2	42.45	0.5	0.48
10	Sendang	11	0,5	104	0,2	15.15	0.2	0.44	0.2	57.33	0.5	0.51
11	Gogodalem	5	0,3	96	0,2	13.05	0.2	0.38	0.2	42.88	0.5	0.48
12	Rembes	8	0,3	102	0,2	12.17	0.2	0.35	0.2	34.21	0.3	0.46
13	Kalikurmo	5	0,3	101	0,2	19.33	0.2	0.56	0.2	65.34	0.5	0.48
14	Sambirejo	11	0,5	105	0,2	12.34	0.2	0.36	0.2	39.61	0.3	0.49
15	Kalijambe	5	0,3	97	0,2	18.49	0.2	0.53	0.2	57.45	0.5	0.48
16	Cape	4	0,2	99	0,2	44.69	0.5	1.29	0.2	27.61	0.3	0.47

Source: Research data analysis, 2024.

Table 5
Social Vulnerability of Bringin sub-district

S.N.	Village	Productive Land Area (Ha)	Area (Ha)	Productive Land		PDRB		Economic Vulnerability Score
				Rp	Score	Rp	Score	
1	Bringin	478.75	562.42	IDR 326,633,739,903	0.5	IDR 3,967,599,218,202.67	0.5	0.5
2	Popongan	174.88	204.40	IDR 119,313,243,097	0.5	IDR 1,441,946,196,784.63	0.5	0.5
3	Fern	262.26	333.09	IDR 178,932,657,745	0.5	IDR 2,349,771,057,322.93	0.5	0.5
4	Trap	227.79	271.06	IDR 155,415,944,304	0.5	IDR 1,912,194,802,148.92	0.5	0.5
5	Appeal	438.83	514.22	IDR 299,399,016,285	0.5	IDR 3,627,561,502,528.50	0.5	0.5
6	Truko	458.01	529.84	IDR 312,486,123,894	0.5	IDR 3,737,717,289,268.28	0.5	0.5
7	Nyemoh	254.63	302.72	IDR 173,728,041,023	0.5	IDR 2,135,493,791,262.01	0.5	0.5
8	Tempuran	439.12	556.26	Rp 299,592,261,293	0.5	IDR 3,924,120,684,050.51	0.5	0.5
9	Wiru	309.86	391.71	IDR 211,403,206,183	0.5	IDR 2,763,268,042,265.03	0.5	0.5
10	Sendang	203.58	288.37	IDR 138,894,976,321	0.5	IDR 2,034,282,537,673.94	0.5	0.5
11	Gogodalem	593.68	702.52	IDR 405,046,883,618	0.5	IDR 4,955,932,291,343.75	0.5	0.5
12	Rembes	418.81	511.08	IDR 285,740,582,552	0.5	IDR 3,605,366,238,690.26	0.5	0.5
13	Kalikurmo	451.13	555.65	IDR 307,792,277,632	0.5	IDR 3,919,845,180,470.81	0.5	0.5
14	Sambirejo	284.42	366.22	IDR 194,046,867,897	0.5	IDR 2,583,511,860,488.45	0.5	0.5
15	Kalijambe	413.55	476.03	IDR 282,151,739,191	0.5	IDR 3,358,168,460,647.91	0.5	0.5
16	Cape	211.51	252.79	IDR 144,303,439,061	0.5	IDR 1,783,276,748,056.50	0.5	0.5

Source: Research Data Analysis, 2024.

Based on the calculation results in table 7. It can be explained that there are 6 villages with low vulnerability, 9 villages with moderate vulnerability, and 1 village has a high level of vulnerability. The village with the highest drought vulnerability score is Sendang village with a vulnerability score of 0, 477. Furthermore, the spatial distribution of the level of drought vulnerability in each village in Bringin sub-district is presented with a map of drought vulnerability in each village in figure 3.

Level of Community Capacity in dealing with Drought Disasters: There were 20 respondents at a low level of capacity and 20 respondents at a medium level. On an average, there were 8 villages with low capacity and 8 villages with medium capacity. The number of samples taken per village also varies, so to determine the level of community capacity in villages that have more than one sample respondent, it is necessary to calculate the average to find the score of community capacity. Based on data analysis, the distribution of the level of community capacity per village can be seen in table 8 and figure 4 on the map of the level of community capacity in facing drought in Bringin sub-district.

Drought Disaster Risk Level: In the calculation in determining the risk of drought disaster, the three parameters are given the same weight based on their classification. This is done because the scores on the threat level, vulnerability level, and population capacity level are different. Giving the same weight is to show that the 3 parameters have equal weight or the same. The following is the weighting used by researchers (table 9).

After weighting, the next thing to do is to overlay the disaster threat map, population vulnerability, and community capacity. Next is to calculate disaster risk using the formula$R = \frac{H \times V}{C}$. Based on the results of the overlap, the score range is obtained between 0.5 and 6. After the calculation, the next thing to do is to classify using the Weighted Method formula, so that the determination of the risk class can be done and the map can be made (table 10).

Based on the map that has been made, the data is obtained in the form of table 11. Based on table 8, it can be seen that the low risk level has an area of 4933.16 Ha or 67.93% of the area of Bringin sub-district. Furthermore, the moderate risk level has 1996.86 Ha or 27.50% of the total area, and the remaining 332.32 Ha or 4.58% has a high-risk level

Table 6
Environmental vulnerability of Bringin sub-district

S.N.	Village	Bushes		Natural Forest		Protection Forest		Mangrove Forest		Environmental Vulnerability Score
		Area (ha)	Score	Area (ha)	Score	Area (ha)	Score	Area (ha)	Score	
1	Bringin	0.819	0.2	0	0.2	0	0.2	0	0.2	0.2
2	Popongan	0	0.2	0	0.2	0	0.2	0	0.2	0.2
3	Fern	0	0.2	0	0.2	0	0.2	0	0.2	0.2
4	Trap	0	0.2	0	0.2	0	0.2	0	0.2	0.2
5	Appeal	10.456	0.3	0	0.2	0	0.2	0	0.2	0.235
6	Truko	5.832	0.2	0	0.2	0	0.2	0	0.2	0.2
7	Nyemoh	0	0.2	0	0.2	0	0.2	0	0.2	0.2
8	Tempuran	18.742	0.3	0	0.2	0	0.2	0	0.2	0.235
9	Wiru	0	0.2	0	0.2	0	0.2	0	0.2	0.2
10	Sendang	0	0.2	0	0.2	0	0.2	0	0.2	0.2
11	Gogodalem	3.837	0.2	0	0.2	0	0.2	0	0.2	0.2
12	Rembes	4.911	0.2	0	0.2	0	0.2	0	0.2	0.2
13	Kalikurmo	29.354	0.3	0	0.2	0	0.2	0	0.2	0.235
14	Sambirejo	0	0.2	0	0.2	0	0.2	0	0.2	0.2
15	Kalijambe	0	0.2	0	0.2	0	0.2	0	0.2	0.2
16	Cape	0	0.2	0	0.2	0	0.2	0	0.2	0.2

Source: Research Data Analysis, 2024

Table 7
Drought Vulnerability of Bringin Sub-district

S.N.	Village	Social Vulnerability Score	Economic Vulnerability Score	Environmental Vulnerability Score	Drought Vulnerability Score	Drought Vulnerability Class
1	Bringin	0.46	0.5	0.2	0.451	Low
2	Popongan	0.47	0.5	0.2	0.456	Low
3	Fern	0.49	0.5	0.2	0.467	Medium
4	Trap	0.49	0.5	0.2	0.466	Medium
5	Appeal	0.48	0.5	0.235	0.464	Medium
6	Truko	0.46	0.5	0.2	0.451	Low
7	Nyemoh	0.49	0.5	0.2	0.466	Medium
8	Tempuran	0.45	0.5	0.235	0.446	Low
9	Wiru	0.48	0.5	0.2	0.461	Medium
10	Sendang	0.51	0.5	0.2	0.477	High
11	Gogodalem	0.48	0.5	0.2	0.461	Medium
12	Rembes	0.46	0.5	0.2	0.451	Low
13	Kalikurmo	0.48	0.5	0.235	0.464	Medium
14	Sambirejo	0.49	0.5	0.2	0.467	Medium
15	Kalijambe	0.48	0.5	0.2	0.461	Medium
16	Cape	0.47	0.5	0.2	0.453	Low

Source: Researchers.

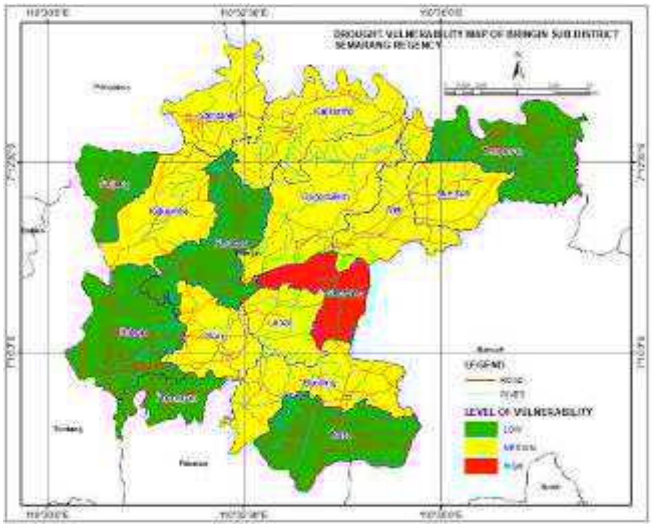

Figure 3: Drought Vulnerability Map of Bringin sub-district

Table 8
Community Capacity of Bringin Sub-district

S.N.	Village	Capacity Score	Description
1	Gogodalem	38	Medium
2	Nyemoh	30	Medium
3	Truko	29	Low
4	Tempuran	31	Medium
5	Wiru	29	Low
6	Appeal	34	Medium
7	Sendang	30	Medium
8	Kalikurmo	36	Medium
9	Trap	32	Medium
10	Fern	29	Low
11	Rembes	33	Medium
12	Bringin	27	Low
13	Popongan	23	Low
14	Sambirejo	27	Low
15	Kalijambe	25	Low
16	Cape	26	Low

Source: Research Data Analysis, 2024

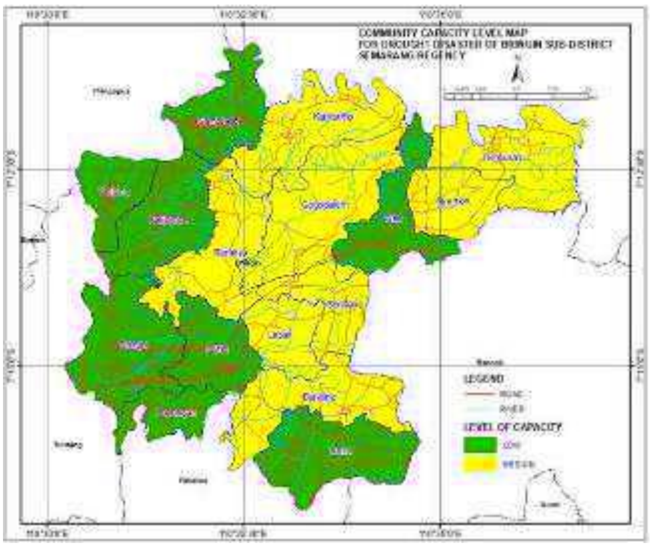

Figure 4: Map of Community Capacity for Drought in Bringin Sub-district

Table 9
Weighting of Risk Parameters

S.N.	Threat level		Vulnerability level		Capacity level	
	Threat	**Score**	**Vulnerability**	**Score**	**Capacity**	**Score**
1	Low	1	Low	1	Low	1
2	Medium	2	Medium	2	Medium	2
3	High	3	High	3	High	3

Source: Research Data Analysis, 2024

Table 10
Drought Risk Class

S.N.	Class Interval	Risk Level
1	0,5 - 2.33	Low Risk
2	2.34 - 4.17	Medium Risk
3	4.18 - 6	High Risk

Source: Research Data Analysis, 2024

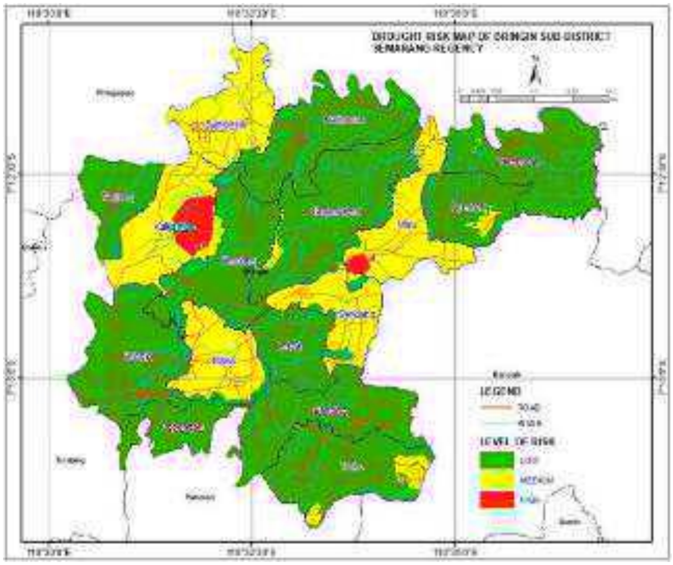

Figure 5: Drought Risk Map of Bringin Sub-district

Table 11
Drought Risk Area

S.N.	Risk Level	Ha
1	Low Risk Level	4933,16
2	Medium Risk Level	1996,86
3	High Risk Level	332,32
Total		7262,34

Source: Research Data Analysis, 2024.

Community Adaptation and Innovation Strategies in facing Drought Disasters: Based on data from respondents/communities through interviews and questionnaires about community adaptation and innovation in the face of drought in Bringin sub-district, the results are in the form of adaptation strategies currently carried out by the community as follows:

a. Structural adaptation strategy: Structural adaptation strategies carried out by the community today include
1) Construction of water tanks or reservoirs to collect rainwater.
2) Construction of reservoirs.
3) Construction or installation of rainwater harvesting equipment.

b. Economic adaptation strategies: Economic adaptation strategies carried out by the community at this time are
1) Creating/following RT or RW rotating saving groups as a form of friendship and drought socialization media.
2) Doing side jobs in addition to the main livelihood to supplement income.
3) Make/participate in community contributions for cash if there is a sudden community need.

c. Social adaptation strategies: Social adaptation strategies carried out by the community today include:
1) Establish/participate in night watch activities, especially during the dry season.
2) Conduct mutual cooperation before, during, and after a drought disaster.

d. Cultural adaptation strategy: Cultural adaptation strategies carried out by the community today include
1) Participate in recitation/ruwah_an/suro_an activities.

The innovation model carried out by residents is as follows:
a. Resident novation model in the form of agent activities:
1) Assist in the implementation of an innovation in dealing with drought in the population.

b. Resident innovation model in the form of resident activities:
1) Realizing that innovation in the face of drought is crucial.
2) Provide basic needs (food, gallon water, and p3k boxes) as an anticipation in case of drought.
3) Unify important documents (diplomas, certificates, family cards etc.) in one container in anticipation of a drought.
4) Make or implement village regulations/applicable norms.
5) Adopt an innovation in dealing with drought.

Some community adaptation innovation strategies that can be adopted or implemented include:
a) Utilization of Smart Technology through technology integration such as soil moisture sensors, geographic information systems (GIS), and the Internet of Things (IoT) to map and monitor drought conditions in real time. This is related to the development of accurate and fast drought prediction and early warning systems, allowing communities to receive information to take preventive measures or appropriate actions quickly based on accurate data before drought occurs.
b) Community-Based Approach, an approach that actively involves communities in the planning, implementation, and evaluation of drought adaptation strategies. This approach ensures that the solutions developed take into account local needs and knowledge.
c) Innovation in sustainable agricultural practices such as agroforestry, vertical farming, hydroponics, or polyculture to increase plant resistance to drought and maximize yields. Farmers are starting to switch to more sustainable agricultural methods, such as organic farming systems or the use of more drought-resistant plant varieties.
d) Efficient water management, and the development of efficient irrigation technologies such as drip irrigation, sub-surface irrigation to increase the efficiency of water use in agriculture and domestic needs.
e) Rainwater harvesting, which is the collection and storage of rainwater, or management of rainwater and groundwater to increase water availability during periods of drought. Wise management of water resources, such as building reservoirs, ponds, or infiltration wells to store rainwater and reduce the risk of drought.
f) Development of drought insurance programs and drought risk mitigation mechanisms to protect farmers and communities from economic losses due to drought.
g) Innovation in education and training on drought risk management, sustainable agricultural techniques to improve community knowledge and skills in dealing with drought.
h) Diversification of income sources where the community develops diverse businesses and sources of income to reduce dependence on the agricultural sector which is vulnerable to drought. Diversification of income sources helps to reduce the economic risk of crop failure due to drought.

Discussion

Bringin sub-district has 3 levels of drought that are spread throughout the area with different areas. Most of the sub-district has a moderate drought threat level, covering 84% of the total area. The threat of drought is strongly influenced by rainfall, this is in line with Adidarma et al who used the precipitation index in determining drought. Another parameter used is soil type, soil type here is used to determine the soil texture in each soil type. Soil with coarse texture has a less good ability to hold water than fine textured soil. This shows that coarse-textured soils are very vulnerable to drought. In Bringin sub-district, the soil types are gray regosol complex and dark gray grumusol, dark brown latosol, and dark brown mediteran. Another factor that has the potential to cause drought is groundwater productivity, which can be seen based on the depth of groundwater in Bringin sub-district. The depth of groundwater in Bringin sub-district is also very diverse. Eastern to central areas of Bringin sub-district have moderate to high drought potential, evidenced by the depth of the well water surface in the area. The level of vulnerability to drought in Bringin sub-district ranges from low to high. 6 villages have low vulnerability, 9 villages have moderate vulnerability, and 1 village has high vulnerability. Basically, vulnerability is closely related to the conditions that are exposed to a disaster threat. The stronger is the resilience of a condition, the lower the level of vulnerability, assuming that the level of disaster threat does not change.

Then, the level of community capacity in Bringin sub-district is divided into two levels, namely low and medium. There are 8 villages at the low-capacity level and 8 villages at the medium capacity level. The level of community capacity in Bringin sub-district, which is dominated by low and medium levels, is because there are several aspects that have not been fulfilled optimally, this can be seen from the fact that several aspects have not been achieved in the 5 parameters studied. From the results of the assessment, the 5 aspects assessed have not been fully met, especially in the aspect of building preparedness on all fronts and the aspect of disaster education, there are still many indicators that have not been achieved. In addition, other aspects also still have several indicators that have not been met. The majority of indicators that have not been met, are indicators related to the community such as cooperation between institutions and communities and community discussion forums.

Based on the level of threat, vulnerability and capacity, there are 3 levels of drought disaster risk, namely low, medium and high. A total of 332.32 hectares of Bringin sub-district has a high-risk level. The areas that have a high-risk level are parts of Kalijambe village, a small part of Sendang and Wiru villages. Meanwhile, an area of 1996.86 Ha of Bringin sub-district has a moderate risk level which includes Sambirejo, Pakis, Sendang, Wiru, Kalijambe, part of Gogodalem Village and part of Truko village. Then, an area of 4933.16 hectares of Bringin sub-district has a low risk level which includes Bringin, Popongan, Tanjung, Rembes, Gogodalem, Lebak, Truko, Banding, Kalikurmo, Nyemoh, and Tempuran villages. The total area of drought threat villages is not the same as the area of drought risk, which is evidence of the influence of the level of vulnerability and community capacity.

The majority of people in Bringin sub-district have not implemented adaptation with structural strategies as an adaptation effort to deal with drought. Then, in population adaptation with economic strategies, many people have implemented the strategy model. The economic strategies that are mostly carried out by the community, are doing side jobs in addition to the main livelihood to increase income and making/participating in community contributions for cash. In population adaptation with social strategies, communities affected by drought in Bringin sub-district have implemented several social strategies. The most widely applied social strategy is mutual cooperation before and after the drought.

In addition to structural, economic and social strategies, there are also cultural adaptation strategies. Cultural disaster adaptation strategies are ways in which communities respond to and cope with disasters by utilizing values, knowledge and social practices that have existed for generations. This approach is very important because it involves all aspects of community life, from beliefs, daily habits, to social systems. Most of the drought-affected communities in Beringin sub-district implemented a cultural strategy by participating in recitation/ruwahan/suroan activities. The community affected by the drought disaster in Bringin district has not fully adopted or adopted only a small part or implemented adaptation innovations in dealing with the drought disaster. This happens because of the lack of role or activities of agents in attracting the community to carry out drought adaptation innovations.

Some drought-affected communities in Bringin sub-district realize that innovations in dealing with drought are very important and they are interested in implementing innovations in dealing with drought. However, only a small part of the community has tried, adopted or implemented adaptation innovations in dealing with the drought disaster due to the lack of agent roles in socializing these innovations. Therefore, it can be concluded that the role of agents in mobilizing the community to carry out adaptation innovations to drought is very important. In order for innovations to be implemented by the community, it is necessary to have agents who can socialize adaptation innovations that can be applied by the community to deal with drought disasters. Thus, the level of community adaptation to drought in Bringin sub-district will increase.

Conclusion

Based on the results of research on Drought Risk Analysis and Community Adaptation Innovations in facing Drought in Bringin Sub-district, Semarang Regency, it can be concluded:

1. There are 3 levels of drought threat resulting from an overlay analysis using 5 parameters: rainfall, groundwater depth, soil type, water source, and vegetation index (NDDI). An area of 5% of Bringin Sub-district is at a low threat level, 84% is at a medium threat level, and the remaining 11% is at a high threat level.
2. Based on the results of the vulnerability level calculation, there are 6 villages with low vulnerability, 9 villages with moderate vulnerability, and 1 village with high vulnerability. The village with the highest drought vulnerability score is Sendang village with a vulnerability score of 0, 477.
3. The results of the interviews showed 20 respondents at a low level of capacity and 20 respondents at a medium level. When averaged over the interview results, there were 8 villages at the low-capacity level and 8 villages at the medium capacity level.
4. Based on the results of the calculation of drought hazard risk in Bringin Subdistrict, it is known that 67.93% of the area has a low risk level, 27.50% of the total area has a medium risk level, and the remaining 4.58% has a high-risk level.
5. The majority of people in Bringin sub-district have not implemented adaptation with structural strategies as an adaptation effort to deal with drought. Then, in population adaptation with economic, social and cultural strategies, many people have implemented it.

The majority of people affected by the drought disaster in Bringin sub-District realize that innovation in dealing with drought disasters is very important and they are interested in implementing innovation in dealing with drought disasters. However, only a small portion of the community has tried, adopted or implemented adaptation innovations in dealing with drought disasters due to the lack of agent roles in socializing the innovation.

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