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Research Article

Enhancing a Sustainable Safe Water Supply for Rural Communities of Mabungo Parish, Kisoro District

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Abstract

In this paper, community perception on the performance status of water supply systems currently available in Mabungo Parish was assessed. A water demand assessment in Mabungo parish so as to determine the present and feature water demand was conducted. We also investigated the actual factors that influenced the sustainability of Kabiranyuma Gravity Flow Scheme. In the ongoing work, we are developing a model of sustainable water supply system for Mabungo communities in Kisoro district.

Keywords: Enhancement; Sustainable; Safe Water; Rural Communities

Background

One of the targets for sustainable development goal (SDG 6) is to achieve universal and equitable access to safe and affordable drinking water for all, which has been one of the top priorities in developing countries over the past three to four decades [1]. However WHO [2] reported that 2.1 billion people worldwide lack safe drinking water at home.

While many developed regions have achieved universal access with millennium development goals (MDGs), improved drinking water access is still a challenge in Africa where 300 million people do not have access to safe drinking water [3] the biggest population being from sub-Saharan African countries (WHO/UNICEF, 2015) where Uganda is part.

The total population of rural communities in Uganda that have access to safe water supply is still lagging compared to urban communities with percentages of 67% and 71% [4] respectively. This is in line with DWD, 2008 which reported that a large number of rural sub-counties are still greatly underserved with safe drinking water infrastructure and experience high levels of poverty.

Kisoro district has a total population of 281,705 [5] with 95% of the people being rural dwellers. Kisoro is one of the water-stressed districts in Uganda, with only 40% coverage where water is concentrated in the northern and eastern parts, whereas in Bufumbira South it is common for people to walk over 7km in search of water [6].

Nyarusiza one of 13 sub-counties of Kisoro district in Uganda, is a rural area located in bufumbira south constituency. The sub-county is composed of four (4) parishes with a total population of 25,000 people, and only 3,402 people served with clean water [7]. Mabungo is one of the parishes in Nyarusiza sub-county, with 12 villages that are all water stressed which has played a big role in contributing towards continuous outbreaks of waterborne diseases among people in the area.

The major factors that contribute to the low water supply in Nyarusiza sub-county include; lack of exploitable surface water with a very deep ground water table [8], abandoned non-functional water points, less capacity to raise the capital needed to procure water infrastructure and inadequate technical expertise to develop less costly water systems and also maintain the few available ones.

In light of this situation, providing a sustainable water supply system suitable for providing safe and adequate water to the rural communities of Mabungo parish in Nyarusiza sub-county will help improve rural living standards and reduce incidence rates of water-related diseases and associated medical expenditures as well as maximizing time for productive activities and long-term human development.

Related Work

In the whole district of Kisoro, only 44% of the total population has access to safe water with (43% rural and 57% urban) [9] which explains a big gap that still exists in the district. The district has only 2 pumped water schemes sourced from Chuho and supplies almost all parts of Kisoro Town Council and Nyakabande sub-county [8].

It is no wander why incidences of cholera, dysentery and other water related diseases outbreaks are common in the district. The situation is even worse for sub-counties like Nyarusiza, Chahi, Nyakabande and Bukimbiri where water access levels still range between 11% and 13% [9].

Kabiranyuma, a swamp that lies between Muhabura and Mgahinga volcanoes at an altitude of 10,000 feet used to provide water through gravity and serve the sub-counties of Nyarusiza, Muramba and Chahi, however the scheme is not functional at the moment [8].

According to Habtamu [3], the major factors that influence the functionality of rural water supply systems, especially in developing countries include; Lack of involvement of the community in selection of site and technology, implementation, operation and maintenance of the water source, use of complicated technology without proper capacity-building at community level, lack of finances at the community level for operation and maintenance of water sources, deep-water table, poor quality of water, among others [10,11].

Research Methodology

Analytical study was employed to conduct the water demand assessment for Mabungo community and to establish factors that influenced the sustainability of Kabiranyuma gravity flow scheme in Kisoro district. The sustainability issues were studied using both qualitative and quantitative data with the main interest focused on community's perception, social-economic activities, operation and management issues, technological and capacity issues, among others.

Primary data was collected using questionnaire whereas secondary data was obtained from district reports, census data and demographic information as well as related websites. Collected data was used to come up with an overview of factors that influenced the scheme's sustainability and at the same time guided in developing the best solutions possible for the area.

Iterative method is being used for model selection, fitting and validation to develop an appropriate model for sustainable safe water supply in Mabungo parish.

Results and Discussions

Community perception on the performance status of water supply systems currently available in Mabungo parish

The study found that, the few available surface water sources for Mabungo community include; streams, unprotected springs, ponds and broken pipelines, but they are all far from Mabungo parish which requires communities to always trek over 4 km to get water for domestic use.

Installation of various water supply systems for communities of Nyarusiza sub-county ranging from boreholes, rain harvesting tanks and public stand posts have been attempted by the government of Uganda through the district and other development organizations but their functionality has always been influenced by sustainability inefficiencies due to inadequate sensitization of beneficiaries, technical breakdown, vandalism, lack of feel for the system ownership by the beneficiaries, poor systems operation and maintenance, among others.

Communities explained that the water collected from unprotected part of Jinya spring can be dirty as it gets mixed up with soil and other pollutants on ground surface and it is also shared with animals which further pollutes it.

Water collected towards protected areas of Mgahinga Gorilla National Park (MGNP) involves taking risks of encountering with dangerous wildlife like mountain gorillas which at the same time have easy access to the water and pollute it with their waste.

It was also found out that the only available clean water sourced from Chuho spring is supplied through public stand posts which are located in three trading centres. These posts are very few compared to the population that depends on them, in addition to inconsistences of their supply, as water is supplied to each post twice a week, which the district officials clarified as a way to ensure equal proportionality in supply due to limited capacity of the spring to pump to far areas.

Locals highlighted that in most of the days, water is available for some hours i.e. from 7:00 am to 2:00 pm beyond that, water gets over which attracts high congestion at each tap stand during that time. The congestion attracts the normal pay of 100 shillings per jerrycan to rise to 200 shillings and those who fail to raise the increment definitely miss out.

As congestion increases, fetching in lines seizes and people begin to fight and injure themselves in scramble for water and only able-bodied people get water in time while less energetic people especially women and girls are not given opportunity to access the taps which prompts them to trek long distances to collect raw water from far available surface water sources than waiting in lines where they have limited hopes of obtaining the water. However communities reported that the raw water is very dirty, mostly polluted by high rates of erosion due to steep slopes, poor agricultural practices in the area, animals and sometimes humans who do open defecation. Communities further reported that, the water has resulted into rampant outbreak of water borne diseases among themselves.

Communities also revealed that rainwater harvesting tanks funded by NGOs in some parishes that neighbour Mabungo also provide water to them, although when the demand goes high, the opportunities are only given to members within those parishes and as a result Mabungo members are definitely denied to access the tanks.

Water demand assessment in Mabungo parish

Yearly projected populations

R = 2.21%							
Sub-county	**Parish**	**No. of households**	**Average household size**	**Populations**			
				Base year (2018)	**Initial Year (2023)**	**Future Year (2033)**	**Ultimate year (2038)**
				$P = P_o (1+r/100)^n$			
Nyarusiza	Mabungo	1,678	6	7,663	8,548	10,636	11,864

Population Projections by service levels

	Service level	**Demand**	**% Populations**			
		l/c/d	**Base year**	**Initial year**	**Final year**	**Ultimate year**
			2018	**2023**	**2033**	**2038**
	Point sources	20	70%	20%	5%	0%
	Public Stand posts	20	30%	80%	85%	70%
	Yard tap	40	0%	0%	10%	20%
	House connections	50	0%	0%	0%	10%
R = 2.21%						
Sub-county	**Parish**	**HH**	**populations (P)**			
			Base yr	**Initial yr**	**Future yr**	**Ultimate yr**
			2018	**2023**	**2033**	**2038**
Nyarusiza	Mabungo	1,678	7663	8,548	10,636	11,864
			% Population * population(P)			
		Public Stand posts	2,299	6,838	9,040	8,305
		Yard tap	0	0	1,064	2,373
		House connection	0	0	0	1,186
		Total	2,299	6,838	10,104	11,864

Population Projections by service levels

Service levels	**Initial year**	**Future year**	**Ultimate year**
	2023	**2033**	**2038**
Public stand posts	6,838	9,040	8,305
Yard tap	0	1,064	2,373
House connection	0	0	1,186
Sum (Service level* population projected)/1000			
Domestic (m^3d)	136.76	223.36	320.32
	15% losses		
Domestic(m^3d)	157	257	368

Ultimate Year Domestic Demand = 368 m^3/day

Population Projections by service levels

Institutional projected population = (40/100)* 11864 =4746 schools
Institutional projected demand = 10* 4746 = 47.46 m^3/day
Commercial projected size = (2/100)*11864 = 237 shops
Commercial projected consumption rate = 50 *237 = 11.85 m^3/day
Total Demand (Average Day Demand) = 368+47.46+11.85
ADD = 427.3 m^3/day
Maximum Day Demand (MDD) = ADD*1.3
= 427.3*1.3 = 555.5 m^3/day.
Storage Calculation = MDD *30% = 555.5*30%
= 166.6 m^3

Kabiranyuma Gravity Flow Scheme to serve the communities of Mabungo parish for 15 years with clean water, it must supply a maximum amount of water worth 555.5 m^3/day, with storage capacity of 166.6 m^3.

Kabiranyuma swamp located at an altitude of 10,000 feet is drained by Kabiranyuma River which flows by gravity to supply water to communities around. It is the only river that does not dry up completely in the driest months of June to August. According to report at Kisoro district, Kabiranyuma scheme has capacity of supplying 1300 m^3/day.

Also hydrological data recorded by Corporation for Assistance and Relief Every Where (CARE) showed that, during dry season, water flow rate in the pipeline from the scheme ranges between 3.2 and 1.1 litres/sec whereas in wet season, the rate rises to 5 - 10 litres/sec.

The actual factors that were found to have influenced the sustainability of kabiranyuma gravity flow scheme included:

- Over stretching of the scheme in existing design which assumed safe yield of 3 l/s instead of the actual one of 1 l/s. The scheme was serving a population of 21,000 from three sub-counties which was far beyond its capacity.

- Mismanagement of the scheme after completion with only few beneficiaries paying for the water while others getting it free of charge. Less interest of beneficiaries to pay a fair water tariff that was being charged was caused by the community's perception that water is a free resource, and the management team did not do much to sensitize the communities to enable them understand the necessity of paying the fee. As a result, the system lacked recovery for operation and management costs.

- Poor implementation of the system with water reaching the main reservoir but not most of the distribution lines, and as a result of high demand from the system with a low supply capacity, some residents from worst hit areas turned hostile towards the project and started cutting and stealing the pipes of the distribution lines. This resulted in the total collapse of the scheme whose operation and maintenance was already poor.

- Sharing of Kabiranyuma swamp's water among humans and animals. The animals ended up destroying gravity water pipes of the scheme.

- Vandalism of distribution pipelines which were not buried in the ground but exposed on surface. Also break pressure tanks and yard taps were not fenced which increased their risks of being destroyed.

- Other factors that contributed to sustainability failure of the scheme included; blockages of pipes, inadequate skills and limited modern technology that was required in the running of the system.

Conclusion

Full involvement of community in operating and managing a water system is the main way to ensure proper functionality and sustainability. Therefore the approach of community management plays a key role in attaining effective sustainability of rural water supplies.

With capacity of Kabiranyuma scheme, serving the population of Mabungo parish for fifteen years will have no harm to the source and communities will fully enjoy constant supply from the scheme.

The paper presents the actual factors that contributed to sustainability failure of Kabiranyuma scheme which are all zeroed on limited involvement of scheme's beneficiaries right away from implementation, operation and management which worked hand in hand with improper system design and limited skills among the

More support from government and other donors to provide technical backstopping, sensitization and funds to local communities in rural areas is much needed to improve communities' feel of water systems ownership hence in long run uplifting the water systems' performance and sustainability.

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