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Water And Sanitation Status Under Emergency Situation After Palu-Sigi-Donggala Disaster

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Abstract: In November 2018, there was a shift in the active fault of Palu Koro which triggered a series of disasters in Palu City, Sigi Regency, and Donggala Regency, South Sulawesi; earthquake, landslides, tsunami, and liquefaction. In the emergency situation, water and sanitation provision then became an issue, both to those who stays in their own home and to those who seek help in shelter. Water and sanitation provision in the shelter is a joint effort from disaster relieve teams, in a form of cost or have team help on executing infrastructure construction. In the shelter, however, some of the domestic wastewater system did not follow the standard in SPHERE Project or was built in a wrong design. As a result, from 5 shelters observed, 3 of them was in a concerning condition. Blackwater and greywater that were supposed to be contained in the septic tank had overflowed and created puddle around it; some shelter toilets were built wrong; and some pipe from the toilets are disconnected from the septic tank, making it flows untreated to the drainage system and increase the risk of disease within or outside of shelter area. In water sector, groundwater was already one of the primary options for water source even before the disaster, and now that water sources from piped networks were cut, the usage of groundwater increases. Therefore, groundwater quality monitoring was conducted in order to monitor the quality of groundwater throughout the impacted area. total of 30 points of sample scattered in disaster impacted areas in Palu city, Sigi district, and Donggala district were taken. The sample results were then analyzed in the ITB Water Quality Laboratory and compared with water quality standards from Minister of Health Regulation number 492 year 2010 about Drinking Water Quality Standard. In total, 22 parameters were analyzed, namely physical parameters (odor, Total Dissolved Solid, turbidity, taste, temperature, color, electroconductivity) and chemical parameters (iron, fluoride, hardness, chlorine, total manganese, sodium, nitrate, nitrite, pH, sulfate, dissolved potassium, aggressive carbon dioxide, acidity using PP, and organic using KMnO4). According to the results, it is known that of the 30 samples analyzed, 13 of them met the quality standards of all parameters, with the best sample results were found in the Toaya and Labuan. Whereas, regions with problematic samples are found in the SigI, Bulili, Sangurara, and Balaroa. The parameters that exceeded the quality standards the most are Iron, Color, Turbidity, and Fluoride.

Key words: Donggala regency, Minister of Health Regulation number 492 year 2010, Palu city, sanitation, Sigi regency, water quality

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WATER AND SANITATION STATUS UNDER EMERGENCY SITUATION AFTER PALU-SIGI-DONGGALA EARTHQUAKE

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INTRODUCTION

Indonesia is a country of archipelago formed by collisions of large tectonic plates and active faults, hence, this country is prone to disasters. On 28 September 2018 at 18.02 Central Indonesia Times, a shift in Palu Koro, an active fault, caused a 7.4 Richter Scale Earthquake and were followed by landslides, tsunami, and liquifaction in Palu City, Sigi Regency, and Donggala Regency, Central Sulawesi. Since then, most survivors have been living in shelters provided by the government with help of many local and international humanitarian organizations. In emergency situation, Water, Sanitation, and Hygiene (WASH) provision became an issue. In shelter, WASH provision is a joint effort from disaster relieve teams of diverse background (local NGOs, International NGOs, Red Cross, or even national army), in the form of material resources (e.g. Food, clothes, WASH tools and equipments) and human resources supplies, as well as helping on infrastructure construction. In resident's houses, some were still within coverage of government aid and NGOs by providing them with basic needs. In sanitation sector, number of domestic wastewater systems in shelters did not follow the standards or was not built correctly, causing discomfort and imposing risks to the dwellers. In water sector, disasters demolished piped water networks and the damages caused by disasters increased the risk of groundwater contamination. Groundwater was one of primary options for water source prior to disasters. Since piped network of water supply was cut, the usage of groundwater increased. Therefore, in order to evaluate shelters sanitation system and to observe groundwater quality in impacted areas, shelter field observation and groundwater quality monitoring was carried out. Total of 30 points of sample scattered in disaster impacted areas in Palu city, Sigi district, and Donggala district were taken. The sample results were then analyzed in the ITB Water Quality Laboratory and compared with water quality standards from Minister of Health Regulation number 492 year 2010 about Drinking Water Quality Standard. In total, 22 parameters were analyzed, namely physical parameters (odor, Total Dissolved Solid, turbidity, taste, temperature, color, electroconductivity) and chemical parameters (iron, fluoride, hardness, chlorine, total manganese, sodium, nitrate, nitrite, pH, sulfate, dissolved potassium, aggressive carbon dioxide, acidity using PP, and organic using $KMnO_4$).

METHODS

The data provided in this study were collected by means of the following ways:
1. field observation
2. water quality sampling

Field observation includes the activity of exploring and documenting that focused on the targetted shelters in order to identify problems and at the same time create problem solvers reconnaissance for future programs and/or interventions. There were 5 shelters observed spread in Palu city: Petobo, Layana, Lere, Masjid Agung, and Balaroa. The shelter locations can be seen in Figure 1. Also, the observation was conducted in 2 recovery shelters in Sigi regency, namely Bangga Shelter and Padende shelter. However, no data could be provided due to some reasons.

Water quality samples were collected from a total of 30 points scattered in disaster affected areas, namely Sigi, Toaya, Bulili, Jono Oge, Labuan, Sangurara, Petobo, Balaroa, and Lolu. The samples were analyzed in ITB Water Quality Laboratory and compared with water quality standards from Minister of Health Regulation number 492 year 2010 regarding Drinking Water Quality Standard. In total, 21 parameters were analyzed, namely 7 physical parameters and 14 chemical parameters

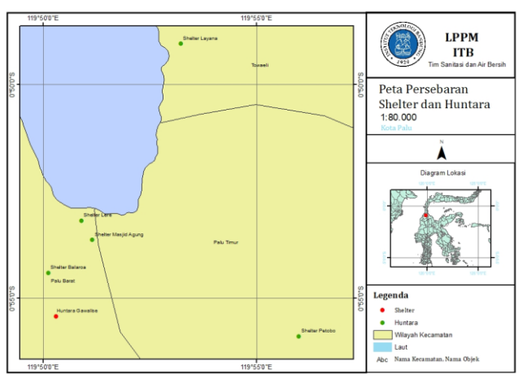

Figure 1 – Points of observed shelters

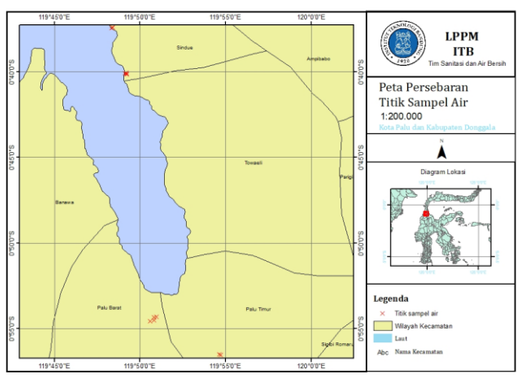

Figure 2 – Points of groundwater samples

CONCLUSION

Under emergency situation in Palu-Sigi-Donggala, groundwater could be used as an alternative or even main sources of drinking water since the water quality were considerably safe. Although, it was most likely affected, no significant contamination occurred due to the disaster in the areas where samples were taken. However, an appropriate of groundwater treatment in some areas should be to be applied in order to produce safe drinking water.

In shelters, sanitation condition in 3 out of 5 shelters observed should be intervened in term of wastewater handling. Some environmental problems were occurred due to incorrect design and/or construction process. Since we were not well prepared yet for any disaster that might happen at any time, time constrain in immediate phase of emergency sanitation always the main reason why the construction process did not follow desired design. For future development, coordination and standard operating procedure (SOP) for every phase of emergency situation must be established.

RESULTS AND DISCUSSION

Table 1 – Samples lab analysis report

Samples Area	Samples Taken	Samples Meeting Standard
Sigi	5	2
Toaya	3	3
Labuan	5	4
Bulili	4	1
Sangurara	5	0
Balaroa	4	0
Petobo	2	0
Lolu	1	1
Jono Oge	1	1
Total	30	12

Table 2 – Samples lab analysis results

Parameter	Unit	Standard	Max
Physical			
Odour	-	-	-
Total Dissolved Solid	mg/L	500	844
Turbidity	NTU	5	44,2
Taste	-	-	0
Temperature	°C	ambience ±3°C	26,9
	Pt.Co	16	100
Electroconductivity	uS/cm	-	1406
Chemical			
Total Iron (Fe)	mg/L	0,3	6,32
Fluoride (F)	mg/L	1,5	7,09
Hardness (CaCO3)	mg/L CaCO3	500	414
Chloride (Cl)	mg/L	250	86,4
Total Manganese (Mn)	mg/L	0,4	1,47
Dissolved sodium (Na)	mg/L	200	119
Nitrate (as NO3)	mg/L	50	66,2
Nitrite (as NO2)	mg/L	3	0,256
pH	-	6,5-8,5	7,93
Sulphate (SO4)	mg/L	250	79,9
Dissolved potassium (K)	mg/L	-	11,4
CO_2 Aggressivity	mg/L	-	
Acidity in pp	mg/L CaCO3	-	107
Alkalinity in mo	mg/L CaCO4	-	447
Organics (KMnO4)	mg/L	10	11,9

According to **Table 1**, it was known that from 30 samples, 12 ground water samples met the quality standards for all parameters, with the best sample results were found in the Toaya and Labuan. Whereas, the rest samples that were taken from Sigi, Bulili, Sangurara, and Balaroa, some parameters were found to exceed the drinking water quality standard. These locations actually the most affected areas by the disaster. So, there might be a correlation between the current water quality with the impact of the disaster that need further investigation. More detailed results could be seen in **Table** 2. The parameters which exceeded the drinking water quality standards were Total Dissolved Solid (TDS), turbidity, colour, total iron, total manganese, nitrate, organics, and fluoride. High concentration of physical parameters such as TDS and turbidity might indicate that the disaster has affected the ground water quality due to the liquefaction process. However, this findings should be further clarified.

In terms of sanitation aspects, from 5 shelters observed, 3 of them were in concerning condition. Number of emergency shelter toilets were built incorrectly and led to closure; Some toilets were built on unstable soil; Some has puddled blackwater and greywater due to overflow or disconnected pipes flow untreated to the drainage system. These conditions increased the risk of exposure to faecal matter of the dwellers and thus making the risk of water-borne diseases outbreak increased.

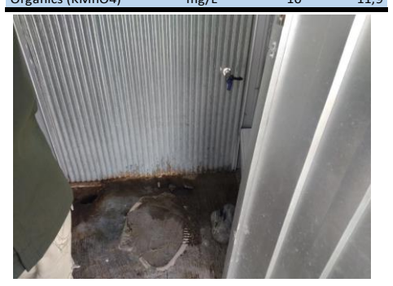

Figure 3 – Toilet covered with concrete to stop usage due to incorrect construction in Petobo Shelter

Figure 4 – Toilets built on unstable soil in Layana Shelte

Figure 5 – Puddled water due to septic tank overflow in Petobo Shelte

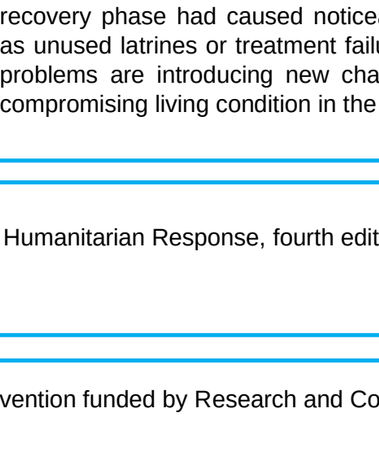

Figure 6 – Puddled water due to bad placement of water tank in Layana Shelter

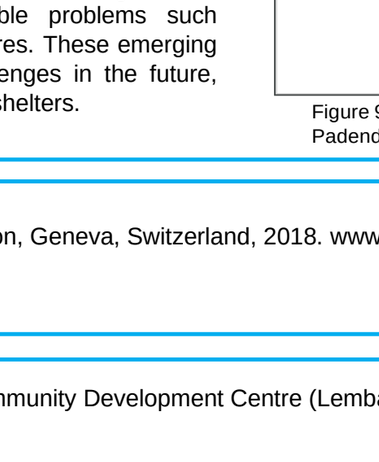

Figure 7 – Puddled water due to disconnected blackwater pipe in Mesjid Agung Shelter

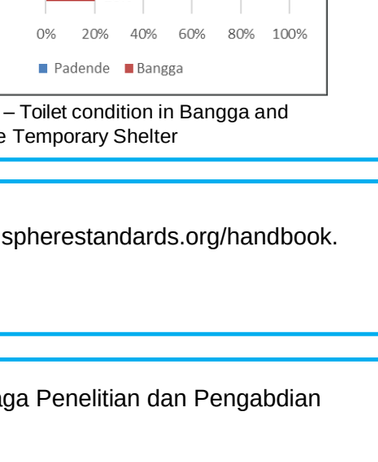

Figure 8 – Puddled water due to septic tank overflow in Bangga Shelter

In the most recent field observation focusing on available toilet quality along with its on-site treatment in recovery shelters, it was found that access to water and toilet in term of safety and comfort were considerably acceptable as shown in **Figure 9.** However, problems occurred in the treatment part of the chain, in which due to the absence of leaching pit after treatment and soil inability to infiltrate effluent, puddles are formed in some area and causing nuisance **(Figure 8).**

Lack of coordination for WASH infrastructure construction in the immediate phase of emergency sanitation, continued with lack of monitoring in the recovery phase had caused noticeable problems such as unused latrines or treatment failures. These emerging problems are introducing new challenges in the future, compromising living condition in the shelters.

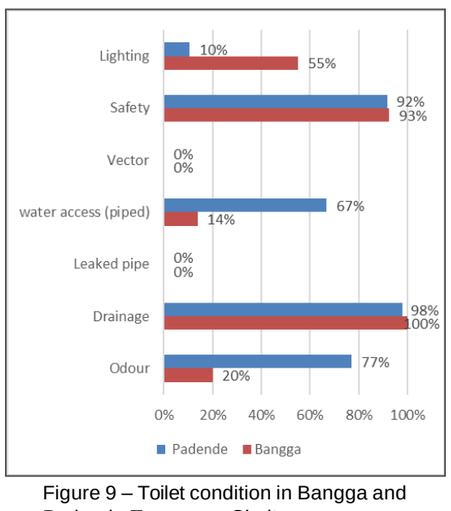

Figure 9 – Toilet condition in Bangga and Padende Temporary Shelter

References: [1] Sphere Association. The Sphere Handbook: Humanitarian Charter and Minimum Standards in Humanitarian Response, fourth edition, Geneva, Switzerland, 2018. www.spherestandards.org/handbook.
[2] Minister of Health Regulation number 492 year 2010 about Drinking Water Quality Standard

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