Environmental literacy, the key to sustainable conservation of wetlands in urban areas

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Abstract
The study focuses on understanding human effect on urban development and wetland degradation in Harare and Chitungwiza, Zimbabwe. Wetlands are a crucial ecosystem as various living things depend on them for their survival and existence. In Africa, particularly Zimbabwe, continued existence of wetlands is under threat due to human activities, such as construction of houses, urban farming and waste dumping. There are limited conservation efforts in place to save the resourceful wetlands whose benefits to human beings and other various living species are immeasurable. This study was conducted in Seke in Chitungwiza, Warren Park and Mufakose in Harare where wetlands are affected by human activities. The study explores the effect of urban development on environmental sustainability due to urbanisation. A qualitative approach was adopted where 30 households were engaged in in-depth interviews. The study highlighted various reasons for residing, farming and dumping waste on wetlands.Moreover, the study explores challenges associated with living in wetlands,while showcasing the limitedlevels of environmental literacy among residents regarding wetlands and environmental conservation. Major gaps have been realised on environment literacy and policies that govern environmental conservation and these were identified as the main factors contributing towards continued wetland degradation in the three areas under the study. The study concluded that individuals are more concerned with their primary needs of securing food and shelter, with little or no consideration of the after effects of such on the environment which include individual heath, as well as depreciation of other services and goods found in wetlands. Recommendations have been put forward to ensure that literacy levels are increased and more importantly, comprehensive and binding policies should be put in place to enforce the conservation strategies.

Keywords: wetlands degradation, urban development, ecosystem.

1. Introduction
Wetlands are fragile ecosystems that remain threatened byhigh levels of unsustainable land use leading to their rapid degradation and loss. Their positive contribution to several ecosystems and their continued degradation and loss due to competing land use, especially in urban areas, has become a cause of concern for various stakeholders and agents of environmental affairs. Defined as areas of marsh, fen and pet land whether natural or artificial, permanent or temporary, with flowing or static water, wetlands are areas where water is the primary factor controlling the environment and the associated plant and animal life [1].Regardless of them being relatively small in size, wet lands are critical to human well-being and comprise of some of the world's most important environments [2]. They provide multiple ecosystem services including flood control, filtration of water, and improvementof air quality among others. However in recent years urban wetlands have

been threatened by increased contest for urban land usedue to rapid changes in infrastructure development, such as housing and factory construction, widespread cultivation, industrial pollution, as masses of waste is dumped in these wetlands [1, 2]. This continued degradation of wetlands under the 'guise' of development in the contemporary society has become a cause of concern for various stakeholders in the environment discourse [3, 4]. Threats to the sustainability of wetlands does not only emanatefrom human actions as there are other natural factors that are exerting considerable amount of pressure on these natural ecosystems. The continued effects of climate change are other threats to the sustainability of wetlands due to intense droughts characterised by high temperatures and low rainfall patterns [4].Given that wetlands are critical ecosystems for the sustenance of various living species, there is need for a comprehensive understanding of the extend of human-wetland conflict so as to ascertain the level of human contribution to wetland degradation. This paper is therefore tailored to evaluate the level of the impact of human activity on wetland degradation and level of environmental literacy among individuals and households in Warren Park and Mufakose suburbs of Harare as well as Seke in Chitungwiza. Such an evaluation can in future help establish possible ways to address the identified challenge so as to ensure wetlands sustainability given their much commendable contributions to the welfare of all living things.

1.1 Functions of wetlands and their advantages

Wetlands often provide several socioeconomic advantages and have played an important part in human development throughout history.These wetlands are an example of the planet's life-support systems that provide a wide range of unmeasured products and services that benefit people and many other living things.Major civilizations relied on them, including the Maya, Inca, and Aztec in Latin America, the Khmer in Asia, the Marsh Arabs in Mesopotamia, and the Nile and Niger in Africa [5]. Wetlands provide water and primary productivity upon which various species of animals, plants and birds depend on for survival [6, 2, 1]. For centuries, certain species of living things have identified wetlands as their home as they provide them with the required food nutrients and habitants for their well-being.The Ghodaghodi Lake Area in Nepal, provides habitat to a variety of animals, which benefits humans in several ways. According to Lamsal et al. [7], the lake was home to about 19 fish species, 41 bird species, 17 mammals which were endangered and vulnerable as well as 5 reptiles which were critically endangered, vulnerable, and near extinction.The lake also contained 45 species of aquatic macrophytes and 54 species of terrestrial/riparian vegetation. Hence wetlands have various services they provide to both human beings and other living species across the world [2, 8].

Wetlands help in ensuring that genetic resources that are used in animal and plant breeding as well as biotechnology are available and maintained. This is because plants, animals, and microorganisms rely on the provision of fresh water from wetlands [9]. For human beings,they provide various services including provision of clean water through purification as it filters polluted runoffs from cities and agricultural lands by trapping sediments.

Barros and Albernaz [4] indicate that there are various benefits that wetlands offer to human society, hence there is great needto preserve, manage and rehabilitate them. Wetlands are regarded as the nurseries of life given that about 40 percent animals breed in wetlands or use wetlands as their habitat. They are also regarded as kidneys of the earth, given their ability to clean the environment off pollutants [2].Clean, safe and adequate freshwater is vital to the survival of all living organisms including human beings [10].Wetlands are well-known for their ability to prevent floods. The plant life and soil in wetlands are accustomed to being soaked as they can hold onto the water better than other soil types [11, 12].Rainfall received as precipitation is captured and retained in wetlands, preventing floods in other areas, especially those not meant to hold water as much as wetlands do [12]. As such areas of residents and farming are protected from flooding; hence these wetlands provide indirect services to humans.

Research has indicated that wetlands have recreational value and, if maintained and managed appropriately, they can attract tourists and produce resources for local community development. Mitsch, et al. [13] found a considerable increase in wetland-related tourist activities, with over 21 million visitors visiting four wetlands in South Korea between 2007 and 2012. In Tanzania's Kilombero Valley, wetlands provide up to 80% of monetary income to the poorest people [14]. Wetlands have provided substantial possibilities for tourism and leisure on a worldwide scale, offering economic advantages to governments, the tourism sector, and local people [15].

1.2. Wetland degradation and its effects

In the recent years wetlands especially in urban areas,have been over modified by the development of infrastructure. The rich wetland ecosystems of some countries are seriously threatened by a number of anthropogenic and bio geophysical factors. In many cities across the globe analyses have indicated that wetland loss is happening at a faster rate due to urbanisation. Matamanda et al. [1] state that almost half of the world's population moved to coastal and floodplain areas in the last century. It has been noted that some of the world's largest cities such as Lagos, Washington DC are wetlands cities [1]. They are established in wetlands. This shows that wetlands across the globe have been greatly compromised. Increased contest for land use in urban areas has been identified as the major cause for this continued loss of wetlands. Construction of houses, churches and industries in wetlands is associated with the loss of wetlands as this affects the water table in the long run. This continued misuse of wetlands is also associated with increased incidences of flooding as well as fast depreciation of the value of the infrastructure, raising the concerns about the welfare of people living in these conditions [2].

Studies by Arrighi et al. [16] and Hickey and Salas [17], highlight that flash flood events in urban areas are likely to increase, given the continued construction of houses in these wet areas. This is as a result of the ever-increasing urban population and continuous need for residential places which force many to construct their houses in wetlands. Among the notable human actions that are affecting wetlands are increasing population pressure, rapid rate of urbanization, mining, oil and industrial waste pollution, uncontrolled tilling for crop production, overgrazing, logging, unprecedented land reclamation, construction of dams,

transportation routes and other physical infrastructure [18]. Other than the human threats there are also some natural threats to wetlands which include marine and coastal erosion, subsidence, and ocean water intrusion, invasion by alien floral and faunal species, sand storm, desertification, and droughts.

Fang et al [19] highlight that Sanjiang Plain which used to be the largest concentrated freshwater wetland in China is fast deteriorating due to the conflict between environmental conservation and arable land demands for food and urbanization that has continued to be a primary challenge for China. This drastic loss of wetlands in the Sanjiang Plain has caused serious ecological problems [20].The hydrological impacts of agricultural activities have a bearing on underground water depletion.

Kumsa [21] noted that the most serious threats to wetlands are unsustainable use of wetland resources through overgrazing, over cultivation, over abstraction of water for domestic use, agriculture and improper use of forest practices, establishment of new human and livestock settlements in wetland areas. As humans settle in a particular area, they cut and burn down other vegetation for housing and commercial activities. In most cases there is a general lack of an operational national wetland policy to guide any activities carried out in such wetland areas. Lack of adequate and continuous funding, personnel for monitoring, management, research, community awareness, as well as lack of community participations in management of various wetland resources is greatly affecting wetlands across the globe [21].

In Zimbabwe, a study by Mhlanga [22]shows that the Mukuvisi wetland which supplies water to the Mukuvisi woodland nature reserve appears to have shrunk in size between 1989 and 2009. The extent of the wet area has reduced in size over the years, and seemingly the trend may continue for an extended period of time. According to Kudumba [6], approximately 115,000 ha of predominantly wetland land in and around Harare is occupied illegally. As such there is no policing and control of activities in such areas. Upstream farming activities around the Honeydew farm have reduced water flows into the wetland area. Considering the abstraction of borehole water for agriculture activities, water flow from the upland has significantly reduced. Expansion of the adjacent Msasa industrial area may also be encroaching into this important wetland area [22].

Chikodzi and Mutowo [23]revealed that wetland degradation is synonymous with rural livelihoods erosion, especially for rural communities in dry areas and directly bearing the brand of climate change. Wetland benefits are completely lost and community innovativeness is often not good enough to bring sustainable livelihood options. Water scarcity and stress is unselective, the water woes spread uniformly and evenly across the breath and width of a local rural community. The loss and degradation of wetlands has severe economic consequences, and removes opportunities for sustainable development [23].

This submission is a correct reflection of the events unfolding in Chingombe community following the drying up of Mutubuki wetland. The loss and degradation of wetlands are

associated with economic costs due to their reduced ability to provide goods and services to humankind and to support biodiversity [23]. The study revealed that wetlands losses in developing countries are likely to have more direct impacts on human well-being than in developed countries, mainly because mitigatory and adaptation measures are less likely to be implemented due to technical and financial constraints [23].

The degradation and loss of wetlands has severe economic consequences, and it inevitably removes opportunities for sustainable development [23]. The study revealed this submission as a correct reflection of the events that unfolded in Chingombe community following the drying up of Mutubuki wetland. The degradation and loss of wetlands reduced their ability to provide services and goods to humankind and to give support to biodiversity, and are thus associated with economic costs [23]. Moreover, this has affected the availability of water in the area, resulting in people spending more time queuing at the remaining few water sources.

In Kigali city, Rwampara is one of the areas that have been experiencing extreme flash flood events during the rainy season in the city [24]. Research has indicated that this is mainly due to lack of storm water management strategies and lack of infrastructures to accommodate peak runoff accumulation from upstream areas such as Gikondo, Kiyovu and Nyamirambo [24].It was further revealed that flood risks are on an increasing trend due to the development of new infrastructures and buildings, particularly informal settlements and slums, where domestic water is not controlled, owing to limited water harvesting systems and lack of adequate water channels.

The consequences of wetland loss and degradation in Ethiopia are enormous and directly affecting the livelihood base of rural communities [21]. The change of wetlands has created numerous problems including decrease and extinction of wild flora and fauna, loss of natural soil nutrients, water reservoirs and of their subsequent benefits.

2. Methodology and study area

The study adopted qualitative research design where in-depth interviews were contacted with 30 households in three separate locations namely Seke in Chitungwiza, Warren Park and Mufakosein Harare. Seke is about 40 kilometre southeast of Harare. Traditionally the area was under traditional authority.However, with the growing urbanisation the rural areas of Seke were turned into urban settlements where people in Chitungwiza and Harare are securing land for residential purposes.Some are also buying the land to establish small agricultural projects such as farming, poultry keeping and pig farming. Settling in the area is yet to be regularised by the local urban authorities. As such individuals are purchasing land directly from the original owners through the traditional authorities making the settlements very haphazardly arranged. There are no clearly marked roads and no service is provided by the local authorities. Fifteen households were interviewed in Seke and twelve of these had male household heads while only three were female headed households. Warren Park is aresidential suburb located in the western part of Harare, the capital city of Zimbabwe. It is situated approximately 15 kilometers from the city center. The suburb is characterized by a mix of residential, commercial, and industrial zones, with a growing

population.Warren Park is also home to several natural features, including wetlands. These wetland areas, although under human threat, they play a crucial ecological role in water regulation, biodiversity conservation, and providing habitat for various plant and animal species. The wetlands in Warren Park are interconnected with the wider hydrological network of the area and contribute to the overall environmental balance. As a rapidly expanding suburb, Warren Park faces various challenges, including urbanization pressures, inadequate infrastructure, waste management issues, and environmental degradation. Understanding the characteristics and dynamics of the study area is essential for addressing these challenges and promoting sustainable development in Harare. Seven households were interviewed in Warren Park and six of these had male household heads while only one was female headed household.

Mufakose is a residential suburb surrounded by Marimba, Budiriro and Grenary. It is situated approximately 16km from Harare CBD. The suburb is characterised by high population numbers, small houses constructed very close to each other, poor waste management, rampant green crimes, and municipal water shortages. Wet lands in the area have been changed to dumpsites and fields for urban farming. Mufakose and Marimba suburb were demarcated by a wetland, which now is filled with residential stands and waste dumping is proliferating in the wetland. These wetlands are becoming dry and they are losing their significance at a rapid pace. Eight households were interviewed in Mufakose, five of them were female headed households and three were male.

2.1. Study findings and discussion

The study revealed various factors to be the causes of wetland degradation in and around Harare. These various causes seem to have their varying effects as well. Below are the various causes and effects of wetland degradation identified in the study:

2.1.1. Urban Expansion

Urban expansion was identified as the major reason for encroachment of human activities into wetlands in the areas under study. As the rate of urbanisation continues to increase, the demand for residential land and industrial land for both large-scale and small-scale production continue to increase. Such findings coincide with Matamanda et al [1] who argue that in recent times more people across the globe have settled in the floodplains and coastal areas. Although the reasons for settling in such areas may vary from one context to the other, it has been realised that the occupation of these wetlands is on the increase. Regardless of the known challenges associated with living in wetlands, some residents indicated that their main concern is securing a place to build their homes.

"*All I wanted was to get a piece of land to build my own house. The rentals are going up every month so we thought its better we get our own place. Now I don't talk to anyone, I do what I want without any worries about the landlord and paying rent."*

Owning a piece of land especially in Harare has been regarded as an achievement by many, as this allows them to build their own homes. Participants reported that securing land in the old residential areas is now a challenge since they are overcrowded and there is no space

to build new houses. As such, people are no longer concerned about the location, but rather about the availability of open space to build their houses.

Responding to the issues of degradation of the environment due to construction of houses and industries, the dominating sentiment was that environmental issues were regarded as secondary and they are more of national concerns while provision of shelter was the primary concern as it was more of a personal issue.

As such very few people would consider environmental conservation as their top priorities. Such sentiments indicated a very limited level of environmental literacy among the citizenry. They seem unconcerned by the environmental challenges regardless of them being the same people to be affected by the challenges such as flooding that come as a result of residing in wetlands [24].

The level of environment illiteracy highlighted in the study is very disturbing. Most of the participants indicated that they were aware of the fact that staying on wetlands was in the long run causing these places to dry up, they were not worried about it as for them it was 'a blessing in disguise'. This was indicated by some participants as they said, "*As much as this year we are living in this waterlogged area, we know it's a matter of one or two years and all the water will be gone. The more time we spend here, the wetness will also vanish with time."*

Such responses show that the residents are not fully aware of the consequences of their stay in these wetlands. They have no comprehension of how much this is affecting the water table and in the long run impacting on their ability to accessclean and safe water. Participants indicated that they actually 'pray' for the areas to dry up fast so that they cannot be bothered by the marshiness and wetness in the area.

Residents indicated that they can facilitate these wetlands to dry up faster by growing plants and other crops round their houses so that their areas can dry up faster. In a way the people are making so much effort to ensure that the wetlands dry up so that the area can be habitable.Such findings help explain submissions by Chikodzi and Mutowo [23] who reported that after years of moving on wetlands, theavailability of water for household use becomes a challenge and individuals ended up walking long distances to fetch safe and clean water while others waited in long queues to get water. Most of the new residential in and around Harare are not supplied household water by the local municipality as they rely on underground water.

Each household sink a borehole while others resort to digging water wells. Given that their activities affect the water table, their ability to access that ground water in the long run becomes a challenge. However, residents are not worried about such since it is not an immediate need.

Fig. 1. Houses built on wetlands in Seke
Source: Field visits in Seke

2.1.2. Poor urban wetland planning and politics.

In the study, the aspect of poor urban wetland planning by the council has been reported as the main cause for wetlands constructions and degradation. The postcolonial city council no longer views wetlands as important for the natural ecosystem but rather they are viewing them as income generating spaces by giving developers to build houses on them. Political influence has been identified as another cause for the proliferation of houses and other development on wetlands.

Participants revealed that this is witnessed mainly towards elections as political figures will be allocating land, including wetlands spaces to the citizenry in a quest to obtain votes. This resonates with the study by Kudumba [6], which highlighted that approximately 115,000 ha of predominantly wetland land in and around Harare is occupied illegally. Concerning this issue, one of the participants ascertain that: *'Wetlands constructions are being facilitated by politicians who are creating housing cooperatives for their supporters, it is a good initiative only if it is donein right building spaces, not the wetlands that are falling victim of their vote buying initiatives.'*

Poor urbanwetland planning is accompanied by a lack of education on how to maintain a wetland, as well as nurturing the place. There is a lack of knowledge on conservation and rehabilitation efforts that can be made to sustain and revive wetlands.

Growing of native plants or floraand creating habitats for various wildlife that contributes to the survival of the wetlands can be a critical measure to sustain these wetlands. Moreover, there is need for establishing ways to educate communities on how they can

ensure that wetlands continue to be conducive habitats for the various living things that depend on them. Concerning this issue, one participant indicated that: *'We do not have knowledge on how to keep the wetlands safe, most people do not even know the contribution that these wetlands have in our lives and everything that survives within them, as people we just view them as places for doing gardens, building and dumping waste, forgetting the crucial role its mandated for.'*

Such findings resonate with Kumsa [21] who indicates the lack of policies on environmental management especially in developing countries. Although in some instances the policies are available, implementation and monitoring are not done effectively, leaving the environment vulnerable.

2.1.3. Urban Farming

Other than construction of houses,agricultural practices and drainage modification are also contributing significantly to wetland degradation.Urban farming has become a popular means of subsistence for urban resilience and food security for many households in Harare given the country's economic outlook.The rate of unemployment has been increasing and the salaries that many receive are not adequate for family provision. As such people have resorted to urban farming to enhance food security and consumption smoothing.

However, given the limited availability of land in urban areas, most of the farming is done on wetlands. Such indications support the findings by Kudumba [6] and Mhlanga [22] who both highlight that farming on wetlands has become popular in the recent years. From the study it was realised that some people did not want to build their houses on the wetlands, but they grow crops on such areas as they regard them as idle and by farming, they can use the land productively. One lady reported that since her income was not adequate to provide for the family, she decided to grow maize on an unused open field which was waterlogged. She indicated that it was better to use the land productively than to let it lie idle yet they could put it to good use.

The study found that urban farming in all the study areas include the use of agrochemicals and improper waste disposal which result in the contamination of wetland waters and degradation of soil quality. Furthermore, it also involves extensive drainage modifications, including the construction of canals and ditches for irrigation and flood control which disrupt natural wetland hydrological patterns and decrease water retention capacity.

These findings support the study conducted by Magombeyi et al. (2017) on wetland degradation in the Lake Chivero catchment, which includes Warren Park in Harare. Their findings highlighted that unregulated agricultural practices and drainage modifications negatively impact wetland ecosystems.The study emphasises the importance of adopting sustainable land management practices and regulating drainage modifications to mitigate wetland degradation.

Fig. 2. Urban farming practised on wetlands
Source: Field visits in Warren Park

2.1.4. Pollution and Solid Waste Disposal

Wetlands have also become convenient dumping areas for many,given the erratic garbage collection in urban areas in the recent years in Zimbabwe and Harare specifically. Many people find these places conducive to dispose of their residential and industrial waste. In most if not all of the mushrooming residential areas, the city council does not provide any amenities from refuse collection, water provision to sewage management. As indicated earlier, residents dwell much on underground water as they drill boreholes at their places of residence or dig up wells for water provision. In terms of sewerage systems, residents use the septic tanks systems, hence each household is responsible for managing its own sewerage. The same applies to refuse management, households are responsible for managing their own refuse since there is no municipal refuse collectionin these areas. One of the respondents said: *"I understand that dumping waste in the wetlands is harmful to the environment, but sometimes we have no other option. The lack of proper waste collection services in our area makes it difficult for us to dispose of our waste responsibly. We have requested improved refuse collection from the local authorities numerous times, but our pleas seem to go unheard. As a result, some people resort to dumping waste in the wetlands out of frustration and lack of alternatives".*

This quotation highlights the perspective of a resident who feels compelled to engage in improper waste disposal due to the absence of adequate refuse collection services. It underlines the frustration experienced by residents who have repeatedly requested improved waste management infrastructure but have not received a satisfactory response. These findings confirm the study by Li et al. [25]on the challenges of solid waste management in urban areas which highlighted that inadequate waste collection services

often result in illegal dumping and improper disposal practices. Residents may resort to alternative disposal methods, such as dumping waste in nearby natural areas, when they do not have convenient access to proper waste collection services. Furthermore, research by Mandishona and Knight [26] also emphasised the importance of responsive waste management systems in urban areas.

Fig. 3. Illegal dumping site on wetlands
Source: Field visits in Warren Park

2.1.5. Overuse of Water Resources

Excessive water extraction is another concerning factor that has led to wetland degradation in Harare. The lack of reliable municipal water supply in Harare has had significant implications for wetland degradation, as people are compelled to seek alternative water sources, including wetlands to fulfil their daily water needs. Respondents emphasised the challenges they face due to the inconsistent water supply from the Harare Municipal system, which has led to increased reliance on nearby wetlands as a primary water source. The unreliable water supply has created a situation where individuals must resort to fetching water directly from wetlands to meet their basic needs for drinking, cooking and hygiene. This practice has become particularly prevalent in areas such as Warren Park, where residents face prolonged periods without access to clean water through the municipal system. As a result, wetlands have become critical lifelines for many communities, albeit at the expense of wetland health and sustainability. One respondent expressed their observation, saying, *"Many residents in Warren Park face severe water shortages due to*

unreliable water supply from the municipality. As a result, they resort to fetching water directly from nearby wetlands. This increased demand for water exacerbates the overuse of wetland resources."

The findings are in line with the study conducted in India by Patel et al. [27] which shed light on the implications of water scarcity on wetlands. The study revealed that inadequate municipal water supply led to increased extraction of water from wetlands, resulting in reduced water levels, habitat loss, and alterations in hydrological regimes. These changes negatively impacted wetland biodiversity and ecosystem functioning. Similarly, a study conducted in urban areas of Uganda by Mwesigwa [28] highlighted that unreliable municipal water supply led to communities heavily relying on wetlands for water. This increased pressure on wetlands led to over-extraction, habitat loss, and disturbances to vegetation, exacerbating wetland degradation.

3. Conclusions

The continued occupation of wetlands for residential and farming purposes shows that people are more concerned with their primary needs of food and shelter with little or no consideration of the after effects of such on the environment, individual heath, as well as depreciation of other services and goods found in wetlands. There are various side effects that are associated with residing in these wetlands. From the area of Seke it has been noted thatduring the rain season, households experience the major problem of flooding. Flooding issues are a big challenge, given that settlements in the area are not planned according to the specifications of town planners. There is no established drainage to control water run-off during the rain seasons.With these continued flooding over the years, the houses will be affected in various ways. The quality and safety of these houses is compromised with some structure eventually collapse. In addition, most of the houses now have a problem of moulds that develop on the walls, on the roofs, and inside the wardrobes. Such can have detrimental effects on the health and welfare of individuals, especially those with respiratory diseases such as asthma. Moreover, households in some areas rely on water from their wells and they use the septic tanks for sewerage management. During the rain season, most of their wells and septic tanks get flooded, exposing them to various waterborne diseases such as diarrhoea, typhoid among others. Over extraction of underground water as well as prolonged staying in wetlands have a negative effect on the water table. As time progresses, access to clean water in these areas becomes inevitable, especially taking into account that reliable water provision is a challenge already. There are various suburbs that are currently going for days without running water in Harare and Chitungwiza.

4. Recommendations

Based on the findings of the study on wetland degradation in the three study areas in and round Harare and Chitungwiza, it has been realised that the environmental literacy among the people is limited. Some of the participants do not fully comprehend the effects and impacts of environmental degradation. Hence the need for holistic programmes to improve their literacy levels. Moreso, there is a need for comprehensive and binding policies on environmental protection. The following is recommended based on the findings of this study:

- Strengthen Wetland Conservation Policies and Enforcement: Efforts should be made to strengthen wetland conservation policies and regulations. This includes establishing clear guidelines for wetland protection, land use planning and sustainable development practices. Additionally, there should be effective enforcement mechanisms to prevent illegal land conversions, encroachments and activities that contribute to wetland degradation. Collaborative efforts among government agencies, local communities, and stakeholders are crucial in ensuring the implementation and compliance of these policies.
- Improve Municipal Water Supply: To reduce the reliance on wetlands as alternative water sources, it is essential to improve the reliability and adequacy of municipal water supply in Harare. This can be achieved through improved investments in water infrastructure, upgrading water treatment facilities, and enhancing water distribution networks. Adequate funding and efficient management of water resources are crucial to ensure a consistent and clean water supply to residents, reducing the pressure on wetlands for water extraction.
- Enhance Waste Management Infrastructure and Awareness: To address the issue of improper waste disposal and its impact on wetland degradation, there is a need to improve waste management infrastructure and services in Harare. This includes expanding refuse collection services, establishing waste sorting and recycling facilities, and promoting proper waste disposal practices. Public awareness campaigns and community engagement programs should be conducted to educate residents about the importance of responsible waste management and the detrimental effects of improper waste disposal on wetlands and the environment.
- Foster Community Engagement and Participation: Active community engagement and participation are crucial for successful wetland conservation efforts. It is important to involve local communities, stakeholders, and relevant organizations in decision-making processes related to wetland management and conservation. This can be achieved through regular consultation meetings, workshops, and capacity-building initiatives to enhance awareness, understanding, and ownership of wetland conservation practices. Encouraging community-led initiatives, such as wetland restoration projects and sustainable livelihood programs can further strengthen community involvement and promote a sense of stewardship towards wetland ecosystems.
- Conduct Regular Monitoring and Research: Continuous monitoring and research are essential to assess the effectiveness of wetland conservation efforts and identify emerging challenges. Regular monitoring of wetland health, water quality, and biodiversity can provide valuable data to evaluate the success of conservation interventions and guide adaptive management strategies. Collaborative research initiatives involving academic institutions, government agencies, and local communities can help generate knowledge and innovative solutions for wetland conservation in Harare.
- By implementing these recommendations, it is possible to mitigate wetland degradation, protect biodiversity, restore ecosystem services, and ensure the sustainable management of wetlands in Harare. These efforts will contribute to the

preservation of valuable natural resources and support the long-term environmental sustainability of the region.

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