

The Construction of Reservoir Model for Dirty Water and Rainwater in Various Types of Houses in Groundwater Conservation During COVID 19 Pandemic

Muhammad Ardi¹, Faizal Amir², Bakhrani Abdul Rauf³, Mithen Lullulangi^{3,*}, Anas Arfandi¹, Alimudin Sa'ban Miru⁴

¹Department of Civil Engineering Education, Engineering Faculty, Universities Negeri Makassar, Indonesia

²Department of Automotive Engineering Education, Engineering Faculty, Universities Negeri Makassar, Indonesia

³Department of Architecture Engineering Faculty, Universities Negeri Makassar, Indonesia

⁴Department of Electrical Engineering Education, Faculty of Engineering, Universities Negeri Makassar, Indonesia

Email address:

mithen@unm.ac.id (M. Lullulangi)

*Corresponding author

To cite this article:

Muhammad Ardi, Faizal Amir, Bakhrani Abdul Rauf, Mithen Lullulangi, Anas Arfandi, Alimudin Sa'ban Miru. The Construction of Reservoir Model for Dirty Water and Rainwater in Various Types of Houses in Groundwater Conservation During COVID 19 Pandemic. *Applied Engineering*. Vol. 4, No. 2, 2020, pp. 63-67. doi: 10.11648/j.ae.20200402.16

Received: December 7, 2020; **Accepted:** December 14, 2020; **Published:** December 25, 2020

Abstract: This research aims to find: (a) the construction models, (b) constituent materials, (c) strategic locations, (d) supporting and inhibiting factors for the application of reservoir model for dirty water and rainwater that function as groundwater conservation and overcome the Corona Virus., in a large type of house. This research is classified as a survey research, located in Makassar, Bone, Soppeng, Sidrap, and Wajo Regencies. Respondents of each location were 75 people selected by purposive sampling method. The research variables are: construction model, constituent materials, strategic location, supporting and inhibiting factors for the application of the construction model of reservoir for dirty water and rainwater, which functions as ground water conservation and overcome the Corona Virus in a large-type of house. The analysis used in this research is descriptive. The results of the research showed that: (1) It was found six prototypes of the construction model of the reservoir for dirty water, and rainwater which functions as groundwater conservation and overcome the Corona Virus for large-type of the houses, namely: (a) single model, size 1.2 m x 3 m; 1.2 m x 2.5 m; and 1.2 m x 2 m; (b) double model, size 1.2 m x 2.5 m-1.2 m x 2.5 m; 1.2 m x 2 m-1, 2 m x 2 m; and (c) a triple model: size 1, 2 m x 1, 2 m - 2 m x 1, 2 m - 1, 2 m x 1, 2 m of 2.5 m in depth; (2) construction constituent materials are: red stone, sand, cement, concrete sand, gravel, and iron concrete; (3) strategic location for construction is in front of the yard, or side, and / or backyard of the house; and (4) the supporting factors for the application of the reservoir construction model are people who have knowledge of environmental sanitation, the environment, groundwater conservation, overcome the Corona Virus, and care for the environment. The inhibiting factors are people who do not care about the environment.

Keywords: Construction Model, Reservoir, Dirty Water and Rainwater, Corona Virus, Conservation

1. Introduction

Doxiadis in Muhammad Ardi, states that housing is a basic human need. One of the human activities that pollute the environment is the discharge of dirty water in every house. The dirty water has an impact on the pollution of the housing environment and triggers the emergence of the Corona Virus [1]. The survey on February, 2019 for several housing

complexes in Makassar, Soppeng, Bone, Sidrap, and Wajo Regencies showed that: (1) rainwater that fell on every house in the housing complex just wasted and flowed into the housing drainage which eventually entered the river, and (2) there is no construction of reservoir for dirty water and rainwater which function as groundwater conservation as well as to overcome the emergence of the Corona Virus.

In the state constitution Number 32 of 2009 stated that the

environment needs to be managed properly so that it is beneficial for humans [2]. Trainer, states that in building houses, one should maintain the environment and utilize natural resources as needed [3]. The survey on March 2019, for several planning consultants, housing developers, and other stakeholders in South Sulawesi, showed that the reservoir construction model for dirty water and rainwater that function as groundwater conservation and overcome the Corona Virus has not yet available. Therefore, this model needs to be designed and introduced to them, and other stakeholders, so that in designing a house, various prototypes have been prepared for the construction of reservoir for dirty water and rainwater which function as groundwater conservation and overcome the Corona Virus.

The objectives of the research are as follows:

1. To Find out a construction model of reservoir for dirty water and rainwater that functions as groundwater conservation and overcome the Corona Virus in the large-type of houses.
2. to find out materials for the construction model of reservoir for dirty water and rainwater that function as groundwater conservation and overcome the Corona Virus in the large-type of houses.
3. to find out strategic location for the construction of reservoir for dirty water and rainwater that functions as groundwater conservation and overcome the Corona Virus in large-type of houses.
4. To find out the supporting and inhibiting factors for the application of the construction model of reservoir for dirty water and rainwater tanks that function as groundwater conservation and overcome the Corona Virus in large-type of houses.

The theories that support this research are described as follows. Muhammad Ardi, states that a house is a place to live that needs the requirements of a decent life [1]. In the Law No. 4 of the Year (1992) stated that a house is a building that functions as a residence or shelter and a means of family formation [4]. Muhammad Ardi, states that the house is a place where people live to socialize, interact socially, and introduce culture [5]. In Wikipedia, said that the current house has a standard size [6].

Hadi in Muhammad Ardi, states that a house is part of a settlement which is an environment where humans live which is equipped with social, economic and cultural infrastructure and is a sub-system of the city as a whole [5]. Kuswartojo in Muhammad Ardi, states that to build an environmentally friendly house, a strategy is needed that can accommodate human aspirations and desires, and they still pay attention to a sustainable environment [1]. Nurhasan, states that the house is the main place for increasing the potential of human resources for all its residents who play a strategic role in improving the morality of the people [7].

Notoatmodjo, states that environmental sanitation is the health status of an environment which includes housing, garbage disposal, supply of clean water, waste disposal, and other impurities [8]. Entjang, states that sanitation is a monitoring of the physical, biological, social, and economic

environment that greatly affects for human [9]. Bakhrani, states that environmental sanitation is a system of storage and disposal of human waste, liquid waste, and garbage so that it does not endanger individual and society [10]. Rauf, states that environmental sanitation is an effort to control oneself from all human physical factors that may cause things to the physical development of health and human survival [11].

Ahmadi, states that the environment is human interference to the ecosystem structure [12]. Adnani, divides the environment into 3 parts, namely: the biological environment, the physical environment, and the social environment [13]. Mesaki, states that "In development, main the purpose" or sustainable is development for humans [14]. Bruntland, states that sustainable development is development to fulfill the needs of the present generation without reducing the future generations needs [15].

In the state constitution number 18 of 2008 stated that domestic waste is waste originating from daily activities in the household [16]. The daily activities of a house that can produce waste are washing, cooking and bathing. Suhartono, states that domestic waste is waste disposed from housing areas, markets, shops and offices, which are the main source of environmental pollution [17]. Furthermore, Suhartono, states that domestic waste contains various kinds of chemical substances, bacteria and if they disposed into the environment, so they can cause environmental pollution [17].

In the constitution No. 32 of 2009 explained that environmental pollution is the entry of substances, objects, and energy into an environment which causes the environment is not function properly [2]. One of the household activities that can pollute the environment are sewage. Eddy, states that domestic waste is liquid waste originating from businesses and / or activities of settlements, restaurants, offices, commerce, apartments, and dormitories [18]. Furthermore, Eddy states that domestic waste contains feces, urine, used washing water, bacteria, and viruses [18]. Agung, stated that the waste disposal without treating will cause decreasing the quality of the environment [19].

2. Material and Methods

This type of research is survey research. The research location was selected by purposive sampling method, namely Makassar, Bone, Soppeng, Sidrap, and Wajo Regencies. The sample selection also uses a purposive sampling method, namely people who understand and can provide an explanation of the environment, environmental sanitation, groundwater conservation, and the responses to the Corona Virus. The samples of each location were 75 people. Thus the total sample was 375 people.

The research variables are: (1) construction model of dirty water and rain water reservoir that function as groundwater conservation and overcome the Corona Virus in large-type of house, (2) materials construction, (3) strategic location of construction, supporting and inhibiting factors to the application of construction models.

Data collection was carried out by giving a questionnaire

to each sample member. The analysis used is descriptive analysis. The analysis aims to describe in depth to the each variable that is considered.

3. Research Result

A. Prototype of Construction Model of Dirty Water and Rain Water Reservoir that Function as Groundwater Conservation and Overcome the Corona Virus.

a. Single Model Prototype Size 1.2 m x 3 m Depth 2.5 m

The results of the analysis of 375 samples of the Single Model Prototype with a size of 1.2 m x 3 m in depth of 2.5 m to be used as the construction of reservoir for dirty water and rainwater which functions as groundwater conservation and overcome the Corona Virus in large-type of house, shows that there are 225 respondents (60%) strongly agree; 143 respondents (38.13%) agreed; 7 respondents (1.87%) expressed doubt. Based on the previous description, it can be concluded that the Single Model Prototype, size 1.2mx3m with a depth of 2.5m can be used as a construction of reservoir for dirty water and rainwater in the large-type of houses that function as groundwater conservation and overcome the Corona Virus.

In the construction volume, the size of the Single Model Prototype reservoir, size 1.2 m x 3 m in depth of 2.5 m can store 9 cubic meters of dirty water and rainwater. The volume is large enough and has the opportunity to seep into the ground. In the depth of construction, it can channel dirty water and rainwater more quickly into the lower soil.

b. Single Model Prototype Size 1.2 m x 2.5 m in depth 2.5 m

The results of the analysis of 375 samples of the Single Model Prototype with a size of 1.2 m x 2.5 m in depth of 2.5 m to be used as the construction of a reservoir for dirty water and rainwater which functions as groundwater conservation and overcome the Corona Virus in large type of house, shows that there are 250 respondents (66.67%) strongly agree.; 120 respondents (32%) agreed; and 5 respondents (1.33%) expressed doubt. Based on the previous description, it can be concluded that the Single Model Prototype, size 1.2 m x 2.5 m in depth of 2.5 m can be used as a construction for storing dirty water and rainwater in large-type of houses that function as groundwater conservation and overcome the Corona Virus.

In the construction volume, the size of the Single Model Prototype of reservoir, is 1.2 m x 2.5 m in depth of 2.5 m can store 7.5 cubic meters of dirty water and rainwater. The volume is large enough and has the opportunity to seep into the ground. In the depth construction, it can be understood that technically in depth of 2.5 m can channel dirty water and rainwater more quickly into the lower soil.

c. Single Model Prototype Size 1.2 m x 2 m in Depth 2.5 m

The results of the analysis of 375 samples of the Single Model Prototype with a size of 1.2 m x 2 m in depth of 2.5 m to be used as the construction of reservoir for dirty water and rainwater which functions as groundwater conservation and

overcome the Corona Virus in large-type of house, shows that there are 280 respondents (74.67%) strongly agree; 89 respondents (23.73%) agreed. And 6 respondents (1.6%) expressed doubts. Based on the previous description, it can be concluded that the Single Model Prototype measuring 1.2 m x 2 m, in depth of 2.5 m can be used as a construction for storing dirty water and rainwater in a large type of a house that functions as groundwater conservation and overcome the Corona Virus.

In the construction volume, the size of the Prototype Single Model of reservoir, is 1.2 m x 2 m in depth, 2.5 m, and can store 6 cubic meters of dirty water and rainwater. The volume is large enough and has the opportunity to seep into the ground. In the depth of construction can be understood that technically in depth of 2.5 m can channel dirty water and rainwater more quickly into the lower soil.

d. Double Model Prototype Size 1.2 m x 2 m - 1.2 m x 2 m in Depth 2.5 m

The results of the analysis of 375 samples of the Double Model Prototype 1.2mx2m-1m2mx2m depth of 2.5 m to be used as the construction of reservoir for dirty water and rainwater which function as groundwater conservation and overcome the Corona Virus in large-type of house, indicated that there are 310 respondents (82.67%) stated that they strongly agree; 63 respondents (16.8%) agreed; and 2 respondents (0.53%) expressed doubt. Based on the previous description, it can be concluded that the Double Model Prototype of 1.2 m x 2 m - 1.2 m x 2 m in depth of 2.5 m can be used as a construction for storing dirty water and rainwater in a large type of houses that functions as groundwater conservation and overcome the Corona Virus.

In the construction volume, the size of the Double Model Prototype reservoir is 1.2 m x 2 m - 1.2 m x 2 m in depth of 2.5 m can store 12 cubic meters of dirty water and rainwater. The volume is large enough and has the opportunity to seep into the ground. In the depth of construction, it can be understood that technically in depth of 2.5 m can channel dirty water and rainwater more quickly into the lower soil.

e. Double Model Prototype Size 1.2 m x 1.5 m - 1.2 m x 1.5 m in Depth 2.5 m

The results of the analysis of 375 samples of the Double Model Prototype, size 1.2 m x 1.5 m - 1.2 m x 1.5 m in depth 2.5 m to be used as the construction of reservoir for dirty water and rainwater which function as groundwater conservation and overcome the Corona virus in the large-type of a house shows that there are 309 respondents (82.4%) strongly agree; 62 respondents (16.35%) agreed; and 4 respondents (1.07%) expressed doubt. Based on the previous description it can be concluded that the Double Model Prototype of size 1.2 m x 1.5 m - 1.2 m x 1.5 m in depth of 2.5 m can be used as a construction of reservoir for dirty water and rainwater in a large type of house that function as groundwater conservation and overcome the Corona Virus.

In the construction volume, the size of the Double Model Prototype of reservoir is 1.2 m x 1.5 m - 1.2 m x 1.5 m in depth of 2.5 m can store 9 cubic meters of dirty water and rainwater. The volume is large enough and has the

opportunity to seep into the ground. In the depth of construction, it can be understood that technically in depth of 2.5 m can channel dirty water and rainwater more quickly into the lower soil.

f. Triple Model Prototype Size 1.2 m x 1.2 m - 1.2 m x 1.2 m - 1.2 m x 1.2 m in depth of 2.5 m

The results of the analysis of 375 samples of the Triple Model Prototype with the size of 1.2 m x 1.2 m - 1.2 m x 1.2 m - 1.2 m x 1.2 m, in depth of 2.5 m to be used as the construction of reservoir for dirty water and water rain, which functions as groundwater conservation and overcome the Corona Virus in large-type of houses show that there are 276 respondents (73.6%) strongly agree; 94 respondents (25.07%) agreed; and 5 respondents (1.33%) expressed doubt. Based on the previous description, it can be concluded that the Triple Model Prototype size, 1.2 m x 1.2 m - 1.2 m x 1.2 m - 1.2 m x 1.2 m, in depth of 2.5 m can be used as a reservoir construction for dirty water and rainwater in a large type of house which functions as groundwater conservation and overcome the Corona Virus.

In the construction volume, the size of reservoir of Triple Model is 1.2 m x 1.2 m - 1.2 m x 1.2 m - 1.2 m x 1.2 m in depth of 2.5 m can store 10.8 dirty water and rainwater cubic meter. The volume is large enough and has the opportunity to seep into the ground. In the depth of construction, it can be understood that technically in depth of 2.5 m can channel dirty water and rainwater more quickly into the lower soil.

B. Materials construction of reservoir for dirty water and rain water

a. Wall Construction

The results of the analysis of 375 samples of the building construction of reservoir for dirty water and rainwater which function as groundwater conservation and overcome the Corona Virus shows that there are 375 respondents (100%) stated that: red stone, sand, cement, and sufficient water. It can be concluded that the building of wall construction are red stone, sand, cement, and sufficient water. In technically the construction of red masonry walls can be done by construction workers. There was no difficulty for construction workers to install the wall until completion

b. Cover Construction

The results of the analysis of 375 samples of the material construction of the reservoir cover for dirty water and rainwater that function as groundwater conservation and overcome the Corona Virus. Single Model Prototype, size 1.2 m x 3 m depth 2.5 m shows that, There are 375 respondents (100%) states: cement, gravel, concrete sand, concrete iron, and sufficient water. It can be concluded that the materials for the cover construction of reservoir are cement, gravel, concrete sand, concrete iron, and sufficient water. The construction covers made of concrete, technically, can be worked out by construction workers. There is no difficulty for construction workers to make the concrete mix, install reinforcing bars, and do the casting to make the tub construction cover until completion.

C. Strategic Location of the Reservoir Construction for Dirty Water and Rainwater

The results of the analysis of 375 samples of strategic locations for the placement of reservoir for dirty water and rainwater that function as groundwater conservation and overcome the Corona Virus show that there are 140 respondents (37.33%) stated on the front yard of the house; 120 respondents (32%) stated on the side of the house; and 115 respondents (30.67%) stated on the back of the house. It can be concluded that the location of the cover construction is at the front, or side, and / or the back of the house yard. If the soil contour of the front yard is lower, the location of the construction is in the front. If the soil contour of the backyard is lower, the construction site is on the back. If the soil contour of the house yard are flat, then the construction location is on the side.

D. Supporting and Inhibiting Factors for the Application of the Construction Model of Reservoir for Dirty water and Rainwater

1. Supporting Facilitator

The results of the analysis of 375 samples of the supporting factors for implementation the construction of reservoir for dirty water and rainwater that function as groundwater conservation and overcome the Corona Virus are people who have knowledge about the environment, environmental sanitation, groundwater conservation, overcome the Corona Virus, and communities who care for the environment shows that, there are 281 respondents (74.93%) strongly agree; 90 respondents (24%) agreed. and 4 respondents (1.07%) expressed doubt. It can be concluded that the supporting factors for the implementation of the cover construction are people who have knowledge of the environment, environmental sanitation, overcome the Corona Virus, and the people who care about the environment.

2. Inhibiting Factors

The results of the analysis of 375 samples of the inhibiting factors for the implementation of the construction of reservoir for dirty water and rainwater that function as groundwater conservation and overcome the Corona Virus are people who do not care about the environment, showed that there are 287 respondents (76.53%) strongly agree; 85 respondents (22.67%) agreed; and 3 respondents (0.8%) expressed doubt. It can be concluded that the inhibiting factor for the application of the cover construction is the people who do not care about the environment.

4. Conclusions

The conclusions of this study are as follows:

1. There are six prototypes of the reservoir construction model for dirty water and rainwater that function as groundwater conservation and overcome the virus corona in a large type of house, namely: (a) single size model, 1.2 m x 3 m in depth of 2.5 m, (b) single size model 1.2 m x 2.5 m in depth of 2.5 m, (c) single size model 1.2 m x 2 m in depth of 2.5 m, (d) double size model 1.2 m x 2.5 m - 1.2 m x 2.5 m in depth of 2.5 m, (e) double size model 1.2 m x 2 m - 1.2 m x 2 m depth of 2.5 m, and (f) the triple model 1.2 m x 1.2 m - 1.2 m x

- 1.2 m - 1.2 m x 1.2 m in depth of 2.5 m.
2. The construction materials of reservoir for dirty water and rainwater that function as groundwater conservation and overcome the Corona Virus in the large-type of houses are: (a) wall construction: red stone, sand, and cement, (b) cover construction: concrete sand, gravel, cement, and concrete iron.
 3. The strategic location of the reservoir construction for dirty water and rainwater that function as groundwater conservation and overcome the Corona Virus in large-type of houses, namely the front, or side, and / or backyard of the house.
 4. Supporting factors for the implementation of the reservoir construction model for dirty water and rainwater that function as groundwater conservation and overcome the Corona Virus in large-type of houses are: (a) people who have knowledge of the environment, environmental sanitation, overcome the Corona Virus and conservation of groundwater, (b) people who care about the environment. The inhibiting factor is people who do not care about the environment.

Acknowledgements

Acknowledgments are conveyed to:

1. Ministry of Research and Technology/National Agency for Research and Technology and the Director General of Higher Education for funding this research as a form of coaching lecturers in Higher Education.
2. Rector of the State University of Makassar for his permission, guidance, and motivation, so that this research is carried out well.
3. The head of the Institute for Research and Community Services (LP2M) Makassar State University for his support and direction in conducting this research well.
4. Soppeng and Sidrap District Governments for their support and granting of permits to Conduct this research.
5. Farmers as research respondents for their participation and cooperation.
6. All members of the research team for their good cooperation.
7. All people that have participated in this research who were not mentioned one by one.

Hopefully what all people and team have done in completing this research can provide the greatest benefit for Makassar State University, Society, Nation and State.

References

- [1] Muhammad Ardi, Bakhrani A. Rauf, dan Mithen. *Desain Rumah Tinggal Berbasis Kearifan lokal Suku Bugis Yang Berwawasan Lingkungan*. Makassar: Badan Penerbit UNM. 2017.
- [2] Undang-Undang R. I. Nomor 32 Tahun 2009 Tentang *Perlindungan dan Pengelolaan Lingkungan Hidup*.
- [3] Trainer, Ted. *The Radical Implication of a Zero Growth Economy* 1 2011. (<http://rwer.wordpress.com/2011/09/06/rwer-issue-57-Trainer/>, diakses 15 September 2018).
- [4] Undang-Undang R. I. No. 4 Tahun 1992 Tentang *Perumahan dan Permukiman*.
- [5] Muhammad Ardi, Mithen, Bakhrani A. Rauf, dan Faizal Amir. *Desain Tampak Rumah Tinggal Berbasis Kearifan Lokal Suku Bugis Yang Berwawasan Lingkungan*. Makassar: Badan Penerbit UNM. 2018.
- [6] Wikipedia Online. 2019. <https://id.wikipedia.org/wiki/Special:Search?search=rumah+tinggal&go=Go&ns0=1>. Diakses 19 April 2019.
- [7] Nurhasan, Indrawati dan Riza Zahrul Islam. "Pendekatan Desain Rumah Sederhana Sehat (rs sehat) dan Lingkungannya Berdasarkan Arsitektur Islam." *Laporan Penelitian*. Solo: Universitas Muhammadiyah Solo. 2010.
- [8] Notoatmodjo, S.. *Promosi Kesehatan dan Ilmu Perilaku*. Jakarta: Rineka Cipta. 2010.
- [9] Entjang, I.. *Ilmu Kesehatan Lingkungan Masyarakat*. Jakarta: Cipta Aditya Bhakti. 2009.
- [10] Bakhrani A. Rauf, Muhammad Ardi, dan Faizal Amir. *Model Jamban Keluarga untuk Masyarakat Ekonomi Lemah pada Wilayah Dataran Rendah yang Aman terhadap Lingkungan*. Makassar: Badan Penerbit UNM. 2018.
- [11] Rauf, Rusdin. *Sanitasi dan HACCP*. Yogyakarta: Graha Ilmu. 2013.
- [12] Ahmadi. *Psikologi Sosial*. Jakarta: Rineka Cipta. 2012.
- [13] Adnani. *Ilmu Kesehatan Masyarakat*. Cetakan 1. Yogyakarta: Nuha Medika. 2011.
- [14] Mesaki, Simeon; and Malipula, Mrisho. 2011. "Julius Nyerere's influence and legacy: From a Proponent of familyhood to a candidate for sainthood". *International journal of Sociology and Antropology*. Vol. 3 (3) pp. 093-100, March 2011. Available online <https://academicjournals.org/journal/IJSA/article-abstract/7DBC2502079>, doi.org/10.5897/IJSA.9000053.
- [15] Bruntland, G. H. "World Commission on Environment and Development", dalam "Our Common Future", Oxford: Oxford University Press. 1987.
- [16] Undang-Undang R. I. Nomor 18 Tahun 2008 Tentang *Pengelolaan Sampah*.
- [17] Suhartono, E. Identifikasi kualitas perairan pantai akibat limbah domestik pada monsun timur dengan metode indeks pencemaran (Studi kasus di Jakarta, Semarang, dan Jepara). *Jurnal Wahana TEKNIK SIPIL*. Volume 14, No. 1, hal. 51-62. 2009. <https://ojs.unud.ac.id/index.php/jits/issue/archive>.
- [18] Eddy. *Karakteristik Limbah Cair*. *Jurnal Ilmiah Teknik Lingkungan*, Vol. 2, No. 2, p. 20. 2008.
- [19] Agung. *Pengolahan Limbah Cair Industri Tahu dengan Metode Elektro-koagulasi*. (<https://core.ac.uk/download/files/379/11735109.pdf>, diakses 12 Maret 2019). 2012.