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Strengthening Community Capacity to Face Drought with Rainwater Harvesting Technology

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Abstract. Kalanganyar Village is a village located at the easternmost tip of Sidoarjo Regency, East Java. This village makes a major contribution to the field of aquaculture and processing. However, in the rainy season, this village experiences inundations and even floods in some areas, and during the dry season experiences drought or difficulty getting clean water. Based on this, this Community Service activity aims to help provide solutions by applying Rainwater Harvesting technology. The method used in this activity begins with permits in related agencies, then planning, counseling, practice making rainwater harvesting installations, and evaluations are carried out. With this activity, the Kalanganyar Village Community can make RHT installations independently after this activity, there are no inundations and floods in the rainy season, in the dry season clean water needs are still met, and the Kalanganyar Village community has been able to increase their capacity in dealing with drought to prevent non-natural disasters.

Keywords: Harvest, Kalanganyar, Rainwater, Strengthening Community Capacity

1 Introduction

Kalanganyar Village is one of the villages in Sedati District located at the eastern end of Sidoarjo Regency, East Java. The village with an area of 27.30 km^2 has a population of 5,705 people spread across 6 CA/ Citizens Associations and 23 NA / Neighborhood Associations [1]. The village with coordinates at 7º23'58.1" South Latitude and 112º47'39.2" East Longitude is directly adjacent to the Madura Strait where two-thirds of the area is aquaculture [2]. When compared to the sub-districts in Sidoarjo Regency, Sedati District is the area that contributes the most to the field of brackish water aquaculture, where the largest brackish water aquaculture pond area is in Kalanganyar Village, which is around 1000 Ha with superior fishery products such as tiger shrimp, milkfish, shrimp paste, crackers and processed milkfish [3].

Geographically, Kalanganyar village has several small rivers that function for irrigation of pond land, is a densely populated village, and most of the land has been used as residential land. Half a kilometer of village roads have been all paved, village roads and alleys are 90% paved. The livelihoods of Kalanganyar villagers are mostly pond farmers, entrepreneurs, and traders in aquaculture and fisheries [4][5].

In general, the daily clean water needs of the people of Kalanganyar village are obtained from groundwater in the form of dug wells and boreholes, this is because there is no water network from the Local Water Company [6]. Because it borders the sea, this village has the potential for seawater intrusion. According to [7]. Seawater intrusion can occur when the water discharge taken from the aquifer with the incoming water is less balanced. During the dry season, boreholes and dug wells in Kalanganyar Village often experience drought, resulting in difficulty for people to get clean water for their daily needs. However, during the rainy season, especially during high rainfall, there are many puddles on village roads due to the decreasing water catchment area. This happens because of changes in land functions that turn into settlements. During the dry season, people use river water to meet their clean water needs. Even in terms of quality, river water does not qualify as a source of clean water because there are many piles of garbage along the riverbanks. Community concern to preserve the environment, for example by managing waste and conserving rainwater, still needs to be improved. Based on the description above, the purpose of this community service activity is as an effort to provide clean water, as well as to deal with floods during the rainy season, as well as to increase the capacity of the people of Kalanganyar Village to deal with droughts that occur every year, namely by applying Rainwater Harvesting / RHT technology.

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Rainwater needs to be harvested so that it can be utilized because the amount is very abundant and free. On a roof area of 100 m^2, if the intensity is 25 mm/hour, with a duration of rain of 1.5 hours, clean water will be obtained as much as 3,375 m^3 [8]. According to [9][10]. This Rainwater Harvesting Technology / RHT was found against the background of several problems such as ongoing floods, increasing cases of drought, decreasing groundwater levels, decreasing groundwater quality and quantity, conventional drainage designs that dispose of water quickly downstream, declining environmental quality, increasing diseases caused by declining water quality, increasing need for clean water, and others. The opinion of [11] states that this technology is the application of environmentally friendly drainage concepts that have the principles of accommodating, infiltrating, flowing, and maintaining. There are four concepts in making tools, namely:

a. When it rains, rainwater on the roof tiles enters the gutters
b. Rainwater passes through filter 1. This stage aims to filter impurities such as coarse dust, leaves, and others.
c. Rainwater passes through filter 2, which aims to filter/dispel fine dust semi-automatically. At this stage, rainwater can pass through precipitation in the tank automatically.
d. Rainwater has been in the storage tank which tank has been equipped with a faucet and if excess rainwater, it will automatically flow to the discharge outlet directed to the infiltration well.

When compared with drinking water quality standards according to SNI 3553-2015 [12], the quality of clean water produced from RHT technology has met these standards, as presented in Table 1 below.

Table 1. Water Quality Test Results Produced from RHT when Compared with Drinking Water Quality According to SNI 3553-2015

Parameter	Unit	SNI	Water from RHT
pH	-	6 – 8,5	7,33
Conductivity	µS/cm	Max 1000	34,7
Turbidity	NTU	Max 1,5	3,64
Fe	ppm	Max 0,1	0,015
Mn	ppm	Max 0,05	0,004
NO_2	ppm	Max 0,005	0,037
Hardness	ppm	-	3,77
Calcium	ppm	-	0,9
Chloride	ppm	Max 250	9,32
Alkalinity	ppm	-	4,2
Magnesium	ppm	-	0,69

2 Method

This activity was carried out in the KKN-PPM program of Dr. Soetomo University Surabaya, located in Kalanganyar Village, Sedati District, Sidoarjo Regency, East Java. This activity is community participatory / community empowerment so from the planning stage to the evaluation stage involves the local community directly, consisting of elements of Village Apparatus, Community leaders, and Karang Taruna. This activity is also supported by BPPD / Regional Disaster Management Agency of Sidoarjo Regency and direct assistance from experts in Rainwater Harvesting technology, considering the threat of drought is one of the non-natural disasters that are often experienced by the community. The stages of its implementation are as follows:

a. Permits to related agencies, as a basis / first step for the implementation of KKN-PPM.
b. Planning, begins with a site survey and coordination.
c. Counseling on the importance of conducting Rainwater Harvesting / RHT carried out by students who have been trained by RHT Experts, BPBD, and Field Assistance Lecturers / DPL.
d. The practice of making RHT installations, starting with the preparation of the tools and materials needed, assembling them to placing the RHT device in a mutually agreed location.
e. The evaluation of activities is carried out with the aim of mentoring and care that must be carried out by the local community after this KKN-PPM activity, including multiplying this RHT tool to be placed in several strategic places in this village.

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3 Results And Discussion

This KKN-PPM activity substantively refers to the priority of SFDR *(Sendai Framework for Disaster Risk Reduction),* namely *understanding* risk or understanding disaster risk by strengthening capacity in urban communities that have disaster risks, especially the potential for drought and the availability of clean water sources. The results of KKN-PPM activities carried out in Kalanganyar Village, Sedati District, Sidoarjo Regency, East Java are as follows:

3.1 Licensing

The implementation of the licensing stage is carried out by LPPM Dr. Soetomo University Surabaya as the organizing institution. This activity can be held if you have completed administration at the administrative offices of East Java Province, Sidoarjo Regency, Bakesbangpong (National and Political Unity Agency) of East Java Province and Sidoarjo Regency, BPBD East Java and BPBD Sidoarjo Regency. Furthermore, the location of the activity place received a copy from the relevant agencies. If the administration has been fulfilled, LPPM visits the location to coordinate directly with the Sedati District and Village Head, especially related to technical implementation in the field.

3.2 Planning

The planning stage begins with a site survey conducted by students after receiving briefings from LPPM, DPL (Field Supervisor), and the BPBD Team. The purpose of the survey was to coordinate directly with Kalanganyar Village, as well as to discuss the schedule for conducting counseling on the importance of conducting Rainwater Harvesting / RHT and determining the location of the RHT equipment placement. Based on the results of deliberation, the location of activities and placement of RHT equipment is centered at Kalanganyar Village Hall.

3.3 Counseling and Socialization

Counseling was carried out at the Kalanganyar Village Hall on the day of the Village Head and his staff, the POLSEK, KORAMIL, the PUSKESMAS, community leaders, residents, DPL, and students. The purpose of counseling is to socialize the management and utilization of rainwater in the local community (figure 1).

(a)  (b) 

Figure 1. Counseling on the Management and Utilization of Rainwater by Experts (a), which is Continued Technically by Students (b)

The thing that must be considered when harvesting rainwater is not to use the first rainwater that falls because it contains many pollutants and viruses. Rainwater that can be harvested, at least 2-3 hours after the first rain falls, rainwater should be collected in rainwater that falls the third time.

3.4 RHT Installation Practice

The practical activities of making Rainwater Harvesting installations are carried out by students by involving the community, which includes:

a. This activity begins with the preparation of all tools and materials needed including drills, variations of drill bits, saws, meters, water containers/reservoirs, water faucets, 4-inch diameter paralon pipes, adapters, feloving toren, stainless steel stell, seals and cotton.
b. Stringing electrolysis, which serves to filter harvested rainwater (figure 2)

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Figure 2. Stringing Electrolysis

Figure 3. Identity Granting

c. Giving an identity to water reservoir tubes used to collect rainwater (figure 3)
d. Furthermore, the pipes, electrolysis equipment, and reservoirs that have been prepared, are assembled into installations as presented in Figure 4 below. The last stage is the placement of RHT installations according to the agreement, namely at Kalanganyar Village Hall, as a pilot.

Figure 4. A Series of RHT (Rainwater Harvesting) Installations Complete with Electrolysis

3.5 Monitoring and Evaluation

The purpose of the evaluation is to provide assistance and care that must be carried out by the local community after this KKN-PPM activity, including multiplying the installation of this RHT to be placed in several strategic places in this village.

Assistance is carried out in conjunction with the manufacture of APH installations, along with how to maintain them. During the assistance, it was also socialized on how to harvest rainwater when the rainfall intensity was high and the reservoir was full, namely by adding one pipe directed to the wells (figure 5). This is done to keep the assistance went smoothly and was enthusiastically welcomed by residents.

Figure 5. Sketch of Rainwater Reservoir Equipped with Infiltration Wells

By applying Rainwater Harvesting technology, abundant rainwater is not wasted on the surface of tiles, yards, roads, and residential waterways which eventually go to rivers and lead to the sea (fast water flow). Abundant rainwater has flowed into infiltration wells so that puddles and floods do not occur during the rainy season. Meanwhile, during the dry season, there is no drought and clean water is still sufficient.

4 Conclusion

Overall, the results of community service activities carried out through this KKN-PPM program include 1). The community, especially through village equipment, Karang Taruna, and local community leaders are very enthusiastic about participating in the whole series of community service activities so that the community can make RHT technology installations independently after the activity ends, 2). Kalanganyar village before this activity experienced inundations and floods in the rainy season, but in the kemaru season experienced drought making it difficult to get clean water. With this community service activity, the community can still get clean water in the dry season, 3). Rainwater has been managed properly so that there is no inundation and flooding during the rainy season, 4). The people of Kalanganyar Village have played an active role in non-natural disaster prevention activities.

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