Ancient technology as mitigation to the 21st century problems: A case of coping with climate change in Ankole region, Western Uganda

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ABSTRACT

The study investigates how communities in Ankole region of western Uganda are coping with climate change and what strategies they have laid to counteract its effects using primordial (traditional) technologies. The study was carried out in the districts of Mbarara and Isingiro, which are separated by the River Rwizi and are part of the Uganda's cattle corridor. Since the end of the 19th Century, this region has experienced prolonged dry seasons. The main objective of the research was to investigate how climate change and human activities associated with social and economic developments have affected the environment; and how the people of Ankole are coping with these issues. The study involved twenty purposively selected participants who were involved in different activities. Interviews were conducted to obtain a deeper understanding of their experiences and opinions to assess their perception of climate change. Site visits were done to observe activities in the area of study. Research findings indicated that these activities have had a devastating effect on the environment. The production of bricks on the banks of River Rwizi has lowered its water table and increased siltations. The cutting of wood for fuel to burn bricks, as well as agricultural activities has led to silting-up of the river and loss of vegetation leading to extended drought in the region. The increasing demand for river sand for construction has equally increased sand mining activities along R. Rwizi which has diverted its course, caused water evaporation and reduced its flow. However, these activities have called for innovative technologies which are environmentally friendly to counteract the climate change, the study has revealed.

Keywords: Climate change, Uganda cattle corridor, environmental degradation, rainwater harvesting, innovations, pottery clays, sand and social economic issues.

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INTRODUCTION

Preamble

The study investigates how communities in Ankole region, western Uganda are coping with climate change and what strategies they have setup to counteract its effects using local traditional innovative methods. It was carried out in the districts of Mbarara and Isingiro which are part of Uganda's cattle corridor. The main objective was to investigate how climate change and human

activities, such as brick making and sand mining associated with social and economic developments have affected the environment. Ankole stands astride the equator and its landscape is characterised by hilly lands of the western and southern, and eastern grassland plateau. River Rwizi, which flows from the western hills of Buhweju with various tributaries from various Nkore hills, including Ntungamo and Sheema hills, join in. Its mouth is in Lake Victoria via the drainage systems of Lake

Mburo, Lake Kachera and Kijanebalola. It supplies water for both domestic and industrial use to the whole Mbarara town and the neighbouring towns of Bwizibwera, Sanga and Biharwe. However the river, which formed a livelihood for many people of Ankole, is drying out due to climate changes, which is affecting the region and man's activities. Most of the natural vegetation has been destroyed through farming, brick making and sand mining. The previous long dry spell, coupled with the global climate changes and massive environmental degradation, has presented new threats to the Ankole region resulting in shortage of food and water for animals and people. However, various people in the Ankole region have come up with innovative ideas to counteract the effects of climate change.

Sabiiti (2016) reports that in the early 1950's the thick vegetation of papyrus and other wetland grasses around River Rwizi acted as water filters and regulated flooding in the area. Today, the river, which drains its water into Lake Victoria, is almost lost. Should the government of Uganda fail to eject or prevent further encroachments on the river, the entire district of Mbarara will run out of water soon, experts say. According to Tajuba (2016), the all-important Rwizi River, which qualified to be called a lone source of life to Mbarara, a town rapidly growing not only in human and animal population but industries too, is now being relegated to a thin stretch of water flowing from the hilly terrain of Buhweju District. The river flows sluggishly to the dry land belt of Mbarara and Rakai on its way to Lake Victoria owing to its reduced water volume, which experts attribute to human activities. Some of the human activities that are making the river to struggle for survival include degradation of its catchments as encroachers look for land for settlement, agriculture activities and setting up factories. These activities have resulted in people cutting down trees and papyrus surrounding the river, digging around and in some extreme cases, reclaiming the river for these activities without looking at the bigger contribution of the river to livelihoods. Exposing the river to increased temperatures due to loss of vegetation is also causing water evaporation, further worsening the situation.

Ntozi (1995:1-3) states that Ankole is inhabited by two main groups of people. The first group is the Bairu (cultivators), who are the majority and mostly live in hilly lands of the west and south. Their main economic occupation is farming growing food and cash crops. They are relatively permanently settled. The second group is the Bahima, who live in the eastern grassland plateaus of Ankole. They are pastoralists, herding the famed Ankole long-horned cattle for food and cash. In the past, their occupation made them nomads looking for good pasture and water for their animals, especially during the dry season. However, due to recent the tendency of individuals to fence their land, most Bahima have been forced to have semi-permanent and, sometimes, permanent settlements. Interposed between the two main

groups are the mixed farmers who live mostly in the central and southern parts of Ankole. They are defined by intermarriages between Bairu and Bahima, their dual economic activities are keeping cattle and growing crops.

According to Kamuntu (2015:4), the average temperature in semi-arid areas in Uganda is rising, especially in the southwest region. The frequency of hot days has increased while that of cold days has decreased. As a result, the malaria parasite is spreading into new areas of the country and the ice caps on the Rwenzori Mountains have shrunk significantly. Changing temperature patterns in Uganda have been linked to more frequent and longer lasting droughts and consequent increased cattle death. Rainfall has decreased and became less predictable, and less evenly distributed. Uganda's economy is particularly vulnerable to climate change given its heavy reliance on its natural resource base. Droughts have significantly affected water resources, hydroelectricity production and agriculture, among many others. Kamuntu (2015:6) further states that drought is on the rise in Uganda. The western, northern and northeastern regions are experiencing more frequent and longer-lasting droughts than have been seen historically. Although Uganda has always experienced droughts, evidence suggests that they are becoming more frequent and more severe due to climate change.

Background to the study

Mwangola (1993:403) argues that there is no life without water, be it for human beings, animals or plants. At the same time, the mere provision or availability of water for human consumption is far from complete if sanitation is lacking. This is supported by Baguma et al. (2012) who argue that water is fundamental to all life. Ideally the situation is more complex with demand for new housing – that requires building materials like bricks and sand. Thus, no one can be lifted out of extreme poverty, without adequate access to water and sanitation without forgetting a roof on one's head. This is why attention is often focused on global water shortages, particularly among the world's poorest people. They argue that much work was underway towards meeting the Millennium Development Goals (MDGs) by 2015, particularly emphasizing eradication of extreme poverty and hunger. They further state that since 1990 more than 1.8 billion people have gained access to improved sanitation. However, almost 780 million people remain without adequate access to improved drinking water sources.

Angurini (2016) reported that, as the United Nations (UN) food agency, Food and Agriculture Organisation (FAO), was preparing to celebrate the World Food Day in Lira, the FAO country representative in Kampala warned that the country was risking more drought, floods, and landslides with farmers to be hardest hit by poor harvests and food insecurity. He said,

"Uganda is experiencing signs of climate change, as exhibited by the current increasing temperatures and unreliable rainfalls. It is expected to increase the frequency and intensity of droughts, floods, and landslides which will significantly impact on the livelihoods of local communities who largely depend on agriculture".

According to Bhagawati et al. (2015), water is one of the most precious resources on earth. The world's single biggest problem is water scarcity. There is increase in demand of water due to increase in population, Urbanization, Industrial and Agricultural development. But these days the problem of availability of water is much more acute and serious. Roof-top rainwater harvesting system seems to be cost effective and easier technical method of conserving water.

Nasser et al. (1993:237) argue that when the United Nations declared the 1980s as the international drinking water and sanitation decade, it was hoped that the people would have safe portable water by 1990. Provision of adequate and safe water is a necessity for a healthy living and the well-being of individuals. It saves women's time and enables them to devote more time to food preparation, with consequent nutritional benefit to their children. On 28 July 2010, through Resolution 64/292, the United Nations General Assembly explicitly recognized the human right to water and sanitation and acknowledged that clean drinking water and sanitation are essential to the realisation of all human rights (UN, 2010).

It is in response to the UN declaration that some Non-Governmental Organisations (NGOs) have come up with some ideas to provide many Ugandans with safe drinking water. However, in areas where natural sources of water cannot be accessed, alternative sources like water tanks, constructed with fired bricks to harvest rainwater, have been availed to various communities, as a strategy to achieve the Millennium Development Goals.

According to World Health Organisation (WHO) (2012), in many developing countries, poor access to safe drinking water is an acute problem, with both health and social repercussions. Lack of safe water for drinking, bathing, and other household tasks is the primary cause of diarrheal diseases, which accounts for 15 percent of deaths among children less than five years of age. Poor access to water also entails large time costs associated with gathering water. In some parts of Africa, women spend up to eight hours per day collecting water. New technologies, such as rainwater storage devices, could improve access to safe drinking water and decrease the time needed for water collection. However, such new technologies are only useful to the extent that they are affordable and acceptable to the intended beneficiaries.

The goal of "Safe Water and Sanitation for All" set by International Water Supply and Sanitation Decade (IWSSD) in the 1980s and now extended to the year

2030 may only be a distant dream at best if there is no increased investment in water supply, says Kamuntu (2015:1). He further states that one way of addressing this challenge is to encourage families and institutions to invest in traditional rainwater technologies that could range from pots to tanks, to provide convenient water supplies that they manage and maintain themselves. Many rural people value these water sources for their convenience, taste, and productive use and most importantly, the actual ownership and control bestowed. Rainwater harvesting through roof catchments is being promoted in the water sector because it is an optimal method, which is also affordable and manageable by individuals, communities and institutions.

Baguma et al. (2012) confirm that rainwater harvesting is practiced worldwide. It is estimated that approximately 40% of households in South Australia use rainwater to supplement the supply of drinking water, as is done in several regions such as Southeast Asia. In Malaysia, for example, rainwater is also used for commercial purposes including car washing via the placement of plastic collection tanks in places like parking lots.

Arayo (2005) states that in every society, water is the source of life. But many people are now facing a water crisis. Overcoming the world's water crisis by achieving water, food and environmental security is one of the most formidable challenges on the road to sustainable development. Progress, however, must start at household level and slowly move outwards.

It has already been noted by the UK – Uganda Network (2006) that Uganda is faced with water problems. It lacks adequate drinking water which is needed by children under the age of 5 years. Many children are dying because of water related diseases. Water is contaminated by people using water sources as dumping ground for human waste and drinking place for domestic animals which drink from the same source. According to Mutagamba (2003), it has been observed that although Uganda may be predominantly rural, it has a fast rate of urbanization. Among the consequences of this urban growth is the growing demand for water and sanitation services. The gap is continuously widening between demand and supply in urban areas, where water, sanitation and hygiene are vital components of sustainable development and the alleviation of poverty.

METHODOLOGY

The study employed ethnographic research methods involved conducting interviews with some respondents in the districts of Mbarara and Isingiro of Ankole region using an interview guide and participant observation. In designing questions, cognisance was taken on the type of information the researcher required. To test experience or behavioural responses and opinions or values, follow up questions were necessary for greater depth of inquiry

(Mayan 2001:11-21).

The researcher also made site visits in order to observe and document activities taking place in the study area and along the R. Rwizi, and also to observe innovative activities that are taking place to intervene with climate change at different sites. Sarantakos (1998:207) argues that observation is one of the oldest methods of data collection. It is a method that employs vision as its main means of data collection and is open to all observable social phenomena. During the course of the study, cameras were used to document activities in the field to provide documentary evidence, depicting material reality (Shank 2006:33). The selection of participants and sites were innovatively and purposefully selected since the identified issues were directly related to activities alongside the river. The target would then involve persons whose direct resources were or are in the bound of the rivers and selected areas. The study was aware of the likely bias on the participants' selection, therefore a snowball method came in handy where a smaller identified group was able to direct the research to the known persons and study sites.

RESEARCH FINDINGS

The researcher made visits to the R. Rwizi where brick making has been taking place for more than a century years. At this site clay has been extracted at a depth of about six metres (Figure 1). The constant excavation of clay at this site has caused pools of stagnant water, which have become a menace to the people living in the surrounding area. One brick maker told the researcher that if it were not for the River Rwizi, which was a few meters from the site, people would not have water because the activities of brick making have lowered the water table around that place. In addition, these activities left behind stagnant water which became breeding centres for mosquitoes (Kayamba and Kwesiga, 2017:13). For the last fifteen years the researcher has been a regular visitor to this site, observing the activities that take place. He noted that the continued brick making along this river has reduced its size because of silting caused by soil erosion from the quarry. He further noted that brick makers are encroaching on the river itself and in a few years it might be no more. From a distance of about 100 metres, piles of dry bricks and kilns could be seen a few metres from the river (Figure 2).

On the contrary, the researcher observed pits of clay were being reclaimed, by filling them with soil because the place was turning into an industrial area (Figure 3). In the neighbourhood stands a dairy plant and an abattoir, which supplies meat to the whole of Mbarara town. Also there was a soft drink factory and three petrol stations. All the dirt that was washed from these factories were released to the river which is a source of water for domestic use. The researcher observed a stream of dirty smelling water flowing to the river, where brick makers

Figure 1. A pool of water left behind after extracting clay for making bricks.

Figure 2. Piles of dry brick and kilns close to R. Rwizi.

Figure 3. Backfilling clay pit on R. Rwizi.

were bathing from after a day's work. One brick maker

informed the researcher that he at times develops rashes on his body and feels some itching after bathing from the river, which never used to be the case. He attributed it to the dirt washed from the factories and released to the river. He also told the researcher that they used to catch fish from this river but the amount of fish has reduced. He further informed the study that there used to be many bird species and small animals, but it is no longer the case.

The researcher moved 7 miles westwards where the river is flowing from, where he documented sand mining activities (Figure 4). The sand miners scooped sand from the river bed creating a basin, and also digging the river banks to get the precious mineral, sand which is on a high demand by builders in Mbarara town which is growing at a high rate. According to Mwebesa (2019), sand mining in the river at Kirehe in Nyamitanga Division has made the river come close to changing course. The residents say environmentalists focus on reclaiming and protecting sections of the river which are easily noticeable, neglecting sections deep in rural and hard to reach areas.

According to Tenywa and Mugisha (2013), R. Rwizi was running out water frustrating industries, including Nile Breweries manufacturing plant, which was established in Mbarara. They went ahead to report that Water Experts say R. Rwizi, Uganda's biggest river feeding to Lake Victoria, is drying up and has been reduced to a channel after years of environmental destruction accelerated by climate change. The river is regarded as the lifeline of pastoralists since it is the only source of water during the dry season in Western Uganda. According to one of the residents near R. Rwizi, he commented that the river had reduced to a trickle, shrinking every dry season but the 2013 season was the worst.

However, the farmers in Mbarara have come up with traditional methods of trapping water during heavy down pours. Using excavators, individual farmers have dug valley dams in their farms creating water reservoirs for their animals. The researcher visited some farmers in Mbarara district during the dry season of January to early April this year, when Uganda was experiencing a serious drought, but they were confident that their water source would take them through the season, until mid-April when it starts to rain again. The researcher documented a dam by a farmer 3 km from River Rwizi in Bubaaare Sub-County, Mbarara district and observed that the dam was filled with water despite being at the peak of the dry season, when most cattle keepers were driving their cattle to the river to water their cows (Figure 5).

During the course of the study the researcher went ahead to document more innovative activities taking place in the area to counteract water shortage during the dry season. He documented the construction of a shallow well in another farm in Bubare Sub-county. The residents of this area informed the researcher that they do not get enough water for domestic use and for their animals. Although they have started getting piped water, its supply

Figure 4. A heap of sand mined on R. Rwizi.

Figure 5. Water reservoir in an individual farm in Bubaare Sub County.

is unreliable during the dry season. It is always a rationing supply of water during the dry season, where water is always released at night. For this reason, some residents of the area have resorted to digging shallow wells in order to meet the water needs for domestic use and their cattle. In a related development, the residents of Bubare Sub-county have started constructing water tanks for rainwater harvesting, so that they could get reliable clean water throughout the year for drinking and domestic use.

The researcher documented the process of constructing a shallow well, where after digging about ten meters deep, builders constructed a wall using fired bricks and sand mixed with rapid set cement, covering round and upwards towards the surface level (Figure 6). Usually, builders use this type of cement because bricks have to bond with cement and sand within the shortest possible time. The builders dug again until they reached the water level. They resumed building from underground

Figure 6. Constructing a shallow well using fired bricks.

Figure 7. Drawing water from a shallow well.

to join the wall above. Upon ascertaining that they had got sufficient water from the ground, they sank some concrete rings at the bottom of the well to support the soft walls and guard against collapsing. However, there are those who can afford to use concrete ring pipes instead of building with bricks. After, they covered the surface with a concrete slab to prevent possible accidents. On the slab they left a window, which was locked after fetching water and also used as an entrance when going down to clean it. Water from such wells is collected by tying a rope and stone to a plastic container and releasing them into the water source. When the plastic container is filled with water, it is pulled to the surface using the rope (Figure 7). The water is transferred to another container and carried home. In some places, locals have adopted the pulley system which enables them to draw water with ease.

One resident whom the researcher visited had modified his shallow well to a borehole which makes the water more protected and safer for domestic use (Figure 8). He used the water to irrigate his gardens which enables him to grow vegetables throughout the year. He is also able to water his animals especially during the dry season when it is hot and when there is scarcity of water in the area. This has enabled the farmer to improve on his daily income by selling vegetables and fruits, in addition to a steady production of milk without being affected by the dry season. In addition, he uses cow dung as manure to improve the soil structure. This helps hold more water and nutrients in the soil and makes the soil more fertile. This has helped him to produce organic vegetables which is highly demanded on the market. As a new innovation, the farmer also irrigates his banana plantation during the dry season which makes him have a steady production of bananas which he uses to produce banana wine at a cottage level, an innovation in value addition of banana. He sells his wine through supermarkets of Mbarara town and Kampala City where it competes favourably with imported wines.

Figure 8a. Pumping water from a borehole.

Figure 8b. Watering animals using water from a borehole.

Rainwater harvesting

Rees (2006) reported that the Development Technology of Warwick University was aimed to research and develop technologies appropriate for practical use in the

Third World. The unit has recently developed three small jars, which included a fired-brick jar (500 to 700 litres) for rainwater storage. The aim was to develop a number of safe, low cost alternatives for rainwater storage. Typical traditional methods of catching water vary from small buckets to large tanks. Old oil drums are commonly seen outside homes in Uganda, in which water is collected using short home-made gutters. The research work was carried out at Kyera Farm, a training centre for organic farming near Mbarara town, in western Uganda. The sample tanks were developed at the farm, and later ten tanks were built in the nearby village of Kyera. A study is now underway to look at the benefits that such small tanks can bring to the users. Small water jars are useful in areas where there is a good distribution of rainfall throughout the year, with two rainy seasons. The householder may still need to collect water from the traditional water source during the drier periods, but for much of the year, the family members will have water at the home. This can save the time and effort spent on collecting water. A similar programme has worked successfully in Kabarole district, in western Uganda.

Rees (2006) further reports that local masons were involved, as fully as possible so that they could share their knowledge with others in the project team, and also, learn about new designs. It was hoped that the masons would then go on to build other jars in the area and would also be able to maintain the system already built. The programme has taken root in the area already and masons are building these jars for individuals. The brick jar was developed to make use of this common building material. The jar is made from a simple brick cylinder (Figures 9 and. 10). A tap brings water out at the right height for a jerry can. It is a good idea to include some reinforcement in the brickwork, such as, a band of wires.

Water Aid (2006) observes that RWH should be a way to go. It has been overlooked by many because they do not have adequate information. Its technology is appropriate, and affordable, and can be adapted in every situation worldwide. Kayamba (2012:175) argues that the ability by the potters to control and fire bricks to higher temperatures has enabled them to produce bricks which are used to build water tanks.

Arayo (2005) reveals that some farmers in Mbarara have become creative by devising alternative means of harvesting and conserving water. This has helped them to start some new enterprises in their homes besides growing food. It has helped them to grow some vegetables, in addition to having water for the dairy animals during the dry season and apiary projects. In addition, the communities have benefitted by getting clean water for drinking. Water harvesting has been described by One World (2006) in the following terms:

“Rainwater harvesting is the method of freshwater collection which intercepts rainfall before it can encounter hazards associated with subterranean travels to a spring or well. Even in its most primitive form, rainfall channelled from roof guttering into a water tank carries no risk of

Figure 9. Brick water jar showing major parts.

Figure 10. Brick water jar for harvesting rain water.

saline, arsenic or livestock pollution. Perhaps more to the point, such collection in a domestic environment cannot be depleted by uncontrolled action of industry or agriculture, nor can it be billed by a profit – seeking Water Corporation. Rainwater harvesting is therefore concerned with the revival of ancient practices, and the enhancement of the 21st century demands of efficiency and quality. These technologies make greater inroads in areas where more familiar water sources are failing, typically urban environments of massive groundwater depletion and mushrooming population”.

Innovations in rainwater harvesting

Further research findings indicated that some people have constructed water tanks to harvest water during the

rainy season. According to the information gathered from the residents of the area, they used fired bricks made from the banks of River Rwizi and sand from the river bed mixed with cement. They build up to 7 feet high, and then cover the top with a concrete slab. However, before covering the top, they plastered the inside using sand and cement, and added a fine finishing of waterproof cement. This ensures that the tank remained impermeable after harvesting water from the rooftops during the rainy season.

The researcher documented different types of water tanks constructed at this site. Some were over the ground while others were partially underground. With the development of appropriate technology, hand pumps made out of plastic pipes have been made to pump water from the tanks (Figure 11). Another simple manually operated hand pump was also fixed to the water tank, and water would be pumped to another tank that would let it flow to the house by gravity (Figure 12). The improvement in technology has helped in improving personal hygiene and sanitation by constructing flushing toilets in houses.

In the neighbourhood, the researcher witnessed one person collecting water from an over ground water tank fixed with a tap (Figure 13), in contrast, the researcher documented a potter in Isingiro collecting water from an underground tank (Figure 14). The tank was constructed in the compound and was built with bricks and cement. It was later plastered and covered with a slab, leaving a window where they collect water from and later covered and locked for safety to prevent children and other objects from falling there. This has helped the potter to have enough water for her pottery throughout the year which has helped her to have a steady production.

The researcher also documented a woman harvesting water using a pot during a heavy downpour, in the neighbourhood (Figure 15) and a man harvesting water using plastic containers (Figure 16). This is a common practice among the people of Ankole, especially those who do not have water tanks. It is this rudimentary practice that called for construction of water tanks to harvest enough water. However, before many families constructed iron roofed houses, they used to harvest rain water from trees using banana leaves and pots. Water Aid (2006) argues that Roof-water or rainwater harvesting (RWH) is an option which has been adopted in many areas of the world where conventional water supply systems have failed to meet the needs of the people. It is a technique which has been used since antiquity and examples of RWH systems can be found in all civilizations throughout history. In Uganda and Sri Lanka, rainwater was traditionally collected from trees, using banana leaves or stems as temporary gutters; up to 200 litres could be collected from a large tree in a single storm. With the growth in corrugated iron roofing in many developing countries, people often place a container under their eaves to collect falling water during a storm; one twenty litre container of clean water captured from

Figure 11. Pumping water using a locally made pump.

Figure 12. Pumping water from a tank using a hand pump.

Figure 13. Drawing water from a water tank fixed with a tap.

the roof can save a walk of many kilometres to the nearest clean water source.

Figure 14. Drawing water from an underground water tank fixed with a tap using a bucket.

Figure 15. Harvesting rainwater using a pot.

Figure 16. Harvesting rainwater using a plastic container.

It has been observed that construction of water tanks and shallow wells in this area has helped a lot in addressing water shortages. It has been noted that a lot of production time in this area used to be lost on fetching water; moreover, from long distances. Water tanks have saved a lot of time and relieved women who used to collect water from River Rwizi, enduring long distances sometimes as far as five miles. They have also helped in obtaining clean drinking water for the household. Harvesting the rain water and storing it in household water tanks has improved water access in rural areas. Lack of clean water can contribute to a high level of diarrheal diseases, malaria, and fever. The provision of adequate and safe water is a necessity for healthy living and the well-being of individuals. It saves women's time, and enables them to devote more time to food production and preparation, with consequent nutritional benefit to their children and pregnant mothers.

Modified clay pots for safe water storage

Although many homes have been able to get a reliable source of clean water, some lack safe drinking water. According to Kayamba and Kwesiga (2016:90), in many Ugandan homes clay pots are used for storing drinking water. Although this is a preferred method for storing water, the repeated hand contact contaminates it quickly, which is a great disadvantage. This has called for an innovation in the development of new improved pot designs fitted with taps, which are ideal for rural communities. This is a women's project who are engaged in making traditional pots. The production of modified pots has benefited the rural poor by selling the pottery products to urban centres. According to Dinh (2009), the modified pots have become popular among the local people, because they keep the water cool and are palatable. It is also convenient to use, even for children, when getting water for drinking. On top of that they prevent the spread of diseases (Figure 17).

According to Baguma et al. (2012), despite such efforts to increase access to water, the reality in most developing countries shows that there remain various obstacles. Principally, water pathogens continue to cause household challenges such that water-related diseases are contributing to morbidity rates and economic burdens in Uganda and other similar countries in the developing world. Worldwide, a primary cause of increased morbidity and premature mortality remains waterborne-related infectious (bacterial, viral and parasitic) and non-infectious (food intolerance- or intestinal disease-caused) diarrhoea, leading to about 2 million deaths each year worldwide.

According to Chekwech (2013) disasters such as mudslides, floods and landslides are becoming common in Uganda. Whenever they have occurred, the victims are left fighting for the basic needs of life. Often when the call

Figure 17. Traditional water pot fitted with a tap. Source: Dinh (2009).

for help is sent out, other Ugandans think the victims only suffer lack of food, shelter and loss of property but the other important and most essential element is safe and clean water. In addition, Uganda is home for almost 1.3 million Refugees who live in Refugee Camps countrywide, Nakivale in Isingiro district, being the oldest refugee camp. Although efforts have been made to pump water from River Kagyera for domestic use and their animals, they lack safe clean drinking water.

Water purification

In response to the above, the Orukinga Water Organisation was started in 2012 by one potter in Isingiro town with the aim of making ceramic water filters locally, to provide safe drinking water to the people of Isingiro in general and the refugees who live Nakivale Refugee camp. The Potter uses clay from the surrounding area mixed with saw dust which is bought from the carpentry workshops from Mbarara town. The clay is first dried, crushed into powder and later sieved. The saw dust is also sieved with a 60 mesh size (233 mm), and it is mixed with clay using some little water to a workable paste. It is then put in a mould, and a model swung to create the inside of a pottery product (Figure 18). The pots are kept indoors to allow them dry slowly. After drying them for two weeks, they pots are stacked in a kiln and fired at a temperature of 800°C. using firewood. The potter monitors her kiln when firing using a digital pyrometer. After firing, the pots are selected and a test is done on each product to find out how long it can take to filter 5 L of water, which is the capacity of the pot. The pots are later smeared inside with silver nitrate, which is meant to kill the pathogens when filtering the water. They are later dried and kept in a store ready for sell (Figure 19). The potter informed the researcher that she has tested her water product using laboratory facilities at

Figure 18. Press machine for making ceramic.

Figure 19. Fired pottery to be used as water filters water filters.

Mbarara University, and the product is 99.9% safe to drink.

The potter had a 20 litre bucket fitted with a tap, whose cover was cut to form a ring that can hold the ceramic water filter (Figure 20). The filter was filled with water and covered with the piece of plastic which had been cut from the cover and placed on a table. It took about 1 hour for the 5 litres of water to be filtered (Figure 21). However, the rate at which these ceramic filters work differ from one filter to another, depending on what temperature they are fired, because not all pots in the kiln's firing chamber fire at the same temperature.

The buckets and taps are bought from the hardware store and they are fixed by a local technician. The potters sell their products at the weekly market and at times sell their products from the workshop. The project has

Figure 20. A bucket fitted with a tap and a ceramic cone.

Figure 21. Drawing drinking water from a bucket.

created employment to young women in the area giving them a stable monthly income. The production of ceramic water filters has enabled the residents of Isingiro have clean, safe drinking water which has reduced water born diseases. The children who used to die at young age are now able to celebrate their 5th birthday. The system is user and environmental friendly because one uses a tap when getting water for drinking, and does not need to boil the water, which saves on fuel for cooking. By reducing the need to boil water for drinking, the project will cause less wood to be burned and lower Carbon emissions. According to ReSource Award (2017) ceramic water filters offer an attractive clean water solution for Uganda. From UNICEF's assessment of the use of ceramic water filters in Cambodia, ceramic filters have the advantage of being lightweight, portable, relatively inexpensive, chemical-free, low-maintenance, effective and easy to use. In 2015 Uganda's Ministry of Water and

Environment approved Purifaaya ceramic filters produced by the social enterprise SPOUTS of Water, stating that the filters are efficient and effective to produce water that meets the recommended standard for human consumption.

CONCLUSION AND RECOMMENDATION

In conclusion, it can be said that man's activities on River Rwizi have caused a devastating effect on its water flow and has accelerated the effect of climate change in Ankole region. The brick making activities has lowered its water table level and causing siltation. The constant sand mining from the river bed and its banks have reduced its water flow and diverted its course on some parts. All these have affected the livelihood of the people of Ankole who have depended on this river for their livelihood, as a source of water for their animals and domestic use. Mbarara town and the neighbouring towns experience serious water crisis every dry season each year, for domestic use and industries. The growth of industries along the river has affected the water quality due to the dirt that is released into the river after cleaning these factories. The human activities on this river have not affected its flow only but also endangered its entire ecosystem. This has called for the people of Mbarara and Isingiro to come up with innovative technologies to counteract these problems in order to get reliable, safe and sustainable source of water for domestic use and for their animals. Valley dams have been constructed to tap running water during the rainy season, and shallow wells have been dug and constructed for domestic use and their animals. Underground and over ground water tanks have been constructed to harvest rain water, which has provided adequate and safe water which is necessary for healthy living and the well-being of individuals. It saves women's time and enables them to devote more time to food preparation, with consequent nutritional benefit to their children and pregnant mothers. The modification of the water pot and production of water filters have provided solutions to safe clean drinking water for many people of Ankole.

Therefore, the researcher recommends that these ancient technologies be revived because they are reliable, cost effective and can enhance the ever increasing demand for clean and safe water for domestic use and animals. He further recommends that rainwater harvesting should be adopted by urban dwellers because in some cases they are most hit during dry seasons when there is water rationing. Yet, during rainy season there is a lot of water wasted because it is not harvested. In some occasions, rains have caused floods and blocked drainages resulting into accidents and deaths because most surfaces in towns are covered with concrete and water cannot be absorbed into the ground. In addition, households and institutions should practice rainwater harvesting because of the benefits mentioned above.

Lastly, the researcher would like to call upon the National Environment Management Authority (NEMA) to sensitise the people of Ankole to put agricultural and brick making activities some distance from the river banks in order to stop the river from silting-up. In connection with this, the people of Ankole should try to restore the lost vegetation along river Rwizi and bear hills of Ankole by planting indigenous trees in order to curb water evaporation and climate change. In addition, the Ministry of Water and Environment should encourage the people of Ankole and Uganda at large to use the ancient technologies for keeping water safe.

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