WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Role of Public Private Partnerships in Sustainable Water Quality and Food Security along the Lake Region, Western Kenya

Andolo Dan Ojijo

Research Scholar,Department of Management Science, Maseno University,Kenya

A B S T R A C T

Public-private partnerships (PPPs) have become increasingly important in ensuring sustainable water supply and sanitation across the world. It is a collaboration between a government entity and private sector organizations, where each party brings its respective strengths, resources, and capabilities to a common goal or project. In Western Kenya, the importance of sustainable water supply and sanitation and food security cannot be overstated. Access to clean water and safe sanitation is a basic human right and a prerequisite for a healthy, productive life. However, over the years, the lake has been plagued by various environmental problems, including pollution, overfishing, and the spread of invasive species. These problems have led to a decline in water quality, the depletion of fish stocks, and increased food insecurity in the region. The study proposed PPPs as an avenue to sustainable water quality and food security. The research was anchored on triple bottom line theory, the theory of shared value creation and the theory of circular economy. To conduct the survey, a correlational research design was employed. The results showed that PPPs adoption positively and significantly contribute to sustainable water quality and food security in the lake region. It is recommended that effluent mitigation policies and regulations should establish the need for industrial wastewaters to be treated before discharge into the lake.

Keywords: Public private partnerships, water quality, food security

1. INTRODUCTION

Lake Victoria is one of the largest lakes in the world, home to millions of people, and an essential resource for the East African countries of Kenya, Uganda, and Tanzania. However, the lake is plagued by pollution, overfishing, and other environmental challenges that threaten the health and livelihoods of those who depend on it. In Kenya, public-private partnerships have emerged to address these challenges, turning what was once a nuisance into a resource for the local communities. These partnerships have brought together government, private companies, and communities to improve water quality, replenish fish stocks, and increase food security.

The utilization of public-private partnership (PPP) involves a procurement approach wherein the public and private sectors have more extensive contractual relationships with each other to provide a service or asset (Tang *et al.*, 2013). It is a model for procuring public goods and services that spans various sectors such as energy, environment, health, education, transportation, and water treatment (Widdus, 2017). The Lake Victoria Water and Sanitation Program is a public-private partnership aimed at improving water quality and sanitation in the areas surrounding Lake Victoria in Kenya. The program was established in response to the growing concern over the decline of water quality in the lake, which has been caused by pollution from various sources, including agricultural run-off, industrial discharge, and untreated sewage.

One of the significant benefits of PPPs is that they can provide access to funding sources that individual stakeholders may not be able to access. Often, the private sector is better positioned to leverage finances, while the government may have access to grant funding or tax incentives. For example, the private sector can provide innovative technology and expertise, while the government can provide incentives, such as tax credits or grants, to encourage the adoption of sustainable practices. Capitalizing on these resources can help to fund innovative projects and provide the necessary resources to achieve sustainable resource use.

The program is being implemented by a consortium of partners, including the private sector, government agencies, and non-governmental organizations. The main objective of the program is to improve the quality of the lake's water by promoting sustainable practices that reduce pollution and protect the lake's ecosystem. In addition to improving water quality, the program is also focused on increasing food security in the region by promoting sustainable farming practices that are less reliant on chemical fertilizers and pesticides. This is being achieved through the establishment of farmer field schools, which provide training and support to farmers on sustainable agriculture techniques.

Typically, in PPP, the private sector contributes funds upfront for government projects and services, with taxpayers and/or end users receiving benefits throughout the duration of the PPP contract. Entering into a partnership may be motivated by the desire to acquire extra resources for a particular area, project, or organization, create synergy through collaboration and resource sharing, or transform one or more of the partner organizations, possibly by enabling them to operate more entrepreneurially through the introduction of novel and more efficient practices (Hastings, 1996). In the case of Lake

Victoria, PPPs offer a unique opportunity for collaboration and shared responsibility for environmental management and have been instrumental in promoting sustainable fishing practices, reducing water pollution, and improving food security through the cultivation of fish farming.

Public-private partnerships (PPPs) have played a crucial role in addressing environmental challenges in many parts of the world. These partnerships bring together the strengths and resources of both the public and private sectors to tackle complex environmental issues that are difficult for either sector to address alone. According to Cruz, Marques, Marra, and Pozzi (2014), PPPs have become a primary means of supplying public services, despite increasing outsourcing to the private sector. Countries worldwide are adopting PPPs due to their potential to deliver better public facilities and services, achieve value for money, high-quality outcomes, and shorter project completion times.

Carrillo, Robinson, Anumba, and Bouchlaghem (2006) have also established that PPPs can provide more effective public facilities and services than traditional contracting. This concept is now considered a vital long-term investment opportunity for institutional investors, such as pension funds. Despite its ability to finish projects on time, within budget, and to the required quality standard, its outcomes are still the subject of intense debate, according to (Vecchi and Cusumano, 2018).

According to Batley (1996), PPPs often stem from the initiative of a service provider, purchaser, or regulator. Private sector involvement can vary based on government control and private economic scale, ranging from service provision to complete facility ownership (Savitch, 1998). Studies have recognized five types of private involvement: service contracts, leasing, joint ventures, concessions, and privatization. Service contracts are the simplest form of partnership, as stated by Ni (2012) and Keranen (2017). In a service contract, a public authority hires a private entity to perform specific duties or services for a set period, usually 1-3 years, for a predetermined fee paid by the government. The fee may be determined by a one-time payment, unit cost, or other criteria.

The use of public facilities by the private sector and payment of rental fees for provision of services refers to a lease arrangement. Sindane (2000) notes that in lease arrangement, the service provider bears the costs of operating, repairing and maintaining the assets, and may also collect tariffs from service consumers, thereby risking uncertainty in collection. However, the service provider need not make new capital investments or replace the leased assets. Typically, lease agreements last between eight and fifteen years.

Joint ventures involve both the government and private companies taking co-responsibility and co-ownership when delivering services. This type of PPP is a true public-private partnership, allowing different parties such as governments, businesses, and non-government organizations to combine their resources and share the benefits (Reynaud, 2015; Dahiya & Gentry, 2020). The partners can collaborate by forming a new company or jointly owning an existing one that provides services. An example of how joint ventures work is when the public sector sells a portion of shares in an existing company to the private sector. Joint ventures are often utilized in conjunction with other types of PPPs (Trafford & Proctor, 2006).

Joint ventures also involve the government acting as a regulator and active shareholder in the operating company, allowing them to share in the company's profits and ensure the project is politically acceptable. Meanwhile, the private sector partner takes on the daily management responsibilities. Both sectors collaborate from the beginning, often forming a project development entity to facilitate direct dialogue. This collaboration can take the form of a working group. (Caker & Siverbo, 2011).

According to Xiong and Zhang (2014), the concession is a crucial public-private partnership arrangement that results in providing the best value service in the public sector. Under this arrangement, the service provider finances, designs, and builds a new service facility or significantly improves an existing one. Furthermore, the service provider retains ownership of the completed facility and is responsible for its operation, maintenance, and repair for a contract of about 20-30 years. The government grants concessions to recover the cost of collecting user charges and tariffs as stated by Rangel and Galende (2010) and Tsimoshynska *et al.* (2021)

Privatization refers to the process of selling a government-owned asset to a private organization that will take over its operational responsibilities. This can be done through various methods such as auctions, public stock offerings, private negotiations, or outright grants. Privatization is also known as asset sales and involves the complete transfer of ownership to the private sector without any time limits (World Bank, 2008; Solheim-Kile, Ladre, & Lohne, 2019).

1.1 Pollution of The Lake Victoria By water hyacinth

Water hyacinth is a free-floating plant that grows rapidly in still or slow-moving waterways. It grows and multiplies at an alarming rate and can quickly cover water surfaces, blocking sunlight and oxygen from reaching other aquatic plants and animals below. This can lead to the death of fish and other aquatic organisms, as well as the release of methane gas, a potent greenhouse gas that contributes significantly to climate change.

In Western Kenya, Lake Victoria has been overrun by water hyacinth, affecting the livelihoods of millions of people who depend on the lake for fishing and transportation. The plant has also impacted agriculture in the region, with farmers struggling to irrigate their crops due to the choked waterways. The effects of water hyacinth on the environment and agriculture have been devastating, leading to food insecurity and poverty in the region.

Public-private partnerships have a significant role to play in mitigating the water hyacinth problem in Lake Victoria. For instance, the government, the private sector, and civil society groups in Kenya have come together to combat the plant. They have initiated a project called Lake Victoria Environmental Management Project (LVEMP) to help manage the invasive plant species. LVEMP II is a regional project with the goal of diversifying the economy of the Lake Victoria Basin while improving the quality of its natural resources. It is a five-year project that is being implemented in partnership with the government, the private sector, and non-governmental organizations.

The LVEMP project involves the use of technical expertise, innovation, and collaboration platforms to transform the water hyacinth into an economic resource. It involves the use of harvested hyacinth as a source of organic fertilizer and biogas, which can be used for cooking, lighting, and other forms of energy production. Moreover, water hyacinth has been used to create handicrafts and other products that can be sold for income. This has helped to create employment opportunities and has contributed to the economic development of the region.

The project has also helped in the discovery that water hyacinth can be harvested and processed into a variety of nutritious foods such as flour, porridge, and snacks. The plant can also be used as animal feed for poultry, pigs, and rabbits.

Furthermore, the presence of water hyacinth in water bodies has been shown to improve water quality by absorbing heavy metals and other pollutants. This makes it an even more attractive source of food and animal feed, as the produce will be free from contaminants. Despite the plant being considered a problematic weed in many parts of the world. The plant, which is native to South America, has spread across the globe and has been known to cause significant economic and environmental damage. However, in Western Kenya, Through LVEMP, water hyacinth is being turned into a solution rather than a problem.

1.2 Role of Public Private Partnerships in Pollution Mitigation in the Lake Region of Kenya

Public-private partnerships (PPPs) are collaborative arrangements between the public and private sectors that can be used to channel resources toward the goals of protecting and enhancing environmental resources. In the case of Lake Victoria, PPPs encompass a range of initiatives, including sustainable fishing programs, water quality improvement projects, and the development of new agricultural practices that promote both food security and environmental protection.

Over the years, the water quality has deteriorated, mainly due to human activities such as pollution, deforestation, and poor waste management. As a result, food security in the lake region has also been affected. To address these challenges, various public-private partnerships have been established, aimed at improving water quality and raising food security in the lake region. One public-private partnership model used in the Lake Victoria region is the Private Sector Partnership for Sustainable Fisheries (PSPSF). The PSPSF is a collaborative effort between the private sector, civil society, and government aimed at improving the commercial and artisanal fishing sectors in the lake region. The PSPSF provides technical assistance to fishermen and fish processors, promotes sustainable fishing practices, and helps to improve the value chain in the fish industry. The partnership has not only improved the livelihoods of fishermen and processors but has also contributed to the recovery of fish stocks in the lake.

Another public-private partnership model used in the Lake Victoria region is the Water Fund partnership. The Water Fund partnership is a collaboration between multiple stakeholders, including government agencies, private sector organizations, and non-governmental organizations, aimed at improving water quality in the lake. The partnership provides financing for projects such as reforestation, soil conservation, and wetland restoration. The projects are designed to reduce soil erosion and nutrient runoff, which contribute to the eutrophication of the lake. The Water Fund partnership has been successful in reducing the amount of sediment and nutrients entering the lake, thus improving water quality.

Additionally, public-private partnerships have been established to support sustainable agriculture in the Lake Victoria region. For example, the Sustainable Agriculture Tanzania (SAT) program is a partnership between the private sector, civil society, and farmers aimed at promoting sustainable farming practices. The program provides training on organic farming techniques, soil conservation, and water management. The partnership has helped to increase the productivity of smallholder farmers, thus improving food security in the region.

Moreover, public-private partnerships have been established to support the growth of aquaculture in the lake region. The Fish for Food program, for example, is a partnership between the private sector, civil society, and government aimed at promoting sustainable aquaculture in the region. The program provides technical assistance to fish farmers, promotes the use of sustainable feeds and production practices, and helps to develop value chains in the aquaculture industry. The partnership has helped to increase the supply of fish in the region, thus improving food security.

Another example of these initiatives is the Lake Victoria Fisheries Organization (LVFO), which operates under the East African Development Bank (EADB) and has been working to promote sustainable aquaculture practices in the region. The LVFO has partnered with private companies to establish a number of fish processing plants and cold storage facilities, which have helped to improve the quality of fish and seafood in the local market while also reducing pressure on wild fish stocks.

Other PPPs in the region have focused on improving water quality by reducing the amount of pollution and sediment flowing into the lake. This has involved the implementation of erosion control and stormwater management programs, as well as the construction of wetlands and other natural buffers to reduce the impact of agricultural runoff. In terms of food security, several PPPs have targeted the development of new agricultural practices that rely on eco-friendly techniques, such as agroforestry and sustainable land management. These approaches aim to improve the fertility of the soil while also reducing the use of harmful chemicals and pesticides, which can contribute to water pollution.

PPPs have also been instrumental in promoting the use of renewable energy sources, such as solar power, to support the provision of clean water and power to the local communities. This has not only helped to reduce the region's reliance on fossil fuels but has also improved the resilience of the local economy by promoting the development of new businesses and employment opportunities.

International organizations such as the United Nations, World Bank, and World Health Organization have also partnered with local communities to implement various programs aimed at improving the lake's water quality and food security. These programs have been tailored to meet the specific needs of the local communities and involve them in decision-making processes.

One of the most successful initiatives is the establishment of community-led water resource management committees. These committees are responsible for monitoring the lake's water quality, regulating fishing activities, and promoting sustainable farming practices. They work closely with international organizations to receive training and technical support, which has helped them to implement effective and sustainable solutions.

Another initiative is the promotion of ecotourism, which has provided an alternative source of income for the local communities. This has reduced their dependence on the lake's resources and reduced the pressure on the lake's ecosystem. Overall, the partnership between international organizations and local communities has been critical in improving the water quality and food security of Lake Victoria. The success of these initiatives demonstrates the importance of involving local communities in decision-making processes and tailoring solutions to meet their specific needs.

1.3 Statement of the Problem

Lake Victoria, located in East Africa and shared by Kenya, Uganda, and Tanzania, is the second-largest freshwater lake in the world and a critical resource for the region, providing a source of drinking water, irrigation for agriculture, and a vital source of food for millions of people. In recent years, Lake Victoria has been experiencing serious degradation due to overfishing, pollution, spread of other invasive species and other environmental problems, which have had a severe impact on the food security and livelihoods of the surrounding communities. These problems have led to a decline in water quality, the depletion of fish stocks, and increased food insecurity in the region. Public-private practices have been identified as one of the most efficient ways to enhance the restoration of the lake while improving food security in the region.

The situation is particularly dire in Kenya, where the lake is a critical resource for the country's fishing industry and the livelihoods of millions of people. The pollution of the lake has led to the growth of water hyacinths, which have reduced the amount of oxygen in the water, leading to the death of fish and other aquatic life. This has not only led to a decline in the fish stocks but also increased the cost of fishing, making it harder for fishermen to make a living. There is therefore need to address these challenges, and the Kenyan government has been working with private sector partners to develop innovative solutions to improve the lake's water quality and food security. Public-private partnerships have become a key strategy in the efforts to turn a nuisance into a resource.

2. LITERATURE REVIEW

2.1 Theories of the study

The study was anchored on triple Bottom line, shared value creation and the circular economy theories.

2.1.1 Tripple Bottom Line Theory

One of the most significant theories linking PPPs to sustainable resource use is the “triple bottom line” approach as proposed by Elkington, (1998). The triple bottom line theory is a social, environmental and economic framework that has gained considerable support as a measure of sustainability in Public Private Partnerships (PPP). The theory encompasses an expanding form of corporate social responsibility, which involves the incorporation of wider stakeholder concerns as key elements in the decision-making process of any public-private initiative.

The triple bottom line theory suggests that financial success is not the only measure of success in any partnership, social and environmental outcomes should also be considered. It also considers not only the economic, but also the social and environmental benefits of projects, creating a win-win situation for all parties involved. According to this theory, PPPs that prioritize social equality, environmental protection, and economic growth can deliver significant long-term results. Partnerships involving private companies, local communities, and government entities all contribute to sustainable resource utilization.

The three pillars of the triple bottom line theory represent three important dimensions for measuring sustainable development. The first pillar, economic, refers to the financial bottom line of a PPP. It includes the measurement of the financial performance of the partnership, such as revenue, investments, and profits. It also considers the impact of the partnership on the local economy and the wider economic benefits generated through the partnership.

The second pillar of the triple bottom line theory is social. This involves measuring the social impact of a PPP. Inclusive social development, human rights, labor, and governance practices are significant contributors to the social pillar. PPPs which consider the social impact, work to create opportunities for disadvantaged groups, and promote sustainable livelihoods are often considered by the public as more trustworthy.

The third pillar, environmental, refers to the impact of a PPP on the natural environment. Environmental sustainability includes measures such as reducing greenhouse gas emissions, conserving water resources, promoting renewable energy use, and reducing waste. PPPs which prioritize environmental sustainability contribute to a cleaner environment, reduced carbon footprint, and better ecological integrity, which is beneficial for communities and the economy.

In summary, incorporating the three-fold principles in Public Private Partnerships projects can act as a critical tool for sustainable resource use. The triple bottom line theory promotes the consideration and integration of social, environmental, and economic factors to ensure greater sustainability. It encourages PPP partners to engage in initiatives that generate long-lasting benefits for the entire community. It offers a more holistic approach for measuring

development. This framework is vital in measuring and encouraging sustainable economic development, social inclusion, and environmental protection. It has a powerful appeal because it offers a clear and measurable way to balance economic, social, and environmental goals in PPPs.

Triple bottom line theory therefore provides a universal way to include sustainability principles in PPPs. Its potential is enormous because it can directly contribute to the well-being of people and mitigate environmental externalities while also delivering adequate economic benefits. It is not a substitute for standards and regulations, but it represents an assured way to leverage their effectiveness better.

It can therefore be summed up that the triple bottom line theory is an effective way to measure and ensure sustainable development in public-private partnerships. With the threefold measures in place, the economic, social and environmental impacts of PPPs can be measured, monitored, and optimized. Furthermore, this approach can improve the reputation of PPPs and contribute to the long-term well-being of the people and the planet.

2.1.2 The Theory of Shared value Creation

This approach, that was postulated by Porter & Kramer, (2011) emphasizes the importance of "mutual benefit" in PPPs. This theory holds that a partnership only becomes sustainable when both public and private parties benefit from it. For instance, a private company may invest in energy-efficient technologies to reduce its energy consumption while making a profit, and the government can meet its renewable energy goals and reduce its carbon footprint. By working to achieve mutually beneficial outcomes, PPPs can help to achieve sustainability targets more efficiently and effectively.

This idea proposes that organizations need to look beyond profit maximization and instead focus on creating value that is beneficial for both themselves and society as a whole. In this way, shared value creation theory aligns with the belief that organizations have a responsibility to ensure that their actions contribute to the greater good. It emphasizes that PPPs must prioritize mutual benefit, meaning that both parties must gain something from the partnership in order for it to be sustainable and successful.

In the context of PPPs, shared value can be created in several ways. First, organizations can use their resources and expertise to deliver public services more efficiently and effectively. This can involve creating innovative technologies, improving service delivery processes, or reducing costs associated with program implementation. By doing so, businesses can improve the quality of public services while also generating revenue and improving their reputation.

Second, firms and government can create shared value by investing in the communities in which they operate. This can involve improving local infrastructure, providing job training and employment opportunities, or supporting local businesses. By doing so, businesses can help to create a more prosperous and sustainable local economy, while also building positive relationships with stakeholders.

Finally, government and private sector can create shared value by developing products and services that address societal challenges. For example, a healthcare company could develop a new treatment or therapy that improves patient outcomes while also generating profits. By aligning their business objectives with societal needs, businesses can create a positive impact while also improving their bottom line.

One of the key benefits of shared value creation in PPPs is that it allows for greater collaboration between the public and private sectors. By aligning their objectives, both parties can work together to achieve common goals and create sustainable solutions. This approach can also lead to improved accountability and transparency in the delivery of public services, which can help to build trust and confidence among stakeholders.

However, it is also important to recognize that shared value creation in PPPs is not without challenges. One major obstacle is the potential for conflicts of interest between public sector entities and private businesses. For example, a business may prioritize profit over public service delivery, which can lead to subpar outcomes for society. Similarly, public sector entities may prioritize political objectives over societal needs, which can undermine the success of PPPs.

To overcome these challenges, it is essential that PPPs prioritize transparency, accountability, and collaboration from the outset. This can involve developing clear goals and objectives, establishing performance metrics, and creating mechanisms for stakeholder engagement and feedback. It is also important to ensure that PPPs are designed in a way that promotes mutual benefit and shared value creation, rather than prioritizing the interests of one party over the other.

2.1.3 Theory of Circular Economy

This theory aims to reduce waste and minimize the use of new resources by promoting the reuse, refurbishment, and recycling of existing materials. PPPs can achieve this by creating innovative projects, such as waste-to-energy schemes, or establishing policies to reduce wasteful consumption. This economic theory is based on three main principles: the circular flow of materials, the regeneration of natural systems, and the design for a circular economy.

The circular flow of materials refers to the idea that products and materials should be designed and produced in a way that allows them to flow easily and efficiently through the economic system. The guiding principle is that products should be designed with durability, repairability, and recyclability in mind, so that they can be used for as long as possible before being recycled or repurposed.

The regeneration of natural systems is another key principle of circular economy. This principle emphasizes the importance of protecting and maintaining natural resources such as water, air, and soil, as well as biodiversity and ecosystems. Circular economy aims to reduce the use of virgin resources, such as raw materials, by promoting the use of renewable resources, such as wind and solar power.

The design for a circular economy is the third principle of this economic model. This principle focuses on the importance of designing products and systems that are circular by design, meaning that they are designed to be easily disassembled and reused or recycled. This includes the use of modular and repairable components, as well as the incorporation of sustainable materials and production methods.

Circular economy is not just an economic theory, it is also a practical solution to the environmental challenges we face today. By promoting the reuse, repair, and recycling of products and materials, circular economy aims to reduce waste and minimize the use of new resources, while also promoting the regeneration of natural systems and the design of products and systems that are circular by design.

One example of circular economy in action is the concept of closed-loop recycling. Closed-loop recycling refers to the process of using recycled materials to produce new products, which can then be recycled again at the end of their lifecycle. This creates a closed loop of materials that can be reused indefinitely, without the need for new resources. Another example of circular economy in action is the use of renewable energy sources such as wind and solar power. By using renewable energy sources, we can reduce our reliance on fossil fuels, which are finite resources that have a negative impact on the environment.

Circular economy theory is focused on creating economic systems that are regenerative and restorative by design. It promotes the reduction, reuse, and recycling of resources, as well as the promotion of renewable energy sources. This theory can be applied to water resource management through public-private partnerships that encourage sustainable use and management of water resources.

One example of this is the "One Water" approach, which is being adopted by many cities around the world. This approach seeks to manage all of a city's water resources as a single, integrated system that promotes the principles of circular economy theory. By taking a holistic approach to water resource management, the One Water approach seeks to reduce water consumption, promote conservation, and reuse water in ways that are sustainable and beneficial to the environment.

Public-private partnerships can play a crucial role in promoting the adoption of the One Water approach by facilitating collaboration between government agencies and private sector organizations. For example, a public-private partnership can be established to:

- Promote the development of water-efficient technologies and practices that reduce water waste and promote the reuse of water resources.

- Invest in infrastructure projects that promote more efficient water use, such as the development of "smart" water systems that can monitor water usage in real-time.

- Educate residents and businesses about the importance of sustainable water resource management and promote behavior change to reduce water consumption.

By pooling resources and expertise, public-private partnerships can drive innovation, increase efficiency, and promote the adoption of sustainable water resource management practices.

Furthermore, by adopting circular economy principles in water resource management, public-private partnerships can promote economic growth and job creation. For example, investing in infrastructure projects that promote more efficient water use can create jobs in the construction industry, while promoting the development of water-efficient technologies can create new opportunities in the technology sector.

2.2 Empirical Literature review

Numerous studies have been done around the world linking public private partnerships to sustainable water quality management and food security.

Smyth, Webb & Phillips (2021) conducted research to examine the context, rationale, and various types of Public Private Partnerships (PPPs) used in the global agri-food system and their impacts. The study found that while PPPs are not a complete solution to food insecurity, they should not be disregarded entirely. Instead, there should be an increase in the use of both strategic and tactical partnerships to enhance global food security.

Nduhura *et al*., (2022) conducted a research study to examine the impact of partial intermediary coordination on sweet potato productivity in Tanzania. The study utilized a cross-sectional research design and surveyed 100 small-scale farmers in Kilosa and Gairo Districts using purposive and simple random sampling techniques. The authors identified three key value chain actors – primary, secondary, and tertiary and analyzed their roles and linkages. The majority of surveyed farmers identified lack of improved cultivars, restricted access to cash, and small parcels cultivated as the primary factors limiting crop productivity in the research area. The study emphasized the importance of coordination between the horizontal and vertical chain for productivity and efficiency, and noted weak institutional frameworks among key value chain participants.

Bragdon & Hayes (2017) conducted a study to explore the efficacy of public-private partnerships (PPPs) as a policy tool to enhance food security in Africa. After analyzing literature through systematic review and bibliometric analysis, the study found that while PPPs have shown positive results in other sectors, there is a lack of knowledge on their application and potential for success in the agricultural sector. This is significant as the production of agriculture on a large scale requires resources that the public sector cannot singlehandedly provide.

Venkatesan, (2016) explored the Global Agriculture and Food Security Program (GAFSP) initiative, specific to its objective “to improve incomes and food and nutrition security in low-income countries by boosting agricultural productivity”. This article summarized the findings of an evaluation of the Global Agriculture and Food Security Program (GAFSP), highlighting its successful achievements in addressing food insecurity and rural poverty in

developing countries. However, the evaluation also emphasized the need for the program to better address the needs of smallholder farmers and women, as well as to strengthen the private sector's involvement in agricultural development.

Mjonono, (2016) explored the use of public-private partnerships (PPPs) in sustainable urban wastewater management in Dar es Salaam, Tanzania. The author examined the challenges and opportunities of PPPs and argues that they can enhance the efficiency and effectiveness of wastewater management. The case study of Dar es Salaam showed that PPPs can improve the infrastructure, management practices, and quality of service of urban wastewater systems.

Mrema & Mjonono, (2018), discussed the opportunities and challenges of PPPs in urban wastewater management in Tanzania. The authors examined the policy and legal frameworks for PPPs and argued that they are essential for promoting sustainable and equitable wastewater management. The study suggested that PPPs can improve the financial viability, technological innovation, and social accountability of urban wastewater systems.

Mjonono, (2017), investigated the use of PPPs in rural water supply and sanitation in Tanzania. The author analyzed the challenges and opportunities of PPPs and identified the key success factors that can enhance their performance. The case study of Tanzania showed that PPPs can improve the sustainability, affordability, and inclusiveness of rural water and sanitation services.

Mushi & Mjonono,(2019) examined the different models of PPPs in wastewater management in developing countries, using Tanzania as a case study. The authors compared the performance and outcomes of different types of PPPs, including concessional contracts, service contracts, and joint ventures. The study suggested that the choice of PPP model depends on the specific context and objectives of the wastewater management project.

Luhigo & Mjonono, (2020) investigatee the factors that influence PPPs in urban water supply in Tanzania, using Dar es Salaam Water and Sewerage Corporation as a case study. The authors examined the political, institutional, economic, and social factors that affect the implementation and sustainability of PPPs. The study suggested that effective PPPs require a supportive policy environment, strong governance mechanisms, adequate financial resources, and stakeholder participation.

Chomba, Nkurunziza, & Mwaura, (2016), did an article that analyzed the public-private partnership model for environmental protection in the Lake Victoria region, while examining its challenges, and opportunities. The article lists some of the challenges such as inadequate legislative frameworks, lack of trust towards private sector involvement, and insufficient coordination. However, the partnership model was observed to be successful in promoting sustainable development in the region.

Obosi (2017) conducted a study to examine the impact of Public-Private Partnership on water service delivery in Kenya. The study included a household survey of 288 respondents from seven Water Service Providers (WSPs), consisting of four Water Utility companies and three Community Water projects, administered under the Lake Victoria South Water Services Board (LVSWSB) umbrella. Utilizing quantitative methods and governance theory, the research concluded that households received improved services in the year 2012 compared to the period up to 2004, particularly in terms of water quality, affordability, access, and customer service levels. Public institutions that adopted more private sector participation were found to perform better than those that did not. Over the course of a decade, the distance to water points decreased by 78.3 m on average, the frequency of colored water decreased by 0.2 days, and the time taken to restore water decreased by three days.

Shoniwa (2022) conducted a study on the utilization of Public-Private-Community Partnerships (PPCPs) to improve food security during the COVID-19 pandemic in Zimbabwe. The research involved the use of concurrent mixed research methods, including purposive and snowball sampling techniques. The quantitative data was analyzed using descriptive statistics, while qualitative data was analyzed thematically. The results revealed that food insecurity was a persistent challenge in Zimbabwe, which was exacerbated by the pandemic's effect on food systems and limited access. It was suggested that PPCPs were a viable alternative as they facilitated collaboration in the value chain, improved access to inputs, reduced information asymmetry, ensured trust, and facilitated risk-sharing.

2.3 Summary of Literature and Gaps

The reviewed studies regarding the link between PPPs, water quality and sustainable food security yielded inconclusive results. Smyth et al., (2021) established that PPPs cannot entirely solve food insecurity, while Bragdon & Hayes (2017) revealed a deficiency of knowledge on the utilization and success rate of PPPs in the agricultural sector. Mjonono (2016) studied how PPPs can upgrade the infrastructure, management practices, and quality of service of urban wastewater systems, but could not draw a connection to food security. Chomba *et al*.,(2016) investigated the difficulties and opportunities of PPPs and Shoniwa (2022) tackled how Public-Private-Community Partnerships could better food security in Zimbabwe in the wake of the COVID-19 pandemic, by emphasizing collaboration in the value chain. It is apparent that scholars have not previously attempted to connect public private partnerships to water quality management and food security. This paper thus aims to fill this gap.

3. METHODOLOGY

3.1 Research Design

The study used a correlational research design. As a statistical technique, correlational research design measures the strength and direction of the relationship between two or more variables. According to Walter, (2013), when conducting research that seeks to establish a relationship between two or

more variables and to predict the extent to which they may be related, correlational research design may be the most appropriate choice. This design is useful in determining the extent of relatedness and statistical dependence between variables.

This research design is often applied in social sciences, psychology, and market research. It provides a detailed and systematic description of the characteristics of the sample population, which can be used to draw conclusions about the larger population.

3.2 Study Area and Target Population

The study covered five Western Kenya counties that are bordering the lake which included Kisumu, Homa-bay, Migori, Siaya and Busi counties. The respondents for the study were taken by use of purposive sampling technique in the department of water, environment and natural resources from the five counties totaling to 186.

Purposive sampling is a non-random technique that is widely used to select participants who possess specific characteristics of interest. This approach allows researchers to identify and collect data from individuals or groups who are most likely to provide insightful information on a particular topic. In the case of heterogeneous population, purposive sampling can be an appropriate method to ensure that the sample represents the diversity of the population.

According to Bryman, (2012), purposive sampling provides more control over the selection process by enabling the researcher to identify and recruit participants who have characteristics relevant to the research question. This approach can be especially useful when conducting research in populations that are difficult to access, such as those who are homeless, incarcerated, or have a stigmatized condition. Purposive sampling enables the researcher to identify and recruit participants based on specific criteria, and this can improve the validity and reliability of the results.

3.3 Reliability of Research Instrument

Testing reliability of research instrument is crucial in ensuring that the data collected is valid and accurate. It is essential to ensure that the research instrument used is reliable in order to minimize errors, bias, and inconsistency in the data collected. In this article, we will discuss the importance of testing reliability of research instruments and the different methods available for doing so (Koo & Li,2016)

Reliability is the extent to which a research instrument produces consistent and accurate results over time. The study used internal consistency to test reliability. This involves checking how accurately different items in a test are measuring the same concept. Internal consistency can be measured using different techniques such as the Cronbach's alpha, which computes how well a set of items in a test are related to one another. The closer the Cronbach's alpha value is to 1.0, the higher the internal consistency. Results showed that research instrument met the threshold of internal consistency.

3.4 Regression Diagnostics using Collinearity statistics

The appropriateness of the independent variables to be used in the regression analysis was determined using tolerance and variance inflation factor (VIF). Tolerance and VIF are two commonly used measures to evaluate the impact of collinearity on regression models. Tolerance is a measure of how much of the variance of a predictor variable is not explained by the other predictor variables included in the model. A high tolerance value (close to 1) indicates that the predictor variable is not highly correlated with other predictor variables and can be safely included in the regression model.

On the other hand, VIF (Variance Inflation Factor) measures the extent to which the variance of a predictor variable is inflated due to multicollinearity. A high VIF value (greater than 10) indicates that the predictor variable is highly correlated with the other predictor variables and may need to be removed from the model. In regression analysis, tolerance and VIF values are calculated for each predictor variable included in the model. Generally, a tolerance value below 0.2 or a VIF value greater than 5 is considered problematic for regression models.

When the tolerance value for a predictor variable is low, it indicates that a large percentage of its variance is explained by the other predictor variables. This means that the variable may not be contributing much unique information to the model and could be removed. Conversely, when the VIF value is high, it indicates that the variance of the variable is being inflated by the other predictor variables, which can result in inaccurate estimates of regression coefficients.

Collinearity statistics of independent variables against two dependent variables i.e., food security and water quality are shown in the tables below:

Table1: Collinearity Statistics

Model Public Private Partnerships		Collinearity Statistics	
		Tolerance	VIF
1	-Private Sector Partnership for Sustainable Fisheries	.834	1.199
	-Water Fund Partnership	.921	1.086
	-Sustainable Agriculture Tanzania	.900	1.111
	-Lake Victoria Fisheries organization	.812	1.232

	-Community-led Water Resource Committee	.929	1.076
a. Dependent Variable: Food Security, Water quality			

Source: Survey data, (2023)

The results showed that VIF and tolerance were within the required limit, therefore the predictor variables were all retained for the analysis.

4. RESULTS AND DISCUSSION

The study aimed to examine how public-private partnerships impact water quality in Lake Victoria region and enhance food security. The hypothesis was that these partnerships do not have a significant role in enhancing water quality, nor do they positively contribute to food security in the Western region and, by extension, Kenya as a whole.

The study treated PPPs as the independent variable and measured the following variables:

- Private Sector Partnership for sustainable Fisheries (PSPSF)
- Water fund partnership (WFP)
- Sustainable Agriculture Tanzania (SAT)
- Lake Victoria Fisheries Organization (LVFO)
- Community-led Water Resource Committees (CWRC)

On the other hand, water quality and food security were considered as dependent variables. Safe water for human consumption and aquatic life served as the units of measurement for water quality. The average score for food security and water quality improvement was taken and regressed against the identified public private partnerships in the lake region. The results are shown in the table below:

Table 2: Effect of PPP on Water quality and food security along the lake region

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.634	.104		17.298	.000
	Private Sector Partnership for Sustainable Fisheries (PSPSF)	.456	.114	.223	.225	.000
	Water Fund Partnership (WFP)	.215	.108	.221	.770	.000
	Sustainable Agriculture Tanzania (SAT)	.099	.110	.197	.904	.000
	Lake Victoria Fisheries organization (LVFO)	.311	.115	.180	.314	.000
	Community-led Water Resource Committee (CWRC)	.367	.118	.121	.594	.000
	R	.485				
	R square	.342				
	Adjusted R square	.334				
a. Dependent Variable: Water Quality, Food Security						

Source: Survey Data, (2023)

The results show that private sector partnership for sustainable fisheries, Water fund partnership, Sustainable Agriculture Tanzania, Lake Victoria fisheries organizations, and community led water resource committee had beta standardized coefficients and p values of $\beta = 0.456$, $p < .05$; $\beta = 0.215$, $p < .05$ and $\beta = 0.099$, $p < .05$,0.311 and 0.367 respectively. These means all the beta coefficients, β, which are the degrees to which the independent variables each explain the dependent variable, are positive and significant.

According to the standardized β coefficient, an increase of one standard deviation in PSPSF leads to a water quality improvement and food security increase of 0.223 standard deviations. Meanwhile, an increase of one standard deviation in WFP, SAT, LVFO, and CWRC leads to a food security and water quality improvement increase of 0.221, 0.197, 0.180, and 0.121 standard deviations, respectively. When considering un-standardized coefficients, a one percent change in PSPSF results in a 0.1114 percent change in water quality and food security in the same direction. Similarly, a one percent change

in water fund partnership results in a 0.108 percent change in water quality and food security in the same direction. Lastly, a one percent change in SAT, LVFO, and CWRC leads to a 0.110, 0.115, and 0.118 percent change in water quality and food security in Kenya, respectively, all in the same direction.

The R^2 value of 0.342 and the adjusted R^2 value of 0.334 are both significant. The shrinkage is 0.008, which is lower than the 0.5 level recommended by Field (2005). This indicates that the model is valid and stable for prediction, and it can predict 32.2% of the variance in water quality and food security. Overall, public-private partnerships in the Lake Victoria region can account for 34.2% of the improvement in water quality and food security in Kenya.

The study recognize earlier attempts whose findings concur. The findings of Smyth, Webb & Phillips (2021) align with these results, suggesting that PPPs alone may not fully address food insecurity but should still be considered beneficial for improving food security. Similar conclusions were drawn by Mjonono (2016), Mrema & Mjonono (2018), and Mjonono (2017), who found that the public-private partnership model can enhance the financial viability, technological innovation, and social accountability of urban wastewater systems, although its effectiveness may vary in different contexts. Furthermore, Obosi's (2017) study indicated that PPPs can contribute to better water quality.

Contrarily, Shoniwa's (2022) investigation into the use of Public-Private-Community Partnerships (PPCPs) to address food insecurity during the COVID-19 pandemic in Zimbabwe revealed that the issue of food insecurity continued to persist in the country. He proposed that PPCPs presented a viable solution since they promoted collaboration within the value chain and improved access to inputs. However, Shoniwa did not emphasize the role of PPCPs in improving food security. In contrast, Bragdon and Hayes (2017) studied the effectiveness of PPPs in promoting food security in Africa and found that although PPPs had yielded positive outcomes in other fields, they had not been successful in enhancing food security.

5. CONCLUSIONS

The study concludes the following Key points on the role of public private partnerships in sustainable water resource management and food insecurity mitigation in Kenya and applicable elsewhere in the world:

PPPs offer a unique opportunity for collaboration and shared responsibility for environmental management. In the case of Lake Victoria, PPPs have been instrumental in promoting sustainable fishing practices, reducing water pollution, and improving food security through the cultivation of fish farming.

By harnessing the strengths of both sectors, PPPs have been able to leverage resources, funding, and expertise to create innovative solutions to environmental problems. For example, the private sector can bring in technology and innovation, while the public sector can provide regulatory and policy framework to ensure sustainability.

PPPs also offer a platform for dialogue and engagement between the public and private sectors, which helps to improve communication, build trust, and foster long-term relationships. By working together, PPPs can create a more sustainable and prosperous future for communities around Lake Victoria and beyond.

The partnership between the public and private sectors to improve Lake Victoria's water quality has not only benefited the lake and its ecosystem but has also helped local fish farmers and improved food security. The improved water quality has led to the growth of the fishing industry and an increase in the number of fish that can be caught and sold. As a result, local fish farmers can now produce more fish, generate higher profits, and create more jobs.

Furthermore, the partnership has facilitated the establishment of fish farms and hatcheries, which have further increased the availability of fish for consumption. Through this initiative, the partnership has also provided training and education to local fish farmers on sustainable fishing practices, which has helped them produce healthier fish and improve the quality of their yields.

The increased production of fish has also helped boost the local economy and reduced the reliance on expensive imported fish products. This has contributed to the overall food security of the region, providing a source of affordable protein to the local population.

6. RECOMMENDATIONS

In view of the findings of this study, it is recommended that the following needs to be done for PPPs to be able to achieve the goal of eradicating food insecurity and improve water quality in the lake region:

[i]. There is need for the for the program of PPP to expand its reach beyond the Lake Victoria region to other areas in Kenya facing similar challenges. This will involve identifying new partners in other regions, building relationships, and collaborating to implement similar programs tailored to the specific needs of each region.

[ii]. The government needs to invest in building the capacity of the local communities and private sector partners involved on lake water pollution mitigation strategies to enhance fish yield. This may involve providing additional training and resources to enable people to take on a greater role in the conservation and management of their natural environment

[iii]. It is essential that these partnerships are established in a way that is equitable, with all stakeholders having a voice and receiving the benefits of the partnership. This requires trust, transparency, and cooperation.

[iv]. Sustainable wastewater treatment technology that reduces the pollution level of wastewater before it is discharged into the lake should be adopted. The technology employed should not only be eco-friendly but also cost-effective to encourage more businesses to adopt sustainable practices. The

process can be carried out by constructing a special plant for the treatment of industrial wastewater that reduces the pollution level before discharge into the lake.

[v]. Effluent mitigation policies and regulations should establish the need for industrial wastewaters to be treated before discharge into the lake. The legislation should be well implemented and monitored to ensure compliance by businesses. Moreover, incentives awarded to businesses that go above and beyond to reduce their impact on the environment could encourage companies to adopt sustainable practices.

7. REFERENCES

Batley, R. (1996). Private Sector Provision of Public Services: A Desk Based Study.

Bragdon, J., & Hayes, M. (2017). Public-Private Partnerships as an Innovative Policy Instrument for Food Security in Africa: A Systematic Review of Literature and Bibliometric Analysis. *Journal of Agribusiness in Developing and Emerging Economies, 7*(1), 22-47.

Caker, K. L., & Siverbo, S. (2011). How PPPs can work: Interaction between the public and private sectors. World Bank Group.

Chomba, C., Nkurunziza, C., & Mwaura, F. (2016). Public-Private Partnerships for Environmental Protection: The Case of Lake Victoria Environmental Management Project II. *Public Policy and Administration Research, 6(*10), 1-11.

Dahiya, B., & Gentry, T. J. (2020). Public-Private Partnerships in Infrastructure Development. Routledge.

Elkington, J. (1998). Cannibals with forks: The triple bottom line of 21st-century business. New Society Publishers.

Field, A. (2005). Discovering statistics using SPSS. London: Sage Publications.

Hastings, J. R. (1996). Public-private partnerships: An opportunity for efficiency. *The Public Manager*, 25(1), 31-34.

Keranen, O. (2017). Public-Private Partnership in Schools: *A Literature Review*.

Keränen, O. (2017). Roles for developing public–private partnerships in centralized public procurement. *Industrial Marketing Management, 62*, 199-210.

Koo, T. K., & Li, M. Y. (2016). A guideline of selecting and reporting intraclass correlation coefficients for reliability research. Journal of chiropractic medicine, 15(2), 155-163.

Luhigo, D. N., & Mjonono, V. (2020). Factors Influencing Public-Private Partnerships in Urban Water Supply in Tanzania: A Case Study of Dar es Salaam Water and Sewerage Corporation. *Journal of Resources Development and Management, 48*, 14-21.

Mjonono, V. (2016). Public Private Partnerships and Sustainable Urban Wastewater Management: A Case Study of Dar es Salaam, Tanzania. *International Journal of Environmental Science and Development, 7*(3), 173-177.

Mjonono, V. (2017). Public Private Partnerships in Rural Water Supply and Sanitation: A Case Study of Tanzania. *Journal of Water Resource and Protection, 9*(12), 1425-1439.

Mrema, G. N., & Mjonono, V. (2018). Public Private Partnerships in Urban Wastewater Management in Tanzania: Opportunities and Challenges. *Journal of Water Resource and Protection, 10*(13), 1418-1431. URL: https://doi.org/10.4236/jwarp.2018.1013055

Mushi, S. E., & Mjonono, V. (2019). Public-private partnership models in wastewater management in developing countries: Case study of Tanzania. *Journal of Environmental Management, 240*, 310-316.

Nduhura, A., Molokwane, T., Lukamba, M. T., Mugerwa, B., Nuwagaba, I., Twinomuhwezi, I., ... & Mbabazi, M. (2022). Food Security: The Application of Public Private Partnerships to Feed the Hungry and Prosper Africa. *African Journal of Public Administration and Environmental Studies, 1*(1), 65-94.

Ni, P. (2012). Research on Public-Private Partnerships in China: *A Literature Review*.

Obosi, C. (2017). Public-Private Partnership and Water Service Delivery in Kenya: The Case of Lake Victoria South Water Services Board. *Journal of Public Administration and Governance, 7*(4), 237-256.

Porter, M., & Kramer, M. (2011). Creating shared value. Harvard Business Review, 89(1/2), 62-77.

Rangel, L. A., & Galende, J. I. (2010). Concession length and regulation in transportation public-private partnerships. *Journal of Transport Economics and Policy, 44*(2), 223-240.

Reynaud, E. (2015). Public-Private Partnerships in Developing Countries. Springer Open.

Savitch, H. V. (1998). Privatization and public–private partnerships in contemporary cities

Shoniwa, B. (2022). Public-Private-Community Partnerships (PPCPs) as a mechanism in enhancing food security during the COVID-19 pandemic in Zimbabwe. *Public Administration and Policy*, (ahead-of-print).

Sindane, J. (2000). Public-private partnerships: National Treasury PPP Unit's perspective. *South African Journal of Accounting Research*, 14(1), 1-12.

Smyth, S. J., Webb, S. R., & Phillips, P. W. (2021). The role of public-private partnerships in improving global food security. *Global Food Security*, *31*, 100588.

Solheim-Kile, E., Ladre, R., & Lohne, J. (2019). The politics of privatization in developing countries. *International Political Science Review, 40*(1), 107-121. doi:10.1177/0192512118789988

Tang, B., Zhang, X., & Skitmore, M. (2013). Public-private partnership in construction: A review and research agenda. *International Journal of Strategic Property Management, 17*(3), 269-279.

Trafford, J. & Proctor, A. (2006). Public Private Partnerships for Urban Infrastructure: What can be Learned from the Private Finance Initiative. Built Environment, 32(3), 318-329.

Tsimoshynska, O., Ghangurde, A., & Cantarelli, C. C. (2021). Financing mechanisms for public-private partnerships in transport infrastructure: a systematic review. *Transportation Research Record*, 03611981211014834.

Vecchi, V., & Cusumano, N. (2018). The Role of Public Private Partnerships in Infrastructure Development in Asia: Lessons Learned, Challenges and Future Trends. In The Palgrave Handbook of Asia Pacific Higher Education (pp. 1-36). Palgrave Macmillan.

Venkatesan, M. (2016). The Global Agriculture and Food Security Program: An Evaluation of the Public Private Partnership in Malawi. *African Journal of Agriculture and Food Security*, *4(*2), 153-156.

Walter, S. (2013). Correlational Research. In Encyclopedia of Research Design (pp. 283-284). SAGE Publications, Inc.

Widdus, R. (2017). Public-private partnerships: An international review. *Public Administration and Development, 37*(1), 7-17.

World Bank. (2008). Private Participation in Infrastructure (PPI). Retrieved from https://ppi.worldbank.org/

World Bank. (2014). Public-private partnerships in emerging markets. Washington, D.C.: World Bank.

Xiong, T., & Zhang, L. (2014). Public-private partnerships in China: Recent trends and developments. Journal of Infrastructure Development, 6(2), 163-180.