STUDY PUBLIC RESPONSE OF SAMARINDA CITY TO THE INSTALLATION OF RAINWATER HARVESTING AND IT'S BENEFITS

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ABSTRACT

Flooding, a lack of potable water, and environmental harm caused by regional expansion are all issues that continue to plague Samarinda City. This research tries to persuade the community to use rainwater harvesting (RWH) systems as a solution to these issues, and then closes with the people of Samarinda's overall response. It was discovered that 33% of respondents collect and use rainwater for various reasons utilizing a survey method and descriptive analysis approach. Only 16 percent of the 33 percent use it for basic needs (cooking and drinking water). The majority of responders (80%) think that using rain water (RWH) can lessen the Regional Water Company's service load. However, the number of people who are aware of the favorable effects of RWH on the environment is still quite small, around 25%. The biggest reasons for respondents not installing RWH in their homes and environs are the expense of installation (26%) and space availability (52%) issues. In order to boost public interest in rainwater collecting with RWH installations in the future, more extensive and precise socialization activities and movements are required.

Keywords: Rainwater Harvesting, Rainwater, Clean Water

1. INTRODUCTION

1.1. Background

Rainwater is one source of clean water available to the neighborhood, but when more people arrive, they abandon rainwater in favor of PDAM (Regional Drinking Water Company)water sources. If rainfall is not accommodated and utilized, it might have an impact on the growing demand for water from PDAM services, community reliance on PDAM, and run-off discharge. However, if rainwater usage is higher, the beneficial effects include reduced run-off discharge, increased watershed retention, and helping to satisfy the needs for clean water. It will assist to keep the quality of the rainwater stored pure by adopting a particular rainwater harvesting (RWH) installation. As a result, the purpose of this study is to look at how the people of Samarinda City react to rainwater harvesting systems and the benefits gained from storing and using rainwater as a way to re-encourage the community to harvest rainwater.

1.2. Purpose

Several essential objectives can be formed based on the foregoing context:

1. Understanding how people view rainwater as a source of water for daily needs.
2. determining how many individuals of the community are already aware of the benefits and functions of rainwater collecting.
3. Identifying how many individuals are willing to install rainwater harvesting systems if they are aware of the benefits and functions of rainwater harvesting.
4. Knowing how many individuals think about the expense of providing rainwater harvesting installations and the cost of putting them in place once they've been agreed upon.
5. Identifying the barriers that the community in Samarinda City faces in installing

rainwater harvesting systems at their homes on their own.

2. LITERATURE REVIEW

Rainfall contributes the most fresh water to Indonesia, which is critical for the survival of all living beings. Rain that falls as a result of this hydrological cycle flows above the ground surface (runoff), with the potential to soak into the earth, fill basins, overflow into floods, or end up downstream.

Because many water absorption areas have been turned into settlements, the area's retention capacity is quite poor in many metropolitan regions. As a result, hardly much rainwater is absorbed into the earth in metropolitan areas, and the majority of the rainwater fills the basin or overflows into floods.

Samarinda City has a flat topography and is located in a lowland area, with 42.77 percent of the city's land area being at an altitude of 7-25 MDPL, which causes the soil surface to be saturated more quickly and runoff to not have enough time to penetrate, causing flooding. It is quite easy to become flooded if the drainage system is not designed to handle runoff. (Bapedal, 2006)

A case study of the impact of severe rain on Samarinda City on May 22, 2020, which resulted in floods as high as 10 - 120 cm for more than four days. (BMKG, 2020)

If you wish to use rainwater for clean water needs, it has a superior quality than other water sources. This is because pollution that happens before rainwater reaches the ground surface is smaller than contamination that occurs after rainwater reaches the ground surface. The basic premise of rainwater harvesting (RWH) is to collect rainwater that falls on the roof surface and drain it to a tank or reservoir via gutters and water pipes. As a result, if many people use the RWH, the volume of rainwater that would normally become runoff will be held back as a source of clean water and infiltration into the ground. According to the calculations, the volume of rainwater that can be gathered in Samarinda City, whose rainfall is around 2000 mm, is 23.97 million cubic meters (53 percent) of the community's 45.1 million cubic meters of clean water demands. The following is a technical installation for RWH application, as shown in **Figure 1**.

During early rains, the water usually contains a lot of dust and grit (eg dust, leaves, or bird and other animal droppings). As a result, during the initial rain, the flow from the roof must be removed and should not reach the reservoir pond, as it may reduce the quality of rainwater in the reservoir. As a result, in **Figure 1**, point 4, there is a dust catcher installation. As shown in **Figure 2**, this method uses the buoyant force of the plastic ball as the initial rainwater filter limit.

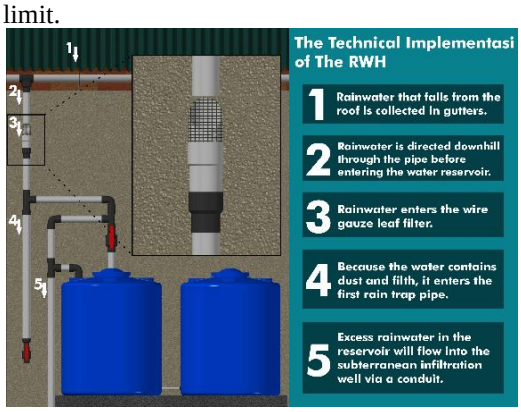


Figure 1. The Technical Implementation of the RWH.

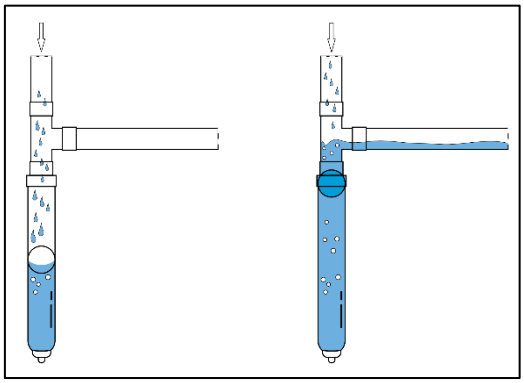


Figure 2. Installation of a Dust Collector

3. Methods

The descriptive analytic method was employed in this study to describe the trend of people's perceptions of Samarinda City in terms of their rainwater harvesting practices and responses. The steps to be followed can be seen in broad terms in **Figure 3** below.

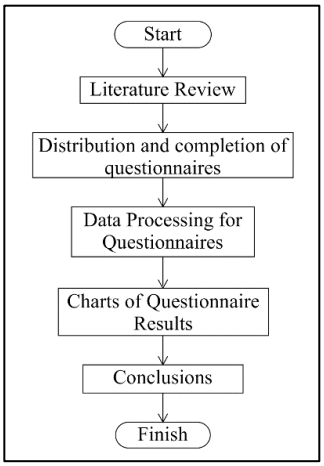


Figure 3. Flowchart of Research Methods

4. RESULT AND DISCUSSION

4.1. Respondent Characteristics

The distribution of respondents in each sub-district, monthly income, most recent education, field of employment, and status or position in work were all used to determine the characteristics of respondents in this study.

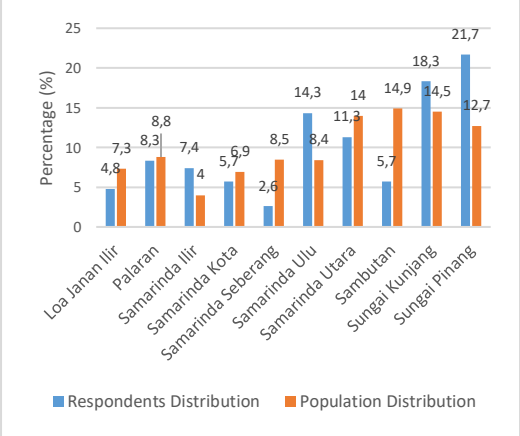


Figure 4. In Samarinda City, the Percentage of Respondents and the Population Distribution in Each District were Calculated.

Figure 4 shows that Sungai Pinang had the highest percentage of responders (21%), Sungai Kunjang had the second highest percentage (18%), and Samarinda Seberang had the lowest percentage (2.6%).

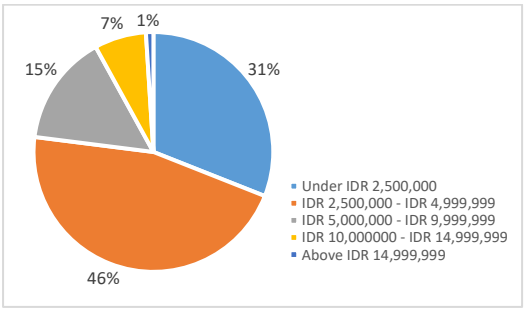


Figure 5. Monthly Earnings

Figure 5 shows that 23 percent of respondents earn IDR 5 million or more, 46 percent earn between IDR 2.5 million and IDR 5 million, and 31 percent earn less than IDR 2.5 million.

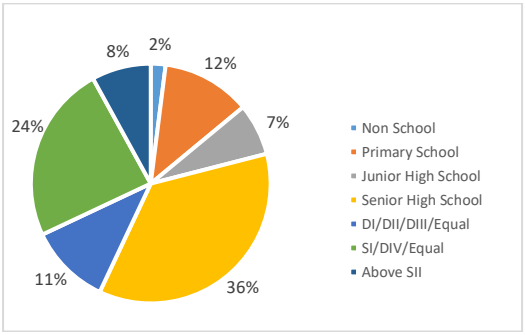


Figure 6. Final Education

Figure 6 shows that the majority of respondents (36%) came from a senior high school, the second (24%) from an SI or equal, and the third (2%), from a non-school background.

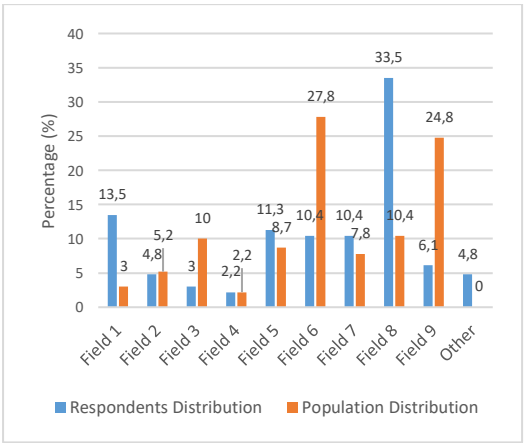
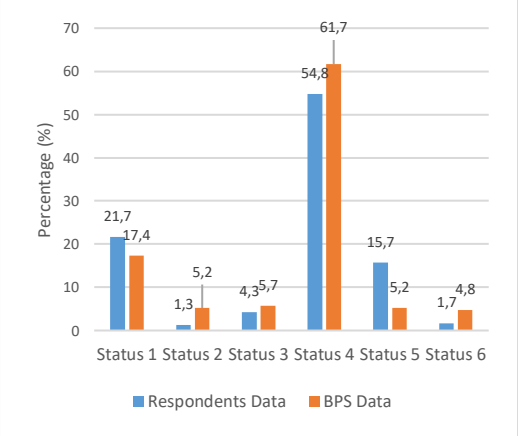


Figure 7. Respondents and residents of the city of Samarinda as a percentage

Description
Field 1 : Agriculture, forestry, hunting and fishing

Field 2 : Mining and excavation
Field 3 : Processing industry
Field 4 : Electricity, gas and water
Field 5 : Building
Field 6 : Wholesale, retail, restaurant and hotel
Field 7 : Transportation, warehousing and communication
Field 8 : Community, social and individual services
Field 9 : Finance, insurance, building rental business, land, and company services
Other : Respondents who fill in fields other than those listed above, such as retiree, teacher, sports coach, unemployed, and others

Figure 7 shows that with a considerable percentage of 33.5 percent, respondent's highest occupation is in the sector of community, social, and individual services.



Gambar 8. Respondents and Samarinda Residents Employment Status

Description
Status 1 : Work alone
Status 2 : Attempting to enlist the assistance of unpaid/temporary workers
Status 3 : Attempting to be assisted by permanent/paid staff
Status 4 : Labor/employee/staff
Status 5 : Freelance work
Status 6 : Family member/unpaid laborer

Figure 8 shows that 54.8 percent of respondents are Labor/employee/staff at their place of employment.

4.2. Condition of the Household Water Supply

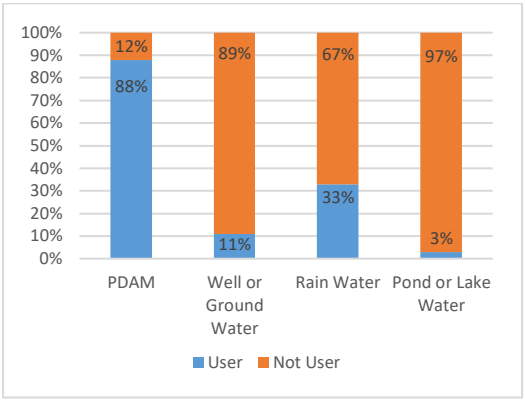


Figure 9. Source of Water

Figure 9 demonstrates that PDAM, rainwater, and wells/ground water are the most often used water sources in the community, with 88 percent, 33 percent, and 11 percent, respectively. Rainwater is used by 99 percent of rainwater users for watering plants and washing cars, 62 percent for domestic labor, 16 percent for cooking, and 1% for fish pond water demands.

Table 1 shows the relationship between each of the community's water sources.

Table 1. The Samarinda City Community's Water Sources in Relationship

The Water Source Was				%
PDAM	Ground Water	Rain Water	Pond or Lake Water	
✓				60.4
✓		✓		22.6
	✓	✓		4.3
✓	✓			3.5
		✓		3.0
		✓	✓	2.2
	✓			1.7
✓	✓	✓		1.3
			✓	0.9

Figure 10 depicts the costs borne by the community for clean water needs.

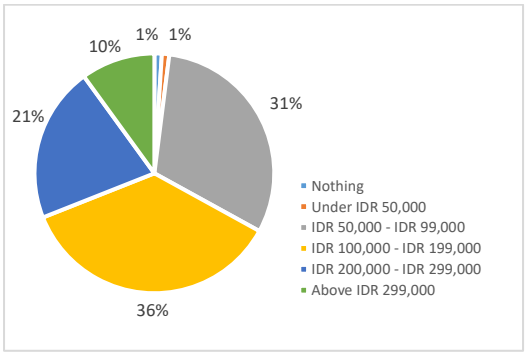


Figure 10. Clean Water Costs on a Monthly Basis

Figure 11 depicts the difficulty level of access to clean water among the population of Samarinda City.

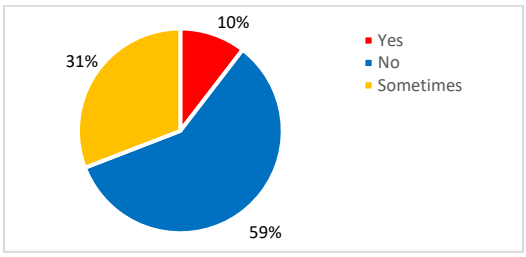


Figure 11. Access to Safe Water is Difficult

4.3. Community Perception When Rainwater is Used for Daily Needs

If all respondents use rainwater, **Figure 12** depicts their descriptions of how they use rainfall for various purposes.

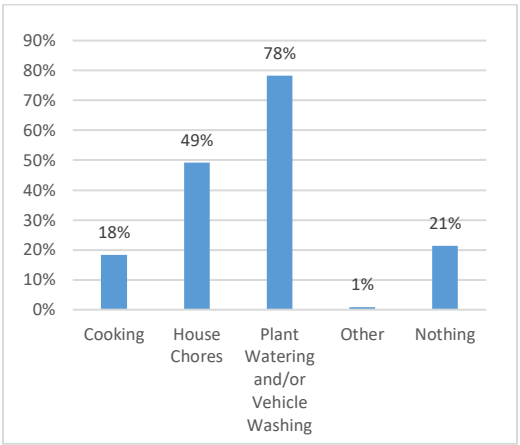


Figure 12. Utilization of Rainwater for Daily Needs

4.4. Application of Rainwater Harvesting with Tanks or Shelters in Each House

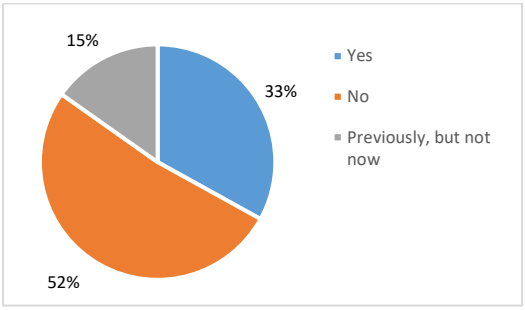


Figure 13. Rainwater Collection in a Tub or Reservoir

From **Figure 13** shows that:

1. Rainwater is collected by 33% of people.
2. 52 percent of people do not collect rainwater for a variety of reasons and constraints, including a lack of room for a reservoir, a preference for other water sources (such as PDAM or drilled wells), and a dislike of rainfall.
3. 15% of people used to collect rainwater, but now they don't because they rely on other water sources (such as PDAM and drilled wells) and need more room.

Rainwater is used for watering plants and washing vehicles by 99 percent of respondents, 62 percent for home tasks (such as washing, bathing, and cleaning the house), 16 percent for cooking, and 1 percent for water needs. pond with fish.

Figure 14. Samarinda City Community Rainwater Storage

In **Figure 14**, the method of collecting rainwater is very dependent on the amount of rainwater used. The reservoir will be left open if rainwater is solely used to wash automobiles, but the shelter will be closed if rainwater is utilized for

other reasons such as schoolwork. Because the system still leaves the rainwater reservoir open and almost all of them lack a sewage filtering system, the majority of the installations executed by the residents of Samarinda City have failed to meet the intended RWH installation criterion.

4.5. Community Insights About the Benefits of Harvesting Rainwater

Using rainwater is a new practice that the community, particularly the people of Samarinda City, is encouraging, but it has become a habit for the community in the past because the town's sole supply of clean water is well water or rain water. Rainwater can be used to aid boost retention in each area within a region, avoiding significant flooding that can occur at any time.

Figure 15 depicts public awareness of the benefits and roles of rainwater collection in general.

Description
Benefit 1 : Meeting the demands of households for clean water
Benefit 2 : Reducing the strain of using ground water and PDAM
Benefit 3 : Reduce flooding
Benefit 4 : Reduce dryness
Benefit 5 : Maintaining the groundwater level's stability

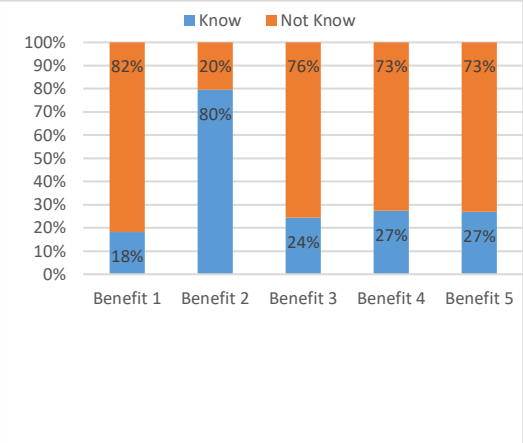


Figure 15. Community Awareness of the Benefits and Roles of Rainwater Collection

Most of the respondents in the image above agree that using rainwater harveting (RWH) can minimize the pressure on PDAM services. However, the number of people who are aware of the favorable effects of RWH on the environment is still quite limited, at roughly 25%. Only 18 percent of individuals believe that rainfall can meet the need for clean water.

4.6. Willingness of the Community to Implement Rainwater Harvesting

The respondent's willingness level can be measured in two ways: before knowing the good impact and after knowing the positive impact, as shown in **Figure 16** below.

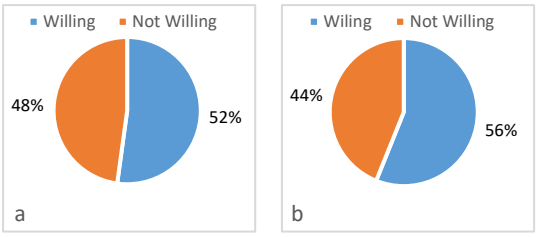


Figure 16. Willingness of Respondents to Install RWH (a) Before Knowing the Positive Impact, and (b) After Knowing the Positive Impact

Figure 16.a reveals that 52 percent of respondents are willing to use rainwater as a source of clean water, indicating that the community was previously unaware of the potential of rainwater as a source of clean water and was reawakened after seeing the installation. **Figure 16.b** shows an increase in willingness from 4 percent to 56 percent. This rise is considered insignificant, implying that the positive impact achieved is not a compelling cause for the community to begin collecting rainwater.

4.7. Obstacles to Rainwater Harvesting Implementation in Communities

It's critical to understand the community's barriers to installing RWH systems so that they can be taken into account in order to continue to promote the rainwater harvesting movement among the people of Samarinda City. **Figure 17** depicts the challenges that the community faces when attempting to install rainwater collecting systems on their own at home.

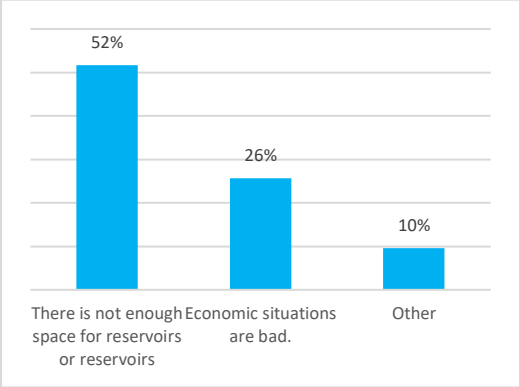


Figure 17. Obstacles to Implementing RWH Installation Independently at Home

4.8. Costs Associated with Installing a Rainwater Harvesting System

Table 2. The Cost of Implementing RWH that the Community Accepts

Costs of Implementation Assumed by the Community	Monthly Income Group of Respondents				
	< IDR 2,500,000	IDR 2,500,000 - IDR 4,999,999	IDR 5,000,000 - IDR 9,999,999	IDR 10,000,000 - IDR 14,999,999	> IDR 14,999,999
Not answered	36 (50 %)	45 (42 %)	6 (18 %)	5 (31 %)	1 (33 %)
Under IDR 100,000	2	0	0	0	0
IDR 100,000 – IDR 249,999	8	9	4	1	0
IDR 250,000 – IDR 499,999	4	8	1	0	0
IDR 500,000 – IDR 999,999	13	17	7	1	0
IDR 1,000,000 – IDR 1,999,999	3	14	0	1	0
IDR 2,000,000 – IDR 2,999,999	4	9	7	1	1
IDR 3,000,000 – IDR 3,999,999	1	1	5	2	0
IDR 4,000,000 – IDR 4,999,999	1	1	2	0	0
IDR 5,000,000 – IDR 5,999,999	0	0	1		0
Above IDR 6,000,000	0	2	0	3	1
Total	**72**	**106**	**33**	**16**	**3**

The parameters of the community's monthly revenue are then changed based on the amount of expenditures that the community can afford to install RWH installations, as indicated in Table 2. There are other respondents in the table who did not respond to the amount of fees they could afford. Uncertain economic conditions, other necessities that they wished to obtain, and a lack of enthusiasm in implementing the installation were among the reasons given by respondents who did not indicate how much the installation cost they could afford. And the fraction of scores that do not respond is decreasing as monthly income increases. As a result, people's purchasing power is heavily dependent on their income and the necessity of installing rainwater collecting systems.

4.9. Increasing public interest in the installation of rainwater harvesting systems

Factors that drive people to collect rainwater include, but are not limited to:

1. Economic conditions.
2. Access to PDAM services is difficult to come by.
3. Recognize that rainfall can be utilised even if other water sources are available.

To re-encourage the practice of rainwater collection, various authorities must contribute, as well as the ability to educate and invite the community directly or indirectly. The government's role as a policymaker can kickstart a movement to collect rainwater in government buildings and install more RWH systems, especially in areas where clean water is scarce and for the poor, so that rainwater collection becomes more widely recognized and accepted. be aware of the advantages and purity of rainwater. Community leaders, such as RT heads, traditional leaders, and others, might provide encouragement or motivation to begin collecting rainwater by putting it to use in their own houses or in public gathering spaces. And, if rainwater is accommodated in great quantities by many individuals, teachers at the school or college level can educate people at all levels of education about the positive impacts of rainwater.

5. CONCLUSIONS AND SUGGESTIONS

5.1. Conclusions

1. The public's opinion of rainfall as a source of domestic water:
   a. 18% of respondents believe that rainwater can be used for cooking.
   b. Rainwater can be used for home purposes, according to 49% of respondents.
   c. Rainwater can be utilized to water plants and/or wash cars, according to 78% of respondents.
   d. Rainwater is suitable for watering fish ponds and toilets, according to 1% of respondents.
   e. However, just 33% of all respondents use rainwater, and the majority of those who do collect it do so without any extra filtration to maintain the water quality clean.

2. The general public's understanding of the benefits and duties of RWH:
   a. RWH can be used as a source of water for families, according to 18% of respondents.
   b. RWH application can lessen the burden of using ground water and PDAM, according to 80% of respondents.
   c. RWH implementation can prevent floods, according to 24% of respondents.
   d. RWH implementation can lessen drought, according to 27% of respondents.
   e. The application of RWH can maintain the stability of the ground water level, according to 27% of respondents.
3. Willingness of the community to implement RWH on its own:
   a. Without explaining the positive impact, 52% of people are eager to apply RWH on their own. People have been re-awakened for a moment to observe the installation after concluding that they were unaware of the potential of rainwater as a source of clean water.
   b. After hearing about the expected costs, benefits, and roles of RWH implementation, respondents' willingness only increased by 4% to 56%. This suggests that the beneficial impact achieved is not a compelling cause for the community to begin collecting rainwater.
4. The large costs of providing RWH that the community can afford are as follows: 26 percent of the community stated that economic conditions are not capable of being an obstacle for them to implement RWH installation independently, and the following are the large costs of providing RWH that the community can afford:
   a. People with salaries below IDR 2,500,000 are willing to spend an average of IDR 100,000 to IDR 1,000,000, according to 50% of respondents in this income category.
   b. Those earning between IDR 2,500,000 and IDR 4,999,999 are willing to spend an average of IDR 100,000 to IDR 3,000,000, according to 58 percent of respondents in this income range.
   c. Those earning between IDR 5,000,000 and IDR 9,999,999 are willing to spend an average of IDR 500,000 to IDR 4,000,000, according to 72 percent of respondents in this income range.
   d. Those earning between IDR 10,000,000 and IDR 14,999,999 are willing to spend an average of IDR 2,000,000 or more, according to 69 percent of respondents in this income range.
   e. Those with an income of more than IDR 14,999,999 are willing to spend an average of IDR 2,000,000 or more, according to 67 percent of respondents in this income category.
   f. Respondents who did not say how much the installation would cost them cited a variety of reasons, including uncertain economic situations, other necessities that they wished to purchase, and a lack of enthusiasm in putting the system in place.
5. Community restrictions in Samarinda City make it difficult to implement RWH on its own:
   a. 52% of respondents said there is not enough space for storage tanks or reservoirs.
   b. Poor economic conditions, according to 26% of respondents, precluded them from implementing it on their own.
   c. Rental houses, which do not require rainwater filtration (it already collects rainwater without filtering), cannot filter odors, and so on, account for another 10% of the hurdles.

5.2. Suggestions

Increase the number of responses in each sub-district and increase the community's presenting skills to make it more appealing.

REFERENCES

[1] Arif, D.A., Mardiatna, D., dan Giyarsih, S.R., dkk. (2017). Kerentanan Masyarakat Perkotaan terhadap Bahaya Banjir di Kelurahan Legok, Kecamatan Telanipura, Kota Jambi. *Majalah Geografi Indonesia: Yogyakarta.*

[2] Badan Pusat Statistik. (2020). *https://samarindakota.bps.go.id* diakses tanggal 11 Maret 2020.

[3] Badan Pengendalian Dampak Lingkungan Daerah Kota Samarinda. (2006). Status Lingkungan Hidup Daerah Kota Samarinda. *Samarinda.*

[4] Bappeda Kota Samarinda. (2015). Rencana Pembangunan Jangka Panjang Daerah Kota Samarinda. *Samarinda.*

[5] Cahyadi, A., dan Tivianton, T.A., dst. (2013). Persepsi Masyarakat Terhadap Pemanenan Air Hujan Dan Dampaknya Terhadap Ketahanan Sumberdaya Air Di Pulau Pramuka, Kepulauan Seribu, Dki Jakarta. *Universitas Gadjah Mada: Yogyakarta.*

[6] Climate 4 Life. (2021). Musim Hujan Tiba, Begini dampak Negatif Muncul. *https://climate4life.info* diakses tanggal 30 September 2021.

[7] Fathur. (2019). Ratusan Miliar untuk Pengendalian Banjir Samarinda Tahun 2020. *https://selasar.co* diakses tanggal 04 Juni 2020.

[8] Fathur. (2020). Kurangi Banjir Hingga 30 Persen, Pembangunan Kolam Retensi di Sempaja Dilanjutkan. *https://selasar.co* diakses tanggal 04 Juni 2020.

[9] Hutabarat, Alexander., (2020). Empat Hari Banjir Besar di Samarinda, Merendam hingga 47.281 Jiwa. *https://intuisi.co* diakses tanggal 04 Juni 2020.

[10] Juliana, I.C., Gunawan, T.A., dan Iryani, S.Y., dst. (2017). Respons Masyarakat Dan Peran Pemerintah Dalam Penerapan Sistem Rainwater Harvesting Untuk Skala Rumah Tangga. *Universitas Sriwijaya: Palembang.*

[11] Kementerian Pekerjaan Umum dan Perumahan Rakyat Badan Peningkatan Penyelenggaraan Sistem Penyediaan Air Minum. (2021). Baru 71% Kurang 9 Ribu Sambungan Rumah, PDAM Samarinda Target Cakupan 100 Persen Tahun 2020. *https://sim.ciptakarya.pu.go.id* diakses tanggal 30 September 2021.

[12] Lawi, G.F.K. (2019). BWS III Kalimantan Mulai Bangun Kolam Retensi Atasi Banjir. *https://bisnis.com* diakses tanggal 04 Juni 2020.

[13] Maryono, A. (2005). Menangani Banjir, Kekeringan dan Lingkungan. *Gadjah Mada University Press: Yogyakarta.*

[14] Maryono, A. (2016). Memanen Air Hujan. *Gadjah Mada University Press: Yogyakarta.*

[15] Persatuan Perusahaan Air Minum Seluruh Indonesia. (2021). Kejar Pelayanan 100 Persen, PDAM Kota Samarinda Butuh Investasi RP 2,4 Triliun. *https://perpamsi.or.id* diakses tanggal 30 September 2021.

[16] Pranita, Ellyvon., (2020). Banjir Rendam Ribuan Rumah di Samarinda, Ini 4 Faktor Penyebabnya. *https://kompas.com* diakses tanggal 14 Juni 2020.

[17] Pusat Pengendali Pembangunan Ekoregion Jawa Kementrian Lingkungan Hidup dan Kehutanan. (2021). Hujan Turun Berkah Teraup. *https://p3ejawa.menlhk.go.id* diakses tanggal 30 September 2021.

[18] Rahayu, P.S. (2020). Normalisasi Waduk Benanga Telan Rp 19 Miliar. *https://korankaltim.com* diakses tanggal 04 Juni 2020.

[19] Suryana, Wahyu. (2018). Pakar Imbau Masyarakat Biasakan Memanen Air Hujan. *https://republika.co.id* diakses tanggal 27 Mei 2020.

[20] Thomas, T.H., dan Martinson, D.B., dst. (2007). Roofwater Harvesting. *IRC International Water and Sanitation Centre: Delft, Netherlands.*

[21] Tjasyono, B.H.K., Juaeni, I., dan Harijono, S.W.B., dst. (2007). Proses Meteorologis Bencana Banjir Di Indonesia. *Institut Teknologi Bandung: Bandung.*