

Preserving The Environment and Rural Community in Sabah Through the Empowerment of Gravity-Flow Water Systems: A Survey Based on APPGM-SDG Solution Projects

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Abstract

The gradual increase in the world's population has caused the demand for domestic water resources to rise as well. In certain situations, existing water treatment plants cannot cope with the high demand of residents. Hence, to avoid a water supply crisis, the community should not entirely rely on one type of water supply (treated tap water supply). Instead, there should be an alternative water supply source in preparation for overcoming a potential water supply crisis. The gravity-flow water system is an efficient technique that has long been implemented in the rural communities of Sabah. Accordingly, this research examines the suitability of the gravity-flow water system implemented in rural areas by focusing on its advantages in preserving the environment and community. A qualitative approach was employed through site visits (SV), focus group discussions (FGD), and document of project proposals, monthly reports and final report from APPGM-SDG Solution Projects. Data were analyzed descriptively to assess the operational effectiveness, environmental sustainability, and socio-economic impacts of the gravity-flow water system. Triangulation was applied to enhance the validity and reliability of the findings. The study results revealed that the villagers' implementation of the gravity-flow water system in several rural areas in Sabah can preserve the environment by sustaining rivers and river basins. Apart from that, the implementation of gravity-flow water systems can also reduce the economic burden of villagers who, on average, have a low economic status. Indirectly through this study also found that there is a great need for technical skills and vocational training (TVET). By empowering TVET indirectly, there is potential for the development of gravity water systems, especially in terms of ideal design.

1. Introduction

Water is one of the most important basic resources in the lives of humans and other living creatures (such as animals and plants). It is also needed in almost all biological, geological and chemical processes (Quante & Matthias, 2006). In the context of human needs, water is used in several processes such domestic, industrial, agricultural (Cetin, 2020; Gössling et al., 2012), recreational (Goswami & Bisht, 2017), transportation (Lampert et al., 2016), etc. Therefore, it is not surprising that achieving universal access to water and sanitation services (SDG 6) is one of the 17 Sustainable Development Goals (Sadoff et al., 2020). Water covers about 71% of the total surface of the earth (Shiklomanov & Rodda, 2003). Of that amount, around 97% is sea water (salt water) while the remainder (3%) is fresh water (Musie & Gonfa, 2023). Of the total fresh water, more than half (68.9%) is in the form of ice and glaciers which are difficult to access (Musie & Gonfa, 2023). Meanwhile, the remainder (30.8%) is in the form of groundwater, soil moisture and swamps. Only a small part (0.3%) is in rivers and lakes (El-Ghonemy, 2012). The water in the atmosphere (for example, in the form of clouds and rain) is only about 0.001% of the total percentage of the entire water found on our planet (Quante & Matthias, 2006). This signifies that the water resources accessed for consumptive needs (e.g., for domestic, industrial and irrigation use) only make up a small percentage of the total water on earth. There are various ways or methods to exploit freshwater resources. For domestic purposes, for instance, fresh water found in rivers or lakes (surface water) can be utilised in treated tap water systems (water treatment plants). Most countries in the world have already applied this method, including Malaysia, which is a developing country (Jafar et al., 2022). In the context of Sabah itself (a region in Malaysia), a total of 84 water treatment plants have been actively operating throughout the state with an average production of 1,300 million litres of water per day. The coverage of this treated water supply has reached the level of 100% in the urban population and 78% in the rural population with a water pipe network of 15,031 kilometres (Sakke et al., 2020).

Ironically, the complete dependence on the use of treated tap water systems have led to its own problems from the aspect of environmental sustainability and the wellbeing of the local community. This is because the operation of treated tap water systems generally requires the construction of a dam as a water reservoir to ensure that the water supply at the water treatment plant is always sufficient. Unfortunately, uncontrolled dam constructions have high potentials of causing changes in river flow regimes, sediment regimes, wetland morphology (Donohue & Molinos, 2009), water quality, temperature and other water physicochemical parameters in reservoirs (Smolar-Žvanut & Mikoš, 2014). Wu et al. (2019) found that construction of dams has the potential of causing negative effects on natural biodiversity, such as plankton, fish (including aquatic mammals), botany and birds. It also influences the wellbeing of each community when areas of their heritage that were originally places of residence, agricultural land, historical places, hunting places or places to collect forest products are taken to be used as the locations of dams. The Indigenous people in Sabah (residents of Kg. Terian & Kg. Buayan), for example, opposed the construction of Kaiduan Mega Dam which was claimed to affect their wellbeing and the sustainability of the environment (Koh, 2020; Willie, 2021). What is more worrying is the gradual increase of water demand due to the continuous increase in population (Dawadi & Ahmad, 2013). According to the estimates of the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the global population could increase by 70% by 2050, leading to higher water demand (Wakeel et al., 2016). Even now, water demand is increasing, exceeding the supply, especially in developing countries (Jango et al., 2022). This, of course, forces authorities to increase the quantity of dam construction in order to ensure that the tap water supply is sufficiently maintained.

A proactive step is required to prepare for dealing with the increase in domestic water demand while simultaneously reducing the full dependence on treated tap water systems. Several alternative methods, such as rainwater harvesting systems (exploitation of water resources in the atmosphere), construction of wells (exploitation of underground water resources) and gravity-flow water systems (exploitation of surface water resources), can potentially be applied to reduce such dependence (Abdin et al., 2021). Among the three alternative methods, gravity-flow water systems closely resemble treated tap water systems since the water source exploited by both methods is the same, i.e., from rivers, lakes and water points (springs). Although both methods exploit the same water resource (surface water), there are differences in terms of operational design as well as the impact of operations on the sustainability of the environment and wellbeing of the population. Compared to treated tap water systems, the operation of gravity-flow water systems are seen to be more environmentally and community friendly.

Technical and Vocational Education and Training (TVET) plays a crucial role in equipping individuals with relevant technical skills to face modern industrial challenges (Salleh & Sulaiman, 2015; Salleh et al., 2016). In the context of Sabah, especially rural areas, TVET has the potential to be the key to empowering local communities through the implementation of gravity-fed water systems. These systems are not only environmentally friendly but also help reduce the economic burden of residents, who are generally low-income earners. Hence, the aim of this paper is to inspect the operation of gravity-flow water systems in Sabah which is one form of wisdom the local rural community in the state have preserved. This paper further examines the advantages of the implementation

of gravity-flow water systems in sustaining the environment (preserving and conserving river basins) and rural communities. By empowering TVET, there is significant potential for the development of more efficient gravity-fed water systems in terms of design and operational effectiveness, thereby contributing to sustainable development goals in Sabah.

2. Literature Review

2.1 Gravity-Flow Water System Design

The application of gravity-flow water systems is not something new. Since long ago, it has been used by rural residents for domestic purposes and to irrigate agricultural areas, such as in Thailand (Waters, 1984), Nepal (Jordan, 1984), Indonesia (Adiningrum, 2017), Laos (Frangi et al., 2004), Cameroon (Kruijf, 2005), Dominican Republic (Good, 2008), Tanzania (Mader et al., 2020), Malawi (Mwagomba & Tilley, 2021) and Sabah, Malaysia (Jango et al., 2022). The use of gravity-flow water systems is very popular, especially among communities that live in mountainous and highland areas. This is why the system is designed to enable water flow from highland areas (hilltops, hillsides) to lowland areas (foothills, valleys) as a natural result of the force of gravity (Waters, 1984; Jordan, 1984; Frangi et al., 2004; Kruijf, 2005; Adiningrum, 2017; Mader et al., 2020; Jango et al., 2022).

The design of the gravity-flow water system sometimes differs from one area to another. Residents in the highlands of Thailand, for instance, designed their water-flow gravity systems to have six main components: 1) split bamboo intake, 2) sedimentation tank, 3) sand filters, 4) reservoir tank, 5) pipe to village and 6) drainage valves (Waters, 1984). This setup slightly differs from the water-flow gravity systems in Laos, which generally consists of eight components: 1) concrete intake, 2) sedimentation tank, 3) break pressure tank, 4) water pipe network (usually 32, 40 or 50 mm external diameter pipes), (5) air valves, (6) water tank, (7) tap stands and (8) self-clog taps. Each component has its own designated operation function in the gravity-flow water system. For example, a concrete intake component (built from concrete structures or gabions) gathers the spring water into the water system and protects it against water run-off coming from the outside, while the sedimentation tank (built with concrete or made of a plastic tank buried in the ground) is a small reservoir. The break pressure tank is a small water tank that can be prepared to reduce the water pressure in the pipe (if needed). Air valves are installed in some systems as an alternative to drain water that may collect at the highest point in the network (Frangi et al., 2004).

Figure 1 presents a typical gravity-flow water system design. The figure shows that gravity-flow water systems consist of various components (4 components) that all work together to channel water to users. Generally, the components consist of: 1) intakes, 2) various tanks, 3) water lines and 4) user connections. The intake, constructed to channel water into the system, is typically situated near springs or small streams. As water progresses from the intake towards users, it traverses through a network of pipes. Conduction lines frequently transport water to a central tank where subsequently, the distribution lines deliver that water to users (Good, 2008).

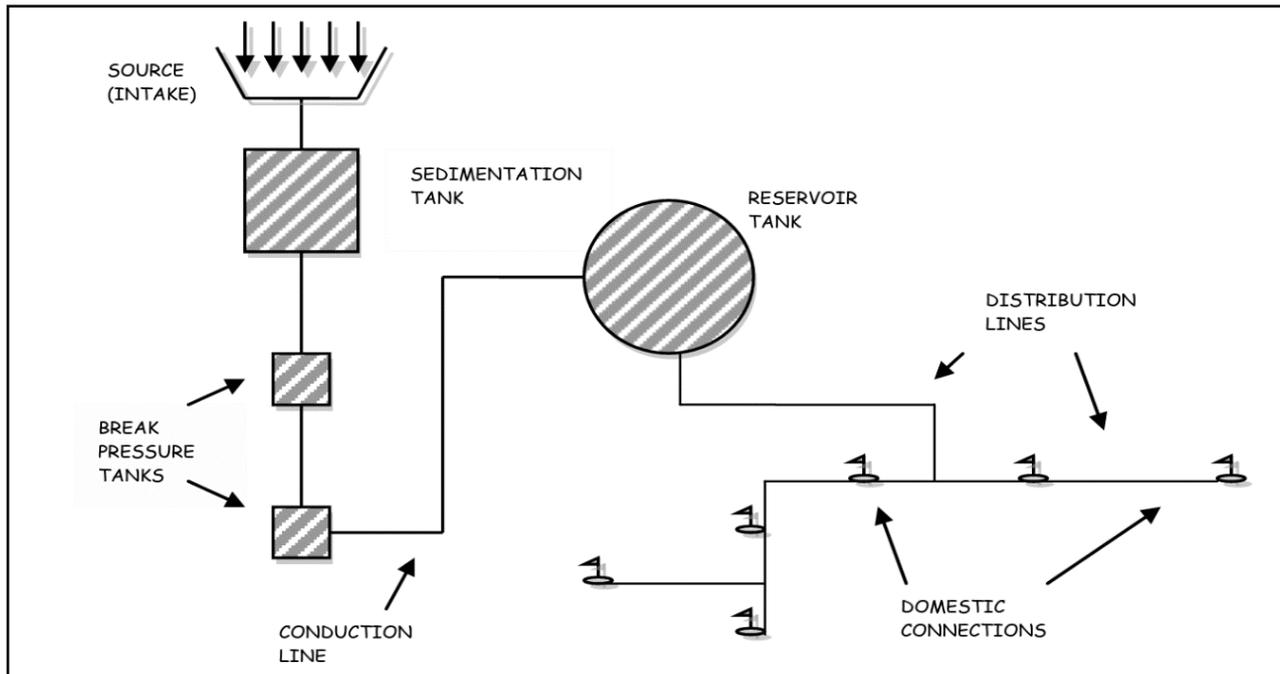


Fig. 1 A Typical gravity-flow water system design, adapted from Jordan (1984) and Good (2008)

2.2 ALL Parliamentary Parties Group Malaysia for Sustainable Development Goals (APGGM-SDG)

The All-Parliamentary Parties Group Malaysia for Sustainable Development Goals (APPGM-SDG) was established on October 19, 2019 (Puteh & Halim, 2023). The objective of this establishment is to localise SDGs in the Malaysian context (Hasan et al., 2023; Abd Rahman et al., 2023). This localisation effort entails offering solutions or projects to tackle all 17 SDG mandates highlighted by the United Nation (UN). Four phases are present in the APPGM-SDG programme implementation: 1) Issue mapping (Design), 2) Capacity Building (Planning), 3) Solution Implementation, and 4) Impact Evaluation. The last phase of APPGM-SDG execution for all solution projects is Impact Evaluation. Three primary methodologies are employed to conduct impact evaluation: 1) identifying impacts, 2) verifying impacts and 3) validating impacts. The objective of SDG projects is to offer sustainable solutions across the three primary dimensions: 1) economy, 2) society and 3) environment. The economic solutions or projects aim to foster the creation or augmentation of participant income through entrepreneurial endeavours. Social solutions or projects address pivotal national issues while emphasising sustainable solutions. Conversely, environmental solutions or projects focus on environmental conservations, particularly in more vulnerable ecosystems (Salleh et al., 2023).

3. Methodology

3.1 Study Area

This study was conducted in Sabah which is located in the eastern part of Malaysia with an area of 73,619 km² (Dollah et al., 2022; Jafar et al., 2023). Due to its natural terrain (topography) which is hilly (Anak Jalin & Radzi, 2022), mountainous (Patrick & Imang, 2016), and has many river networks, Sabah is a region that has high potential in developing gravity-flow water systems, particularly in rural areas. Five ranges (namely, the Crocker Range, the Trus Madi Range, the Brassey Range, the Wittti Range and the Maitland Range) cover most of the region of Sabah and they play an important role in creating the highland landforms in the state (Hussein & Raman, 2010).

3.2 Sample and Data Collection

This study was conducted with the support of APPGM-SDG and focuses on the impact assessment phase (refer to Section 2.2) of the implementation of gravity-flow water systems towards environment sustainability (to achieve SDG 6 & SDG 15) and the community (to achieve SDG 8 & SDG 11). The impact assessment was conducted using the qualitative approach which involves site visits (SV) and focus group discussions (FGD). The impact assessment process was also accomplished by examining information from three documents submitted by Solutions Providers (SP): the project proposal, monthly report and final report (Sharifah et al., 2023). Solutions Providers is a service

provider that comprehensively manages projects from the conceptualisation phase to execution for the advantage of beneficiaries. Beneficiaries (BF) are individuals who reap the benefits from the implementation of initiatives conducted by SP. In the context of this study, BF refers to the villagers who benefit from the effects of the implementation of gravity-flow water system projects.

Four projects are present related to the implementation of gravity-flow water systems in Sabah. A summary of the projects is shown in Figure 1. The four projects were used as a sample to evaluate the impact of implementing gravity-flow water systems on the sustainability of the environment and rural communities in Sabah. FGDs were conducted with the beneficiaries (villagers in three locations) to identify the implementation method of gravity-flow water system in their respective areas. It is crucial to first understand the implementation method of gravity-flow water systems before identifying the impacts caused by the system towards the environment and communities since the operation of a project greatly influences the impact caused by that project.

The data collection process from FGD and site visits for the SP001 project were conducted in November, 2022 while the rest of the projects were carried out in November, 2023. It should be emphasised here that Projects SP069 and SP070 refer to the same gravity-flow water systems. The only difference is the objectives of each project implemented. Therefore, in the finding section (specifically Section 4.1), the explanation focuses more on Project SP070 compared to Project SP069.

Table 1 Background summary of solution projects

No	Project Code	Project Name	Location (District)
1	SP001	Improvement of Gravity Pipe Water System in Sayap Village	Kota Belud
2	SP069	Water Management Program Towards Sustainable Agriculture	Tenom
3	SP070	Sustainable Gravity Water System in Bakuku Village	Tenom
4	SP078	Tonobon Baru Village Gravity Water Resource Improvement Project	Keningau

3.3 Data Analysis

Raw data obtained from FGD implementation was descriptively analysed and presented in narrative form in accordance with the appropriateness of the study objectives. The analysis involved a detailed observation of the information gathered to support the objectives of this research. Additionally, raw data obtained from Solutions Providers (project proposal, monthly report & final report) were also descriptively analysed. The results of the descriptive analysis were supported by photo evidence taken during the site visits. The use of descriptive analysis in this qualitative study is significant since the main focus is to extensively understand the phenomenon. By portraying the data descriptively, an in-depth interpretation can be accomplished more easily. In fact, this study also applied the library research method by critically and extensively analysing library materials (journals, books and newspapers) related to the research objectives.

4. Findings and Discussion

4.1 Operation of Gravity-Flow Water Systems in Sabah

The form of operations for the gravity-flow water systems at the three selected locations in Sabah do not significantly differ from each other (refer to Table 2). From the aspect of project scale, they all fall under the small scale. Generally, gravity-flow water systems are classified as small-scale when they have a small number of beneficiaries (usually only among the residents of a village). Village-level management organisation have a simple gravity-flow water system design as well as a small-sized dam. According to Waters (1984), the application of small-scaled gravity-flow water system projects is common for communities living in rural mountainous areas. Each village in the area (rural mountainous areas) usually has its own gravity-flow water system to accommodate the needs of villagers. For example, in the rural areas of Thailand, a single small-scale gravity-flow water system in the 80s could supply domestic water supply to approximately 30 houses (Waters, 1984). Surprisingly, the results of this study found that the average gravity-flow water system in Sabah is now able to cover domestic water needs with a much larger capacity of up to 380 houses. The study results further found that gravity-flow water supply is not only channelled for the domestic needs of villagers, but also for agricultural, business and tourism purposes as well as other basic needs (refer to Table 2).

The results of the final report and FGD also revealed that all gravity-flow water systems in this study are managed, supervised and organised by the villagers themselves. A special committee has been formed at the village level to ensure that the existing gravity-flow water systems can smoothly operate. The committee formed includes: the Chairman, Deputy Chairman, Secretary, Deputy Secretary, Treasurer, and other committee members.

Usually, all appointed committee members are people from among the villagers themselves since they are more capable in managing the gravity-flow water system which ensures their survival (refer to Table 2).

To ensure that the gravity-flow water system can effectively operate continuously, a special fund is required for maintenance purposes and repair cost of the system. Hence, the gravity-flow water systems' management committees for Project SP001 and SP078 have been charging annual fees to residents of the respective villages that employ the system. Repair works of the gravity-flow water systems (for example, replacing damaged pipes, repairing leaking pipes or tanks and cleaning clogged mini dams) are jointly carried out by the villagers depending on the current needs. It is slightly different from Project SP070 where repair works of the gravity-flow water systems are conducted according to the monthly rotation system. Villagers (beneficiaries) have been divided into 12 groups (1 group per month, for 12 months). Within a year, each group of villagers is responsible for ensuring that the gravity-flow water system is operating well for the entire month. Therefore, the cost of repairing the gravity-flow water systems will be fully borne by the group on duty at that time. Repair works of the system will also be done collaboratively by group members on duty at that time (refer to Table 2). The implementation of a duty schedule rotation, collaboration and fund collection (fees) is not something new in the context of managing gravity-flow water systems. This has been practiced in other districts such as Tambunan, Sabah (Jango et al., 2022) and rural village areas in Tanzania (Mader et al., 2020).

From the design aspect, it was found that all three projects have almost the same gravity-flow water system design. The gravity-flow water systems in each project (SP001, SP070 & SP078) operate with the use of four main components: intakes (mini dam), various tanks (sedimentation tank & reservoir tank), water lines and user connections (refer to Table 2). Interestingly, the gravity-flow system design researched in this study has many similarities with the gravity-flow water system design used in the highland rural areas of Nepal (Jordan, 1984; Good, 2008). Each component has its own specific function in moving the gravity-flow water system. The mini dam built in the tributary areas (streams) located in a high position (usually near the top of the hill) serves to retain and collect river water which is then channelled to the sedimentation tank. The mini dam was built using concrete or an arrangement of river stones (refer to Figure 2a). The water from the sedimentation tank is then channelled to a reservoir tank which has a lower position (refer to Figure 2b). From the reservoir tank, it is then channelled to the villagers' houses that are at the lowest topographical position (refer to Figure 2c). The water distribution from the mini dam to the villagers' houses is made possible with the use of PVC pipes (refer to Figure 2d) and with the help of gravity. The selection of PVC pipe stems is different in terms of size; i.e., 2.5-inch pipe stems are used for the dam area and 2-inch pipe stems are used in the middle area, while residential areas use smaller pipe stems of 1.5 inches. Using different pipe stems is intended to ensure that the pressure of the water flow in the pipeline becomes stronger and more even.

Table 2 Operation of gravity-flow water systems in three selected locations in Sabah

Item	Project Code (Location)		
	SP001 (Kota Belud)	SP070 (Tenom)	SP078 (Keningau)
Project Scale	<ul style="list-style-type: none"> ● Small ● Distributed to homes (206 homes/1627 residents of Kg. Sayap) 	<ul style="list-style-type: none"> ● Small ● Distributed to homes (180 residents of Kg. Bakuku) 	<ul style="list-style-type: none"> ● Small ● Distributed to homes (1680 residents of Kg. Tonobon/380 families)
Target Beneficiaries	<ul style="list-style-type: none"> ● Distributed to homestay entrepreneurs and stalls 	<ul style="list-style-type: none"> ● Distributed to SK Ulu Tomani ● Distributed for rice paddy farming areas 	
Organisation	<ul style="list-style-type: none"> ● Established a special committee among the villagers 	<ul style="list-style-type: none"> ● Established a special committee among the villagers 	<ul style="list-style-type: none"> ● Established a special committee among the villagers
System Maintenance Method	<ul style="list-style-type: none"> ● Imposed annual fees for cost of repairs ● Practices collaboration 	<ul style="list-style-type: none"> ● Implemented a duty schedule rotation system ● Practices collaboration 	<ul style="list-style-type: none"> ● Imposed annual fees for cost of repairs ● Practices collaboration
System Design	<ul style="list-style-type: none"> ● 4 components 	<ul style="list-style-type: none"> ● 4 components 	<ul style="list-style-type: none"> ● 4 components



(a) Mini dam in Tonobon Village



(b) Reservoir tank in Bakuku Village



(c) Residents' water tank in Bakuku Village



(d) PVC pipes are used in Bakuku Village

Fig. 2 Gravity-flow water system facilities at the study location

4.2 Measures of Environmental Preservation and Conservation Through Implementation of Gravity-Flow Water Systems in Rural Areas

Since a long time ago, the Indigenous people of Sabah have instilled traditional practices of environmental preservation and conservation through the implementation of the 'bombon' or 'tagal' system that functions not only to maintain environmental sustainability, but also to ensure the survival of food resources (e.g., fish and shrimp) (Tangil & Amat, 2021). Knowledge of the 'bombon' system is not something new among the community and academics. From the aspect of environmental preservation, many studies were conducted in Sabah to explain the 'bombon' system, among them are Luyan & Lunkapis (2016), Hossin (2019), Marks et al. (2020), Tangil & Amat (2021) & Foo et al. (2022).

There is another traditional practice implemented for generations by the Indigenous people of Sabah which unknowingly also functions as a medium for environmental preservation. The said traditional practice is actually the gravity-flow water system. In the context of Kg. Bakaku itself, gravity-flow water systems have been implemented since more than 20 years ago. Uniquely, this system fully depends on the cleanliness level of the existing river or spring water. Unlike treated tap water supply, this system does not require a water treatment plant to treat the raw water supply obtained from a river or spring. Therefore, it is important to ensure that the level of cleanliness and quality of raw water sources (rivers and springs) used for domestic purpose through gravity systems are always in good condition. In general, the level of river water that is suitable for domestic use without going through an intensive treatment process is within the range of Class 1 and Class IIA (JPS, 2024). This statement is in line with the research findings of Masleh (2014) in Sg. Mensangoh, Tambunan. He found that the quality level of the river which is the source of water for the residents belongs to Class 1 and 2.

This situation indirectly necessitates that the community must be proactive in preserving the cleanliness of their water sources and prevent it from being polluted. Necessary actions include not throwing rubbish into the

river, not channelling sewage waste into the river, avoid the excessive use of pesticides and fertilisers, prohibit the dumping of industrial waste into the river, etc. Water Management Program Towards Sustainable Agriculture (SP069) is one of the projects conducted by the residents of Kg. Bakuku to prevent pollution problems of their gravity water sources in their village. It is also essential to know that river pollution can also occur if the river basin system is disturbed (Sakke et al., 2023). This means that activities that can cause the quality of river water to dwindle are not limited to direct pollution into the river (e.g., throwing rubbish and channelling sewage waste into the river), but can also include interference from humans in the land area of the river basin itself such as afforestation, logging, mining, agriculture, industrial activities, etc. Therefore, by applying gravity-flow water systems, it can indirectly prevent the occurrence of environmental deterioration activities (degradation) in river and land areas, especially in the context of river basin ecosystems.

Another great benefit of using gravity-flow water systems is that it does not require the construction of mega-sized dams. As we already know, constructions of mega-sized dams are prone to cause ecosystem and biodiversity deterioration in construction areas (Mamat, 2012). Hence, the act of applying gravity-flow water systems can indirectly prevent disruption of the drainage basin ecosystem and biodiversity. This is in line with the goals of SDG 6 (Clean Water & Sanitation) and SDG 15 (Life on Land) which are to protect and restore water-related ecosystems while conserving and restoring terrestrial and freshwater ecosystems (Guppy et al., 2019; Krauss, 2022).

4.3 Benefits of Gravity-Flow Water Systems on Rural Communities in Sabah

Generally, the economic status of rural residents is far lower than those in urban areas (Balwi, 2005). The poverty rate of communities in rural areas is almost three times greater than in urban areas (Khalid, 2012). This shows that on average, the household income of rural communities is much lower than the household income of urban communities. The small income of rural communities makes it difficult for them to bear the cost of daily expenses, including utility expenses such as water and electricity.

Uniquely, gravity-flow water systems are able to lessen the rural communities' burden of utility expenses. This is also the case in the context of study location. The results of the interview found that all villagers (Kg. Sayap, Kg. Bakuku & Kg. Tonobon Baru) obtained gravity-flow water sources for free. Hence, the villagers are not burdened with water bills that must be paid monthly. However, the villagers (Kg. Sayap & Kg. Tonobon Baru) must pay a bit of money (in the form of annual fees) to cover the cost of repairs of the gravity-flow water systems. Even so, the amount of monthly payment that the villagers have to pay is far lower than if they were to use the services of treated tap water supply. In the context of Kg. Bakuku, it was initially agreed that annual fees are to be collected from each villager to cover the repair costs of the gravity-flow system. The agreed payment was set at RM1 per month per family. However, the fee collections did not go smoothly since several families felt burdened in paying the fees. Therefore, a rotation and collaboration system was applied to resolve the issue. This also proves that the economic status of some villagers of Kg. Bakuku is so low that they are burdened to spend for the cost of water utility. The following is the result of an interview from the committee of gravity-flow water systems project in Kg. Bakuku regarding the matter:

"Back then, villagers were asked to pay RM1 per month for the fee, but there were those who did not pay and sometimes it was not enough for the cost of repairs of the gravity-flow water systems. So we had to use the rotation system and collaborate together to repair the gravity water."

Apart from that, the implementation of gravity-flow water systems in rural areas can also indirectly control the widespread construction of mega dams. Dependence of treated tap water supply will reduce with the application of gravity-flow water systems. This is crucial to prevent the loss of residential sites, farming sites and forest harvesting sites as a result of widespread dam construction. This is in line with the goal of SDG 11 (Sustainable Cities and Communities) which is to strengthen efforts to protect and safeguard the world's culture and heritage (Turner, 2017).

5. Conclusion

It can be concluded that the implementation of gravity-flow water systems in rural areas is still relevant to this day, even with the existence of treated tap water supply systems. This is due to the function of the gravity-flow water system, which is more environmentally and community friendly, making it very suitable to implement in rural areas. The implementation of gravity-flow water systems is seen to have become increasingly relevant when it is able to reduce the dependence on treated tap water supply while making it an alternative water source for rural residents. Based on that, this very valuable traditional practice (local wisdom) must be retained. It is not only greatly beneficial and useful as a medium or instrument to sustain the environment (especially river basin ecosystems) but can further maintain the wellbeing of rural residents.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: **study conception and design:** Adi Jafar; **data collection:** Adi Jafar, Eko Prayitno Joko, Ramli Dollah, Mohammad Ikhrum Mohamad Ridzuan, Mohd Hishamuddin Amid; **analysis and interpretation of results:** Adi Jafar, Eko Prayitno Joko, Ramli Dollah, Mohammad Ikhrum Mohamad Ridzuan, Faerozh Madli; **draft manuscript preparation:** Adi Jafar, Eko Prayitno Joko. All authors reviewed the results and approved the final version of the manuscript.

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