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THE EFFECT OF USING BIOPORE ON FLOOD REDUCTION IN DISTRICT OF BESUKI, TULUNGAGUNG REGENCY

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ABSTRACT: The District of Besuki is one of the regions in Tulungagung Regency which has karst morphology. The high quantity of rainfall and unpredictable weather in the karst area can increase the risk of natural disasters such as floods and landslides. The technology of making biopore infiltration holes can be used as one of the solutions in flood disaster mitigation efforts. These infiltration holes generally used in dense areas of settlements or regions that have minimal water catchment areas. This study aims to determine the use of biopore to prevent flood in Gambiran, Besole Village, district of Besuki, Tulungagung Regency. This type of research is an experiment. The measure water absorption was utilizing a variety of tools such as double-ring infiltrometer, stopwatch, special ruler measuring the water speed. The results showed that the use of biopore is effective in reducing the impact of flooding in karst topographic areas, especially in Gambiran Hamlet, Besole Village, Besuki district, Tulungagung Regency. This was proven by experiments conducted by making comparisons between treated soils with biopore infiltration holes and soils without any treatment. During one month, with four times the treatment of water absorption can increase more than doubled. If the point without treatment is only able to absorb water as deep as 23 cm / 30 minutes or an average of 0.7 cm/minute, then the treatment point can absorb water as deep as 57cm / 30 minutes or with an average value of 1.9 / minute. With the increasing absorption of groundwater, the use of biopore infiltration holes can reduce the impact of flooding in karst areas, especially in Gambiran Village Besole Village Besuki District Besuki Tulungagung Regency.

Keywords: Biopore, Flood Reduction, Tulungagung Regency

1. INTRODUCTION

Besuki sub-district, Tulungagung Regency is one of the sub-districts that has karst morphology. Various typical natural features show that the domain is a visible karst region in this area where many limestone host rocks. The mining products are abundant compared to other areas, and there is typical vegetation of the karst region, namely teak trees. From the data recorded by the sanitation POKJA in Tulungagung Regency, there is 88.72 ha of mining land used in Besuki from 123.53 ha of mining land located in Tulungagung Regency.

In addition to the advantages of the area in the Karst region, which is rich in mining materials, this region also has various problems that can harm places or creatures in the region. In earth science, karst identified with a perishable area, where underlying rocks are readily soluble, and the soil is infertile [1]. Various threats can trigger damage in the area. Problems with the natural environment and erratic weather conditions add to the adverse effects of regions that have karst morphology. The high quantity of rainfall and unpredictable weather can increase the risk of natural disasters such as floods and landslides [2] [3].

According to the Tulungagung BPBD (Regional Disaster Management Agency), two subdistricts that were prone to flash floods were identified by the Tulungagung BPBD team in Besuki and Bandung Districts [4]. Gambiran Hamlet Besole Village Besuki Subdistrict is an area affected by the natural floods in 2016 where the flood was severe compared to other regions of Tulungagung. Gambiran area which has a kart area has arid forests and is close to Sungai Parit Agung and Parit Raya, if rainfall is high causing the area is still potentially experiencing flooding in the following years

Therefore, sustainable management for the karst region needed that is environmentally friendly and can be carried out by all components of the community. The use of scientific facilities in the form of man-made products that are ecologically friendly needed as an effort to mitigate natural disasters, such as biopore. The technology of making biopore infiltration holes can be used as one of the solutions in flood disaster mitigation efforts [5]. These infiltration holes generally used in dense

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areas of settlements or regions that have minimal water catchment areas [6].

Making biopore infiltration holes are expected to be able to minimize the effects of floods in the karst region [7] [8] [9]. Based on the studies that have done before, there are some features of the use of biopore compared to other methods, namely: 1) increasing the absorption of groundwater; 2) able to convert organic waste into compost; 3) able to improve soil fertility; and 4) making it very easy and straightforward [5] [8].

The researcher hopes that the technology of making biopore infiltration holes can be used as a solution to reduce flood disasters in Tulungagung Regency. These infiltration holes generally used in densely populated areas or areas that have minimal water catchment areas. This simple and environmentally friendly technology is still rarely used, and researchers previously suggested the need for action in the form of socialization to the public about the importance of using biopore.

2. METHOD

This type of research is experimental research. The experimental study is research conducted through preliminary activities aimed at getting the intended results. This research is one part of the kind of quantitative analysis [10].

The instrument used in this study, to measure water absorption utilizing a variety of tools such as double-ring infiltrometer, stopwatch, special ruler measuring the water speed.

Methods of data collection include observation and field studies; mapping; remote sensing; Interview; treatment/action in the form of infiltration measurements using a double-ring infiltrometer.

The treatment or action in this research is in the form of an experimental work carried out on the sample to obtain data on water absorption. The procedure is given by using several specialized tools and techniques, namely by the measurement method using a double-ring infiltrometer. At the selected points, each double-ring infiltrometer will be install. Then measures and measurements with specific rhythm patterns are carried out to determine the rate of infiltration of water per unit time.

To measure and know the use of biopore to minimize the impact of flooding, namely by conducting field research activities by measuring the level of infiltration of land without biopore (as a control variable) and with biopore (as a variable subject to action). To obtain water absorption figures using the double-ring infiltrometer measurement technique. Data analysis using formulas:

R O1 X O2

R O3 - O4

Information:
R = control group and experiment taken by random method.
O1 & O3 = Both of these groups observed by carrying out the pretest.
O2 = variable that has been subject to quality control.
O4 = variable that is not subject to quality control.

Furthermore, the difference is that if O2 is more significant than O1, the quality control group has a positive effect, and if O2 is smaller than O4, it has a negative impact [11].

3. RESULTS AND DISCUSSION

Description of Pre-action Soil Absorption Data

They measure the absorption capacity of groundwater in pre-action activities carried out to conduct a pretest. The results of the pretest of water absorption at two points are as follows.

Table 1. Pretest Soil Absorption

No.	Time (minutes)	Point A	Point B
1.	5	2	3
2.	10	7	8
3.	15	17	9
4.	20	22	22
5.	25	23	24
6.	30	23	24

Source: Results of data analysis, 2018

From the data above explains about the amount of water infiltration until it reaches a constant condition that is for 30 minutes. At point A it permeates 23 cm deep, and at point B it penetrates 24 cm.

Description of First Action Soil Absorption Data

The first action to measure soil fertility is carried out at five predetermined points and is the same as the place for measuring water absorption. The data analysis of soil fertility obtained in the field and laboratory are as follows.

Table 2. Water Absorption First Action

No.	Time (minutes)	Absorption (cm)			
		Point A	Point B	Point C	Point D
1.	5	12	17	66	66
2.	10	25	30	78	75
3.	15	39	48	85	89
4.	20	45	50	96	94
5.	25	47	53	98	95
6.	30	47	53	98	95

Source: Results of data analysis, 2018

From the data above, it explains about water infiltration at the points given treatment and points that are used as control variables. Points A, B, C, and D are the points treated. At Point A, water can constantly seep 47 cm for 30 minutes. At point B, at the same time, it can absorb 53 cm of water. At Point C, 98 cm of water incorporated in the soil with the same time-frequency of 30 minutes. At point D, 95 cm of water absorbed over 30 minutes. While the absorption capacity by using a double ring (as a control variable) as much as 25 cm with the same time that is as long as 30 minutes.

The average at point A has decreased by 1.5 cm in one minute; point B is 1.7 cm in one minute, point C is 3.2 cm in one minute, point D is 3.1 cm in one minute, and the control variable point is using double The ring has an average decrease of 0.8cm in one minute.

Description of Second Action Soil Absorption Data

The second action in measuring water absorption is carried out after one week from the first action at the five predetermined points. The data on water absorption in the second action is as follows.

Table 3. Water Absorption Second Action

No.	Time (minutes)	Absorption (cm)			
		Point A	Point B	Point C	Point D
1.	5	15	20	71	70
2.	10	32	42	85	77
3.	15	41	54	94	90
4.	20	55	57	97	95
5.	25	59	61	99	98
6.	30	56	61	100	98

Source: Results of data analysis, 2018

From the above data, it is explained that the water infiltration at point A can seep to a constant depth of 59 cm, at point B as much as 61 cm, at point C as much as 100 cm, at point D as much as 98 cm and double ring as much as 27 cm. All calculated with the same time-frequency of up to 30 minutes.

The average point A has decreased by 1.9 cm in one minute, point B is 2 cm in one minute, point C is 3.3 cm in one minute, point D is 3.2 cm in one minute, and the double ring is 0.9 cm in one minute. In the treatment to the third week, there was an increase in each point.

Description of Third Action Soil Absorption Data

The third action to obtain water absorption data is done one week apart from the second action at the same location as before; the water absorption data performed on the third action is as follows.

Table 4. Water Absorption Third Action

No.	Time (minutes)	Absorption (cm)			
		Point A	Point B	Point C	Point D
1.	5	18	22	74	74
2.	10	38	45	87	82
3.	15	45	57	95	91
4.	20	58	66	99	96
5.	25	64	69	100	98
6.	30	64	69	100	100

Source: Results of data analysis, 2018

From the above data it is explained that the water infiltration at point A can seep continually as deep as 64 cm, at point B as much as 69 cm, at point C as much as 100 cm, at point D as much as 100 cm and double ring as much as 28 cm with the same time that is up to 30 minute.

Point A on average decreases by 1.9 cm in one minute, point B by 2 cm in one minute, point C by 3.3 cm in one minute, point D by 3.2 cm in one minute and double ring 0.9 cm in one minute. In the treatment to the third week, there was an increase in each point.

Description of Fourth Action Soil Absorption Data

The fourth action is the last action carried out by the researcher in measuring water absorption. This action is carried out at the same five location points as before. The data absorption for water absorption in the fourth step is as follows.

Table 5. Water Absorption Fourth Action

No.	Time (minutes)	Absorption (cm)			
		Point A	Point B	Point C	Point D
1.	5	20	25	79	76
2.	10	42	52	90	84
3.	15	55	61	96	94
4.	20	68	69	99	96
5.	25	70	72	100	100
6.	30	70	72	100	100

Source: Results of data analysis, 2018

From the above data it is explained that the water infiltration at point A can sink to 70 cm, at point B as much as 72 cm, at points C and D as much as 100 cm and double ring as much as 29 cm all with the same time ie, 30 minutes, at point C and D are 100 cm in 25 minutes. The average point A has decreased by 2.1cm in one minute, point B is 2.3 cm in one minute, point c is 4 cm in one minute, point d is 3.3 cm in one minute and double ring 0.9 cm in one minute.

The use of biopore infiltration holes is a technology that provides many benefits, one of which can reduce the impact of flooding [12] [13]. That is because the biopore infiltration hole can absorb surface water faster than without using the biopore infiltration hole [14].

The use of biopore infiltration holes by using pipes which are perforated and filled with organic waste make the ability of the soil to absorb water from the top faster [15] [16]. This is the reason why this technology is said to be able to reduce the impact of flooding [17]. If this technology is installed in every house or installed in an orderly manner every few meters, it will be interpreted as an effort to reduce the problem of flooding the higher the success.

Data in the field shows results that indicate the accuracy of the use of this technology. The action was taken four times every week. This research tested in the area of karst, which is commonly affected by flooding, namely in Gambiran Hamlet, Besuki Subdistrict, Tulungagung Regency.

Karst soils are identical to dry, shallow surface soils, and there are land boundary factors. As has been reviewed in the theoretical study that karst has a meaning of a place without water and cold which also interpreted as a rocky area with a bare surface [18]

Besides this area is prone to soil erosion. To anticipate these impacts, activities that are like soil conservation are needed to preserve the environment [19] [20]. To conserve the soil and reduce the impact of flooding, the use of biopore in karst areas is needed to conduct a study. Flooding can occur because the absorption of water in the soil is not optimal [21].

Here is a diagram that shows data that shows the differences at each point during several actions taken.

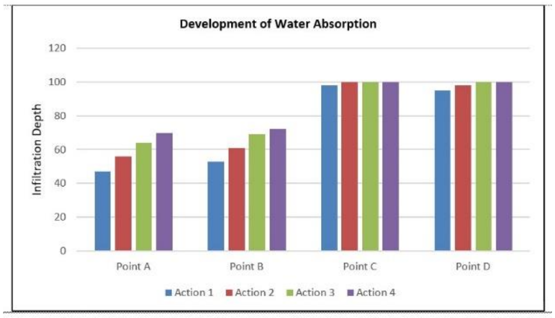

Fig 1. Development of Water Absorption

The diagram above shows the ability of water absorption. Points A, B, C, and D are points that installed biopore infiltration holes. Whereas point E is a control point without the treatment of biopore absorption holes. Measurement of water absorption at points where biopore absorption holes are applied is a double ring infiltrometer. Doble ring infiltrometer is a device that usually used for soil practicum that aims to determine the speed of water absorption or water seepage at the surface of the ground [16] [22].

The numbers listed in the bar chart taken at intervals of 30 minutes, and all of them show a fixed point. From points A, B, C, and D show the effective use of this technology. Every week after the application of this technology, the ability of the soil to absorb water increases even at points C and D able to quickly absorb water to a depth of 100 cm.

If averaged, point A is able to absorb water 60 cm / minute, point B 63.75 cm / minute, point C 99.5 cm / minute and point D 98.75 cm / minute. If we compare it with the water absorption at the point without using biopore, the impact of the ratio will be very far, where the water absorption point E has an average value of 26.35. If we calculate the ratio of water absorption in the soil without the use of biopore absorption and using is 1: 3.

Based on these measurements shows the effectiveness of the use of biopore infiltration hole technology in accelerating the ability of the soil to absorb water so that this technology can reduce the impact of flooding in the karst topographic area and is a flood-prone area.

4. CONCLUSIONS

The use of biopore is effective in reducing the impact of flooding in karst topographic areas, especially in Gambiran Hamlet, Besole Village, Besuki district, Tulungagung Regency. This was proven by experiments conducted by making comparisons between treated soils with biopore infiltration holes and soils without any treatment. In the first week, the location of the land used as the research site has relatively the same water absorption capacity. In the following weeks, it was shown that the points with biopore treatment had higher water absorption than the point without treatment. During one month, with four times the treatment of water absorption can increase more than doubled. If the point without treatment is only able to absorb water as deep as 23 cm / 30 minutes or an average of 0.7 cm/minute, then the treatment point can absorb water as deep as 57cm / 30 minutes or with an average value of 1.9 / minute. With the increasing absorption of groundwater, the use of biopore infiltration holes can reduce the impact of flooding in karst areas, especially in Gambiran Village Besole Village Besuki District Besuki Tulungagung Regency.

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