Contribution of Water Vendors in Mitigating Water Scarcity in Keffi Town, Keffi Local Government Area, Nasarawa State, Nigeria

Dogara Adamu Ahmad[1], Dr. Joshua Ibrahim Magaji[2]

Department of Geography, Faculty of Environmental Science, Nasarawa State University, Keffi in Partial Fulfillment of the Requirementfor the Award of Master of Science in Environmental Resource Management

DOI: https://doi.org/10.47772/IJRISS.2026.100700723

Received: 28 July 2026; Accepted: 03 August 2026; Published: 11 August 2026

ABSTRACT

Access to clean and potable water remains a significant challenge in many urban and rural areas of Nigeria, including Keffi Town in Nasarawa State. In response to this challenge, water vendors have emerged as a crucial component of the water supply chain, providing water to households and businesses. This study investigates the contribution of water vendors in mitigating water scarcity in Keffi Town, with a focus on their role in bridging the gap between water demand and supply. The specific objectives were to: identify the sources of vended water supply by the vendors; assess the factors influencing the price of vended water supply in the study area; investigate the distribution pattern of vended water supply and to examine the challenges of patronizing vended water supply in the study area. The selection of the sampled population was based on electoral wards. There are 10 electoral wards as pointed by Independent National Electoral Commission (INEC) in Keffi L.G.A, and five wards were randomly selected for sampling considering the homogeneity of the population in terms of water access experiences and the prevalence of water vending activities. Areas (settlements) within these wards were randomly selected and adults especially male/female head of the households were surveyed so as to ensure that the desired experiences of respondents were achieved. The households were selected systematically so as to ensure a fair and unbiased representation of the households in each of the selected area. Also, in order to determine the sample size of questionnaire to be administered, Krejcie & Morgan (1970) sample size table was used, which states that for a given population size more than 75,000 and less than 100,000 at confidence level of 95% and margin error of 5.0%; the required sample size for respondents is 383. In this regard, the sampled population was projected at 57,540. Therefore, given the above sample size 383, a total of 250 respondents were sampled due to limited time frame and resources. This was done considering the homogeneity of water access experiences and the distribution of vended water in the study area. Using a mixed-methods approach, the study examines the operations, challenges, and impacts of water vendors in Keffi Town. The findings reveal that water vendors play a vital role in providing water to residents, particularly during periods of scarcity. However, their operations are hindered by several challenges, including inadequate water sources, high operating costs, and limited regulatory support. The study recommends that policymakers and stakeholders recognize the importance of water vendors and provide them with support and resources to improve their operations and contribute more effectively to mitigating water scarcity in Keffi Town

Keywords: Water Vendors, Water Scarcity, Keffi Town, Nasarawa State, Nigeria.

INTRODUCTION

Background to the Study

Water is the most plentiful resource on Earth and is essential to life. Water is so essential to man that it is recognized as a basic human right (Anan, 2001). Human existence depends on water and we all need water to survive. A healthy life depends on more abundant access to water for hygiene and daily household use. Beyond this, a comfortable life requires water to be safe when it is easily and reliably available when needed. It is also necessary in production processes through which we earn our livelihoods. Despite its basic importance, safe

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VII July 2026

water for domestic use is not readily available to many households across the world, due to various factors such as increasing population, source pollution and poor management of water resources. United Nations Development Programme (2011) asserts that by 2050 7 billion people in 60 countries may have to cope with water scarcity. It was indicated that water demand already exceeds supply in many parts of the world, and as world population continues to rise at an unprecedented rate, many more areas are expected to experience this imbalance in the near future. It was revealed that water problem is worse in poor countries, most especially in Sub-Saharan Africa (United Nations International Children Emergency Fund [UNICEF]/ World Health Organization [WHO], 2000).

Furthermore, almost half of the total global population without access to improved drinking water is in Sub-Saharan Africa. Between 1990 and 2015, the region registered an increase of 20% in the use of improved sources of drinking water, but without meeting the Sustainable Development Goal (SDG) target (UNICEF/WHO, 2015b). Yet, access to an improved water source does not always guaranty adequate and affordable provision. These figures are likely to worsen given the new demanding definition for access to water, introduced by the Sustainable Development Goals (SDGs), which include aspects of universality, affordability and equity (WHO-UNICEF, 2015).

The paucity of clean water and access to adequate sanitation are widespread. Children die of dehydration and malnutrition, due to diarrheal illnesses that could be prevented by clean water and good hygiene (Metwally, Ibrahim, Saad & Abu El-Ela, 2006). Diarrheal morbidity and malnutrition for children under five years is severe. Diarrheal infections, mainly caused by the use of unsafe drinking water, were responsible for approximately 2.2 deaths in 2001, while two people out of five lacking drinking water in Sub-Saharan Africa (Ntouda Sikodf, Ibrahim & Abba, 2013). Women and young girls, the major actors in accessing and carrying water spent majority of their day walking miles for their daily water needs.

The dismal state of water access in Sub-Saharan Africa is not the result of lack of interventions, but rather a failure to device effective approaches in solving the problems facing the sector. Improving access to safe drinking water has been a priority for many countries particularly in the post-colonial period. Development organizations such as NGOs, donors and World Bank have been actively supporting efforts for improving access to safe drinking water, ever since the United Nations proclaimed the period from 1981-1990 as the first International Drinking Water Decade, an appeal to support for clean and safe drinking water for everybody by 1990 (United Nations, 1977).

Therefore, despite the efforts of government and non-governmental agencies like the World Bank, NGOs and SDGs among others, have recorded significant success in making portable water available to few communities, a lot still need to be done in many other communities (Kjellen, 2000). To cover this inadequacy in water provision by public utilities in many cities, alternative suppliers exist such as non-state water providers (NSPs) including both formal and informal local private providers commonly known as water vendors. Historically, water vending is an old practice world over. Water vending is probably as old as human society and trade, but in recent times it has been overshadowed by the expansion of networked piped systems (Van Dijk, 2008). Water vending is often taken as a symptom of failure in the piped systems, which still provide water to only a minority of urban dwellers in many parts of the world (Kjellen, 2000). Water vending was spurred by studies of willingness to pay for water. The premium on vended water shows a willingness to pay for water that flies in the face of the claim that people believe water is a free good, which should not be bought and sold. This has been one argument for the increase of water tariffs and the capitalization of private initiatives in the water sector. Vending provides a valuable service for people in urban and rural areas who have no access to piped water; otherwise they would not choose to buy vended water. People moving into slums and squatter settlements on the fringes of rapidly expanding urban areas must rely on vendors until the piped system is expanded, if ever. The principal benefit of water vending to the consumer is that it provides a significant saving of time compared to fetching of water from other sources.

Water resources for vendors may differ in space and time, for example in Ethiopia it is primarily from municipal supply system while in Kenya vendors sell from a combination of municipal supply and privately owned boreholes and wells (Ayalew, Chenoweth, Malcolm, Mulugetta, Okotto & Pedley 2014). The mode of

distribution may be home deliveries (by distributing vendors) using hand-carried, donkey carts, push-carts or trunk tankers, or at reselling stations (from which consumers collect water) (Kjellen, 2000; & Nigerian Industrial Standard [NIS], 2007). The understanding and interest in water vendors remains minimal. However, small vendors are already providing water services to a large share of the world's poorest urban dwellers, often in the face of official discouragement. Private utility operators are less significant, and it is not clear that they will be interested in serving more than the small fraction of urban poor living in the vicinity of the large piped-water networks. Better services from water vendors may be considered inadequate by international standards, but their services yield a substantial improvement in the well-being of urban dwellers (Kjellén & McGrahanan, 2006). Water vendors have been praised for their entrepreneurship as well as their ability to reach the poor and areas that are difficult to develop with conventional infrastructure. At the same time, they are still often scorned for exploiting people's absolute and basic need for water (Kjellén & McGrahanan, 2006).

In most cities of developing countries especially in low income areas, access to water of sufficient quantity and acceptable quality remains one of the major problems for many households (Kjellen, 2000; Acey, 2008; Sansom & Bos, 2008; Abubakar, 2016). Millions of people in developing countries obtain water from commercial vendors who sell water or deliver it to their homes. Despite the fact that water vendors serve millions of people in cities and villages through the developing world and may offer a more convenient service than is available from public hand-pumps or public taps (although at a high price), water vending has received little or no attention from professionals in the water resources field, and it is often seen as an indication in the failure of the supply institutions to provide an adequate service (Whittington, Donald, Lauria, Daniel, Okun & Xinming Mu, 1989). International statistics on access to water revealed that those who buy their water from vendors are classified as those not having reasonable access to improved water supply, along with those who get their water from unimproved wells or surface water sources (Kjellén & McGrahanan, 2006).

In Nigeria, more than 60 million people are required to meet Sustainable Development Goals (SDGs) target for improved water by 2025 and is unlikely to be achieved only by public supply. To cover these water availability gaps water vendors exist and ignoring their role is potentially deceptive. In Nigeria also, there has been a widespread recognition and acceptance that conventional water utilities have fallen short in providing adequate water services to populations especially the urban poor. Festac Town, Lagos, Nigeria is a typical community that is presently not being serviced by such water utilities due to the inability of the Water Supply Agency (WSA) in supplying water to the area. Households therefore seek other alternative sources including water vending. Whittington *et al* (1989) in a study of water vending in Onitsha, Nigeria, observed that millions of people in developing countries obtain water from commercial vendors who deliver it to their homes, yet this phenomenon has received little attention from professionals in the water resources field. Most of the households obtain their water supplies from well-organized water vending system that is operated by the private sector. In this city, on annual basis, households pay water vendors over twice the cost of piped water. A similar study carried out in Kaduna and Katsina States in Nigeria reveal that vendors charge as much as 20 times the unit rate of the respective State Water Agencies (Federal Republic of Nigeria [FRN] & Water Supply and Sanitation [WSS], 2000).

In Keffi, growing water scarcities have plunged various households into a water crisis. It was reported that drinking water supply in Keffi is grossly inadequate especially in the hilly areas. Many households, often the poorest, end up purchasing water from private informal vendors which is much more expensive than from the public supply. Water supply services, where they exist, are unreliable, of low quality and are not sustainable because of difficulties in management, operation and pricing, and failure to recover costs.

Statement of the Research Problem

Water scarcity is a serious problem in many developing countries with Nigeria inclusive and Nassarawa state, and Keffi in particular is also not left out (Ndabula & Jidauna, 2010). In this regard, water vending plays an important role in the supply of water for domestic purposes. However, despite the significant role that water vendors play as an integral part of water system with respect to water provisioning, the sources of vended water supplied by water vendors are often from unimproved sources. No doubt, these sources are often defined as unsafe. The consequence of this in some communities especially during the peak of the dry season often

manifests in the outbreak of some water borne diseases like cholera, guinea worm and typhoid. Hence, the greatest challenge to water service delivery through this mode is the quality of supplies. Vended water has been associated with outbreaks of diarrhea disease as some of the vended water is obtained directly from unprotected source such as unprotected wells and surface water including rivers/streams, ponds and canals etc (WHO, 2006).

Besides water-related diseases associated mostly with informal water vendors (Olajuyigbe, Rotowa & Adewumi, 2012; Kjellen & McGranahan, 2006; Hutin, Luby & Paquet 2003), water vending is often more expensive, resulting in households paying more than the stipulated bills charged by public utilities (Kjellen, 2000; Ishaku, Peters, Haruna & Dama 2010; Dauda, Yacob & Yadam, 2015). This was attributed to the lack of access to subsidies that would cover their initial investments and operating cost (Opryszko, Huang, Soderlund & Schwab, 2009), and then blaming the governance (Njiru, 2004). Some problems bedeviling water vending includes lack of recognition and regulation by government. Despite the fact that National Agency for Food and Drug Administration and Control (NAFDAC) is giving licenses to formal vendors, sustainable solutions need to be developed especially in the area of developing mechanisms to incorporate informal water vendors that have been making significant contributions to water provision. It is of no doubt that recognizing them as part of a regulatory framework will assist in the realization of Sustainable Development Goals (SDGs) target (Njiru, 2004; Ayalew *et al.,* 2014) while safeguarding extensive surveillance will ensure safety (Ishaku *et al.,* 2010; Sheshe & Magashi, 2014).

Whittington *et al* (1989) in a study of water vending and willingness to pay for water, asserts that people in some rural villages are willing and able to pay substantial amounts of money for vended water, even when traditional sources are readily available. For instance, in Ukunda 64% of the water used in the village in the rainy season was sold by kiosks to distributing vendors and individuals. Distributing vendors in Ukunda sold more than 45% of the total water consumed in the village. People in Ukunda spend about 9% of their income on vended water. Secondly, households are paying much more for vended water than would be necessary to provide and sustain a piped distribution system with yard taps. Such information is important because grants from donor agencies and national governments are not sufficient to meet the huge demands for piped water in developing countries.

Similarly, study by Olajuyigbe *et al.* (2012) on water vending in Nigeria-Festac Town Lagos, revealed that most households (90.6%) depend on vended water for their needs. A further breakdown revealed that informal vendors provide the largest percentage (74.9%) of the household water needs in this community. They provide door to door services and are usually conversant with the water needs of the residents. However, as valuable as this group of service providers is, it should be realized that most of them obtain water from uncovered wells. Thus, there is an apparent danger of this source exposing households to water-borne diseases. Formal vendors have their individual connection and do not rely on supply from any government agencies. On the other hand, informal vendors obtain their water from unprotected surface wells and get it delivered through the use of carts and shoulder held cans. Only few rely on water from utility pipes from neighboring communities.

These sources are generally inefficient as supplies from them are unreliable. Though the sources attract payment of fees, but the concern here is the large proportion of the informal vendors that obtain their water from uncovered well which had been defined as unimproved source (WHO & UNICEF, 2010). Consumers patronizing these vendors are therefore susceptible to water borne diseases. Most respondents felt that the water supplied by both formal and informal vendors is unsafe as it contains some pollutants. 50.3% adduced such pollution to poor handling by vendors while others attributed it to loading, transportation and offloading operations. In addition, 25.1% opined that the pollution might be as a result of the poor condition at the sources of water supply available to vendors. These observations constitute great challenge to the health of this community.

Also, study by Dakyaga, Alphonce, Kyessi & Msami (2018) revealed that prices per unit of water sale are largely in-marginal. The pricing mechanism contributes to cost recovery to favor actors' business operation rather than affordable water provision to salvage the water demand of the urban poor in the informal settlements. As a respondent remarked: "Getting water today and tomorrow will continue to be problem here, since I came here the number of water sellers has been increasing yet prices per liter of water have not decreased" The income status of the urban poor are highly incompatible with the water tariff of the informal water markets. From the survey, 65.8% of the respondents spent more than 5% of their monthly households' disposable income on water

despite the spatial proximity to the water markets. The consequences are enormous ranging from the provision of un-affordable water to the urban poor, poor quality of the water due to lack of disinfection, and low reliability of water supply.

Again, a study conducted by Ahmad (2017) on the role of water vendors in water service delivery in Dala LGA, Kano, Nigeria, also revealed that there is lack of water quality awareness among many water vendors; their perception on water quality is typically assessed by observing color, odor and taste of water. Thus, the quality of vended water is questionable in the study area—as it is the case in many parts of the world— leading to water-related disease. The commonly reported water-related diseases by respondents in the study area were stomach ache, cholera, diarrhea, typhoid and malaria. Only 13.8% have not been affected with one or more water-related diseases in the recent time. It is obvious that this high incidence of diseases is related to the fact that vended water is usually unsafe since it is commonly susceptible to contamination arising from poor sources and exposure during haulage. The cans are not wash regularly and in some having greenish colour in them (Spirogyra).

Furthermore, the observed potentials for the water sellers are worthy of formalization and improvement in poor neighbourhoods. But prior to formalizing the informal water markets, there is the need to first of all, recognize the operations of the water sellers through registration, formation of associations to provide an avenue for regular monitoring of their activities and training to build their capacities in water quality management. Informal water sellers should be supported by water policy issues, to contribute to the implementation of water related policies and make them more effective and efficient in the urban water supply. This will at the same time increase their access to microfinance services and facilitate investment in water provision. Though the lack of unionized system of operation resulted to the lack of non-collective pricing fixing body or established basis for a unit cost of clean and safe water (Wutich *et al*., 2016; Ahmad, 2017).

Finally, while the studies mentioned above have been conducted to assess community's ability and willingness to pay water in various parts of the developing world and Nigeria in particular, none to the best of my knowledge has been conducted in Keffi town. It was on this backdrop that the study therefore focuses to fill this gap and answer the following questions below.

Research Questions

The study will address the following questions:

i. What are the sources of vended water supply in Keffi Town?
ii. What are the factors influencing the price of vended water supply in Keffi Town?
iii. What is the distribution pattern of vended water supply in Keffi Town?
iv. What are the challenges of patronizing vended water supply in Keffi Town?

Aim and Objectives

This study aimed at assessing the role of water vendors in meeting domestic water need in Keffi Town, Nassarawa State. This aim was achieved through the following objectives:

i. Identify the sources of vended water supply in keffi town.
ii. Assess the factors influencing the price of vended water supply in the study area.
iii. Investigate the distribution pattern of vended water supply in the study area.
iv. Examine the challenges of patronizing vended water supply in the study area

Significance of the Study

Water vending is worthy of study because vending activities will continue to exist in developing countries in the foreseeable future due to severe shortages of capital for piped systems or for wells and hand-pumps. In some circumstances, it may actually prove to be an appropriate technology for a community at a given level of economic and social development because it is typically very reliable. Vending systems can be improved in

quality and in aspect of fixed price. Also, this study is important as it will provide information on the sources where water vendors obtain their water from for onward supply to the end users; the quantity and quality of water supplied by vendors, and reasons why vended water is perceived to be unsafe. Information on the cost and the factors influencing the cost of vended water; the distribution pattern of vended water supply and the challenges of water vending, as well as proffer solution to the challenges of water vending, which may be useful for traditional water supply planning decisions

Scope and Limitation of the Study

This study only focus on the contributions of push-cart vendors for onward distribution, it does not include the contributions of truck tankers. The specific considerations made in this study include, sources of vended water supply, portability of vended water, level of water vendors patronage by various households, availability of vended water, cost of patronizing vended water, as well as general challenges of water vending by both the water vendors and the households. Due to limited time and resources, the study was unable to investigate some aspects of water vending activities like the seasonal variability in the quality and quantity of water supplied by water vendors, and only a particular (dry) season of the year was captured in this research study. This might not be the same condition during the wet season.

LITERATURE REVIEW

Conceptual Review of Water Vendors

Various terms have been used to describe the different types of unofficial water service providers, some of which include; small-scale water providers (SSWP), informal operators, small water enterprises, suppliers, water vendors and resellers among others. However, the limits in the definition of each term are difficult to assess, as there is no standard definition to describe and classify small-scale private providers. There is therefore considerable variety in the nature and the scale of vended water activities, which fill the niche markets, depending upon local circumstances such as water resources, topography, utility service levels and the regulatory framework (McGranahan, Njiru, Albu, Smith & Mitlin, 2006).

In the context of this study, water vending implies private selling of water for domestic use, but does not include bottled or packaged water or water sold in bottles. Water vending refers to the reselling or onward distribution of utility water, or water from other sources (Kjellén & McGrahanan, 2006). Zaroff & Okun (1984) describe water vending "as the sale and distribution of water by container, ranging from the delivery of water by tank trucks to the carrying of containers by individuals". Water vending is therefore referred to any form of water sale. Vendors may either sell water directly to consumers or act as middlemen. That is, selling water to carriers who in turn distribute it house to house for the consumers. The water may be obtained from private or municipal taps, stand posts, rivers or wells and sold either from a public vending station or door-to-door. The mode of distribution may be home deliveries (by distributing vendors) using hand-carried, donkey carts, pushcarts or tank trucks, or at reselling stations (from which consumers collect water) (Wutich, *et al*., 2016). The term "direct vending" is often referred to as "reselling". In Katko (1991) "reselling means that the owner of the water connection sells water to customers who use to come and fetch it as well as pay the stipulated amount". Typically, it refers to households selling water from their utility connections, but it also refers to itinerant vending.

Types/Categories of Water Vendors

Water vending is usually formal or informal. It is formal when it is undertaken with the consent of registered association like National Food and Drug Administration Control (NAFDAC) or water union or registered associations. Where formal vending is practiced, the majority of the water is likely to be supplied in tankers and will supply a service to the end user equivalent to an in-house water supply. Typically, such water will come either from treated utility supplies or from registered sources. Formal systems will be much easier to control and regulate than informal systems. On the other hand, informal vendors obtain water from many different sources, protected and unprotected and deliver small quantities of water for domestic use in a variety of ways ranging from carts and cycles to containers or wheel barrows, trolleys and animal-drawn or mechanized carts and tanker

trucks (Olajuyigbe *et al*., 2012). Where informal systems exist, the priority is likely to be to increase access to formal water supplies or promote household water treatment rather than controlling vended water quality.

However, different types of informal water providers usually operate in parallel within the same city or settlement, serving different categories of customer (Kjellén & McGranahan, 2006). The water may be obtained from private or municipal taps, stand posts, rivers or wells and sold either from a public vending station or door-to-door. The most important advantage of informal water vending is that households who are unable to buy water connections and set aside larger quantities of money to pay bills are able to purchase small quantities of water on a daily basis according to what they can afford. While water vending is ubiquitous in developing countries, it takes many forms and is organized in many different ways. All systems have one or more of the three types of vendors.

Different types of categories exist for water vending activities, depending on the classification criteria. As such, just as there are many forms of water vending, there are also several ways of labeling or categorizing the different practices. According to Whittington *et al*. (1989.b), all vending systems have one or more of the three types of vendors; which includes wholesale, distributing and direct vendors.

Wholesale Vendors

Wholesales water vendors sell water from privately owned commercialized boreholes popularly known as water kiosk. Wholesale vendors may own a borehole or may buy water in bulk either from private borehole owners or from utility companies. These vendors own or rent tanker trucks with large capacity which allows them to sell bulk quantities of water to small-scale vendors.

Distributing Vendors

Distributing vendors interact with the consumers usually door to- door, and make up the majority of the small water enterprises (Collignon & Vezina, 2000). The majority of distributing vendors are water carters who tend to be young migrant men from rural areas who need little investment to get started. They carry the water in carts drawn by hand, animals, bicycles or motorbikes. Hand-carrying water vendors haul water in buckets or other smaller containers by hand, without carts or animals, and earn very small wages though they are not abundant in many low-income cities. Vendors hauling water by hand are declining in number as more use carts to haul the water (Collignon & Vezina, 2000). Water carting, like water collection for own use, is a heavy and physically demanding activity. In Dar es Salaam, pushcart vendors complain of pains in the chest and joints, and that they often fall sick with fever. Their earnings are generally low, and at times they go hungry. Average earnings are less than the minimum wage for the country (Kjellén, 2000a). As many start by renting their push-carts, they cannot start slowly but have to work full days, and after that they just sleep. The job is so tough for the equipment, and the next problem is push-cart breakdowns, including punctures and warped rims.

In Tanzania, pushcart vendors are supposed to carry small-business licenses (of the most inexpensive sort) but none of them do. And the authorities seem not to be bothered by this (Kjellén, 2000a). From Khartoum (Sudan), Njiru & Albu (2004) report that one of the constraints faced by donkey-cart operators is the persistent harassment from local officials in respect of up to five different taxes or licenses that they are meant to pay. Head-carrying and wheel barrow water vending tend to be the most physically taxing but are often among the most easily entered businesses requiring little funds for start-up. Distributing vendors typically sell water in volumes ranging from bucketful to 20-litre jerry-cans to their consumers.

Tankers or Car tankers are other distributing vendors, delivering water to wealthier households that have large storage tanks or to large facilities such as hotels, schools or restaurants. Tankers are also used during festivals and special events such as weddings to supply large quantities of water domestic use. Distributing vendors tend to charge the highest price since they deliver to the door and serve peak demands for people who have little time for water collection or can pay for the convenience (Snell, 1998).

The Tanker trucks water supply market was observed as the most patronized water supply market and serves the largest segment of the low, middle and high-income categories of households. It comprised of unionized

(registered tankers) and non-unionized (unregistered tankers) operators. Tankers play pivotal roles between the public water supply network and households that are beyond the water supply network. The connection between the unionized tanker truck operators, and households is due to the following; the inability of the public water supply network to deliver pipe water services to households at the peripheral, the existing non-served households in which the utility has the mandate to serve (Gasson, 2017), network failures and seasonal pricing fluctuations as hindrance to public water services delivering, and the limitations of the utility network to meeting the water needs of all households within the network.

Direct Vendors

The term "direct vending" is often referred to as "reselling". According to Katko (1991) "reselling means the owner of the water connection who sells water to customers who come and fetch it as well as pay the stipulated amount". Typically it refers to households selling water (unofficially) from their own utility connections, and it also refers to as itinerant vending. Direct vendors have consumers come to them. They also tend to charge mid-range prices and are in greatest demand where well water is of poor quality or is too expensive (Snell, 1998). In many urban areas in low income countries where utilities reach only a portion of the population, direct vendors can be dominated by households with piped water supply connections that resell the water to households without connections, thereby extending the reach of the public utility either legally or illegally. The Water Utility Partnership (2001–2003) defines a reseller as "an individual who purchases water (e.g. from a network connection or private borehole), then transports it to their homes and/or businesses. Beyond household resellers, these direct vendors also include various forms of kiosk, standpipe, or hydrant operators, depending on the degree of investment, legality and recognition.

Also, Collignon & Vézina (2000) divide these vendors/resellers into three categories:

a. Standpipe/kiosk vendors: are small entrepreneurs who operate standpipes installed by the city water concessionaire.
b. Licensed water resellers: are micro-entrepreneurs with permit, contracted to resell piped water to their customers or who may invest in standpipe installation and network extension.
c. Unlicensed household water resellers, who are not seen as professionals, although they do provide water to a major share of the market.

Water kiosk is a type of direct vending commonly found in Africa and Asia (Kjellen & McGranahan, 2006; McGranahan *et al.*, 2006). A water kiosk is generally described as a stationary water sales point with an operator who monitors the quantity – and in rare instances the quality of water sold and collects payments. Kiosks may be divided into two categories based on water source: those that are extensions of public utilities and those that are erected from private or community-owned water sources. Kiosks are often used by the poorest households and allow the purchaser to control the volume of water purchased and total cost since the purchaser travels to the water and does not require additional services such as door-to-door delivery (Collignon & Vezina, 2000).

Some kiosks are solitary stand posts with no treatment of the water, while other kiosks are more elaborate, having a shelter along with various types of water treatment devices. Water treatment ranges from simple cartridge filters or sand filters to more advanced system such as chlorination (McIntosh, 2003; McGranahan *et al.*, 2006; Albert, Aristanti & Sudjarwo, 2008). Water may be sold from kiosks directly into water vessels brought by customers or in pre-packaged containers supplied by the kiosk operator.

Kariuki & Schwartz (2005) further outlined the organizational forms of small scale water providers/ water vendors to include:

1. Piped networks operators with smaller networks of 5 to 50 connections which are more likely to have legal status. These are typically owned by individuals that might have started with borehole or water wells and later connects to neighbours.
2. Point sources which include kiosks which also may hold simple license or permits for abstracting ground water or operating kiosks. Most of these operate in areas where public utility has no connections. Some of them remain informal because of legal or administrative constraints rather than by their own choice.

3. Mobile distributors such as, trucks or car tankers and push cart street vendors. These may have a transport license but in most cases they do not hold a permit to sell water. Push cart street vendors as a category of mobile distributors are crucial in distributing water. They may purchase water from tankers, kiosks or public utility pipes and deliver to the customer by the jerry cans via pushcarts. These operators may or may not be the owner of the vehicle/equipment used to distribute water. Many of them rent carts on daily, basis for instance.

For the purpose of this study regarding the three forms or categories of water vending described by Collignon & Vezina (2000); McGranahan *et al*. (2006); Kariuki & Schwartz (2005); Collignon & Vézina (2000), the push-cart vendors were considered and used to assess the role of distributing vendors in household delivery of domestic water.

Sources of Vended Water

Usually, the sources of vended water supplied by water vendors are often from unimproved sources and in rare cases improved sources which include both groundwater and surface-water sources such as rivers, streams, dug wells, boreholes and taps (Olajuyigbe *et al.,* 2012). Owing to the unhygienic nature of most well waters (i.e. mostly unprotected and untreated), vendors prefers to source their water mostly from either shallow wells/stand pumps and or pipe borne water sub distribution stations to satisfy their customers. According to Kjellen (2000), majority of water vendors source their water from one or more deep wells with submersible pump and 5000litre Gee Pee tanks often fixed in the yard on a concrete platform. However, Seasonal variation in precipitation influences the sources of water collection.

A study of Festac Town, Lagos in Nigeria by Olajuyigbe *et al* (2012) revealed that all the formal vendors obtain their water from boreholes which are more secured and hygienic. Formal vendors have their individual connection and do not rely on supply from any government agencies. On the other hand, informal vendors obtain their water from unprotected surface wells and get it delivered through the use of carts and shoulder held cans. The concern here is the large proportion of the informal vendors that obtain their water from uncovered well which had been defined as unimproved source (WHO & UNICEF, 2010). Consumers patronizing these vendors are therefore susceptible to water borne diseases.

Another study by Ahmad (2017) revealed that apart from water kiosks where water vendors obtain water, there are also a significant number of hand-dug wells scattered all over Duniyar Yangaruwa that had sold water to vendors and some neighboring households. It was gathered that people dug wells on plot of lands to sell water and hence the high number of these kind of wells. In many cases however, the vendors buy water from both sources. The choice of water source would mostly depend on distance and to some extent on quality (whether soft or hard water). Hard water (Ruwan zartsi) is generally cheaper than soft water (Ruwan dadi). No Water kiosk was found to have been supplied with water from private water tankers.

Angueletou-Marteau (2008) in her study on Informal Water Suppliers Meeting Water Needs in the Peri-urban Territories of Mumbai revealed that private reselling of groundwater to neighbours is a general phenomenon of the area. They are mostly located in areas with an important slum population, who cannot afford the borehole construction charges. People have to do queuing and transport water, and this is a very time consuming activity. These sources are cheap, but nor the quantity, nor the quality of water is guaranteed all over the year. Free open category include all sources of water which are not directly chargeable (some indirect cost may exist: transport, equipment, treatment), such as public wells and boreholes, lakes and rain water. We consider these sources of water as “informal” as there is no control over them. The quality of these sources depends on the season and their location in the area.

Vended Water Quality and Health Aspects

With regards to water quality, water vendors are often blamed for supplying unsafe water. Enforcement of regulation and monitoring is very difficult, especially for decentralized and informal packaging. It is quite likely that all the pouring from one vessel to another exacerbates the risk of contamination at the point of retail or at

the household level. Often times, there is lack of water quality awareness among many water vendors; their perception on water quality is typically assessed by observing color, odor and taste of water. Thus, the quality of vended water is questionable as in many parts of the world — in which in many cases leading to water-related diseases. The commonly reported water-related diseases are usually stomach ache, cholera, diarrhea, typhoid and malaria. It is obvious that this high incidence of diseases is related to the fact that vended water is usually unsafe since it is commonly susceptible to contamination arising from poor sources and exposure during haulage. The cans are not wash regularly and in some having greenish colour in them (Spirogyra) (Ahmed, 2017).

The consumption of water purchased from vendors in Ibadan (Nigeria) has been found to be associated with diarrhea among children (Oyemade, Omokhodion, Olawuyi, Sridhar & Olaseha, 1998). In Accra (Ghana), water from vendors was found to have alarmingly high counts of coliform bacteria (Benneh, Songsore, Nabila, Amuzu, Tutu, Yangyuoru, & McGranahan, 1993). It is quite likely that all the pouring from one vessel to another (which is not necessary in a piped supply) exacerbates the risk of contamination. Still, Kjellén (2000a) found pushcart water vendors in Dar es Salaam to be surprisingly quality-conscious. Moreover, a study covering several places in East Africa found water from vendors and kiosks as well as that which is piped to the house to be relatively safe in terms of low diarrhea prevalence among children in families relying on those sources (Thompson, Porras, Tumwine, Mujwahuzi, Katui-Katua, Johnstone & Wood, 2001; Tumwine, Thompson, Katua-Katua, Mujwahuzi, Johnstone, Wood & Porras, 2002). In any case, the fear of poor water quality is there, fairly or unfairly, despite the fact that most vendors display their goods as “clean water” or “pure water”. Water vending is normally a competitive business. Often, there are many people without jobs, and entry into the (artisan) vendor market is easy (although achieving profitability is more difficult). Pushcarts as well as containers can be rented on a daily basis, implying that little or no investment is needed in order to enter the market. As expressed by Collignon and Vézina (2000, p. 2): The level and harshness of competition in water markets may vary, but the earlier stereotypes of water vendors as highly exploitative in the prices they charge has been replaced with a recognition that the prices charged generally reflect real costs (UN-HABITAT, 2003).

Factors that Influence the Cost of Vended Water

The pricing of water by vendors have no fixing body or established basis and is generally left to the individual. Vendors, however, often respond to certain elements; the topography of area, the demand for water at any given time and the distance between the water sources and delivery points. In periods of water shortages, prices are higher than at ordinary times. Prices may depend on factors such as water availability, water quality and customer loyalty. According to Kjellen (2000), the price to the end consumers is typically determined by the cost and effort of procuring water, and the distance between the source and the point of delivery. Also, road conditions and elevation affect the effort that needs to be compensated by purchasing households. Water carriers are typically poor people themselves, supplying to other low-income people.

However, the lack of unionized system of operation resulted to the lack of non-collective pricing fixing body or established basis for a unit cost of clean and safe water (Wutich *et. al*., 2016; Ahmad, 2017). Although this contrast the observation of similar operators in Bolivia, where informal water vendors form an association as the basis for collective pricing of water (Wutich *et. al*., 2016). Though mutuality, collective self-interest exists among the actors, it does not culminate in communal water pricing, for affordable and reliable water supply to the urban poor (Ahmad, 2017). Rather, each water seller is self-motivated by profit; determine water price based on the value consumers attach to the water, the scarcity of improved water and the distance of the water wholesaler (Ahmad, 2017). This non-collective pricing predisposes the purchasing power of the poor households and renders them inaccessible to improved water supply services despite their spatial proximity to water in the informal settlements. Again, the cost of accessing water has led to many impoverished households to reduce their budgetary commitment of equally significant basic needs such as decent clothes, health needs, food and transport. From the survey, 85 (29.1%) of the clients disclosed their inability to purchase adequate food for domestic consumption due to the cost involved in accessing water, 52 (17.9%) are unable to cater for their health needs due to the frequent purchase of water.

Prices for vended water may be set competitively or controlled at any of the several possible points in a vending system. Any of the three categories of vendors may be formally or informally organized, or operate

independently. The prices distributing vendors receive may be set in a competitive market, while they may buy water from wholesale vendors with monopoly power. Alternatively, wholesale vendors may compete freely, but distributing vendors may be organized to control prices. Water from a public tap is generally free, but, when attended, the direct vendor makes a charge. Generally, the prices vendors charge for water are high because hauling water manually is labor intensive (Whittington *et. al,* 1989). The distribution of water by vendors is expensive, whether the vehicles are powered by people, animals or engines. Households which are served by vendors generally pay more per month for 20-40litres per capita per day than those directly connected to a piped system that might use as much as 400litres per capita per day. Households sometimes pay over 10% of their monthly income for vended water, as compared to 1-5% for most piped water systems (Whittington *et. al.,* 1989; Zaroff & Okun, 1984).

In a study conducted by Ahmed (2017) in Dala LGA Kano State, Nigeria, the retail water vendors pay ₦3–5 per jerry-can (₦60 per 12 or ₦100 per 20 jerry-cans pushcart). In the case of the hand-dug wells, each well has an average of 4 vendors on daily basis that pay a fixed rate of ₦100 and draw as much water as they can. Thus, each well can have a fixed rate of ₦400 every day. The maintenance of the well is carried out by the well owner to ensure continuity. The average price during dry season is ₦20.08 ($0.07) with a standard deviation of 4.97. The lowest price is ₦10 within 100m. During rainy season, the average price is ₦14.02 with a standard deviation of 4.20. The price during rainy season is low because households have enough water they have harvested and stored, and so the demand is low and consequently the price.

Similarly, another study by Salahudeen (2015) revealed that price differentials across the seasons indicate that during the raining season, the price for 25litres of water from the wheel barrow vendors is sold between ₦5 - ₦15, while during the dry season, the price for the same quantity of water (25litres) is sold between ₦10 -₦25. With price differentials that ranges between ₦5 - ₦10 across the seasons. Also, tanker truck vendors, costs between ₦3000 -₦ 3,500 per 1000litres during the raining season and between ₦4000 -₦5,500 for the same quantity (1000litres) of water during the dry season, indicating price differential that ranges between ₦1000 - ₦2000 across the seasons.

Water Vendors and Water Demand/ Supply

Persistently unfulfilled promises and delayed official responses to water problems induced citizens to adopt long term access strategies such as drilling deep wells (Daily News, 2010). According to Angueletou-Marteau (2007), the activity of small-scale water providers otherwise known as water vendors is not uniform everywhere, as they tend to respond to specific local demands. The presence of these operators depends on the physical and temporary availability and accessibility of water, the location of the demand, the type of settlements, and the financial means of households. Hence, there is a big disparity in sourcing for water from the alternative water providers.

The main advantage of independent providers is that they are demand responsive, as they increase their service delivery as demand grows (Solo, 1999). They are able to adapt their offer to local conditions and to offer flexible, convenient services perfectly tailored to the needs of diverse customers with a flexible payment system. Prices may depend on factors such as water availability, water quality and customer loyalty. They are highly innovative and are typically not restricted by conventional engineering standards on service provision (Njiru, 2004). Thus, technical, operational solutions found in one part of the city will not necessarily be transferable to another location. The demand may be seasonal (only in summer, when the municipal supply is insufficient), exceptional (for festivals and celebrations) or on a more regular basis. Exceptional supply conditions: extreme drought, heavy monsoon rains, or mechanical breakdown of the network may disturb water markets. For example, the heavy rainy season of July-August 2005, which destroyed kilometres of pipelines, made tankers' water supply essential for the survival of large parts of the peri-urban population of Mumbai in India Angueletou-Marteau (2007).

Given their nature, water vendors cannot easily access the sources of finance that formal companies do. Banks consider them as high risk and would not therefore advance funds for business purposes. Research shows that water vendors are faced with a number of constraints mainly because of their informal nature of operation. Such constraints are related to factors such as regulation, policies, competition, lack of technical skills and capacities, financial resources and social discrimination. Being informal and often considered illegal, conventional water

utilities regard water vendors as enemies. Perhaps because of their innovativeness and need for survival, water vendors operate whenever there is a need, regardless of whether the prevailing political climate is enabling or hostile (Njiru, 2004).

The availability of the resources will determine the quantity of water supplied. So, providers have to diversify their sources throughout the year. They are often blamed for supplying unsafe water and households are very sensitive to this feature. The survey showed that people associate a certain quantity and quality of water for each use. Households are very keen to get at least 20-40litres of good quality water per day for drinking and cooking. Often, the illegitimate character of water vendors inhibits the investments that would improve the reliability or quality of supplies (Njiru, 2004). Baker (2006) emphasized that water sources varied significantly. According to a study in Cambodia, about 75% of water vendors secure their water from pumped surface water, whereas in the Philippines, estimated 69% relied on ground water for their operations, in Kenya, most operators had gravity systems fed by springs while 13% in Philippine sell water purchased from public utilities or private suppliers.

Water Vending and Distribution Pattern

Vended water providers mostly operate in low-income areas and depend mainly on public standpipes or private standpoints for water. In the case of water scarcity, the number of users at these public standpipes may be large and often forcing people to stand in long queues and spend many hours to retrieve water. In a nutshell, water vending goes on more often on a daily basis than weekly or monthly, with the daily procurement of water also enabling various households have their water demand met by their daily supplies with the least chances of incurring wastage, which is usually the case in the face of having more than what they need for a day (Onyenechere, Eleazu, Azuwike, Osuji & Igwe, 2012).

In some areas, vendors use donkey or horse-carts. For instance, McIntosh (2003) observed that in Karachi (Pakistan) about a fifth of the population is served with vendors using tankers, donkey carts, or manually transported leather bags. Elsewhere, low-income urban dwellers in Nouakchott (Mauritania), Dakar and Bamako are able to buy small quantities from donkey or horse-pulled carts (Collignon & Vézina, 2000). Paid water vendors are typically male, and use some form of equipment in order to carry the heavy load of water. This includes the use of plastic or metallic cans loaded onto bicycles, tricycles, hand-pushed carts, tankers and head carriers. Water vending especially through the use of carting/wheel barrows is a heavy and physically demanding activity. It is normally a competitive business and is often engaged in by those without any reasonable form of sustainable jobs, and entry into the (artisan) vendor market is easy (although achieving profitability is more difficult) (Kjellen & Mcgranahan, 2006).

The distribution pattern of water vendors can be describe from the point of obtaining water at source to the delivery of water to the consumers. Usually, water vendors often obtain water from sources very far from their delivery points. Although, the distribution pattern of water is not common in all places where there is prevalence of water vending. In some places, water vendors obtain water within the area from either public and/or private stand-pipes, protected and unprotected dug-wells, boreholes, rivers, etc., and distribute it to their customers. While in some places, vendors obtain water outside the area and travel a long distance to distribute the water to their customer. According to Kjellen (2000), whether water vendors obtain water within or outside a particular area, the common thing is that they travel a substantial distance to distribute water.

Challenges of Patronizing Water Vendors

Water quality and prices have often been considered as the most common challenges faced by those that patronize vended water. It is generally believed that water does not cost the same everywhere; the price of water varies widely between cities and rural areas and between economic sectors. Increasing cost of water has slowly provided incentives to change the way water is valued. As noted by Baisa, Davis, Salant & Wilcox (2008) that in water vending, the following costs are considered; pumping, treatment, storage and purchase costs as such, price is, no doubt, the most important determinant of a household's decision to opt for a new source of supply. Residents that resort to buying water from vendors often do so at extremely high prices, often 5-10 times existing tariffs for public water supply. Studies by Whittington *et al.* (1989) reveal that in the dry season water vendors

delivered twice, as much water as the public water system and that payment for vended water were more than 20 times the payments made for water from the utility in Onitsha Anambra state Nigeria. (Onyenechere, *et al.*, 2012) discovered that the price of water is usually influenced by the volume of sales; it costs N4000 ($27) to procure 1,000litres of water and N2500 ($16.7) to procure 500litres from tanker vendors (wholesale). While in the case of retail (cart/wheel barrow vendors), it costs N30 to procure 20litres (1 gallon) of water.

In addition, prices of vended water were reported to be up to 40 times the amount charged by water utilities in areas where the utility supplied the water which is then trucked or carted to neighboring areas beyond the water lines (Zaroff & Okun, 1984). This is further supported by Kariuki & Schwartz (2005) who found that water collected from point sources and sold through vendors cost up to 4.5 times utility water while water delivered door-to door cost up to 12 times utility-supplied water. The researcher went on to stress that water vendors do not have access to the subsidies (such as finance from government and bank loans) that support most water utility systems, as such, it is not surprising that vendor's products are more expensive.

Also, the higher cost of vended water over utility supplied water account due to the labor-intensive nature of water vending coupled with the added cost of vended water arising from the additional service of providing water in a variety of quantities without the advantages of economies of scale (Snell, 1998; Solo 1999; McIntosh, 2003). Private water vending is a competitive business in most areas and prices are set to cover costs (Solo, 1999). Truckers are often the only type of water vendor able to access formal loan programs, since there is a tangible asset to support the loan (Snell, 1998). Other vendors often obtain credit through informal sources that may charge between 5 and 10% interest per month (ADB, 2003).This situation also causes the price of vended water to vary. Kjellén & McGranahan (2006) argued that different types of vended water vary in their price and these variations depend on the distance from where water is drawn and its availability. The influence of other factors on the price of vended water such as water quality, customer loyalty, seasonal variation of water availability and cost at the purchasing point are noted by Njiru (2004).

Beyond cost considerations, vending is sometimes linked to health problems as hawkers may sell from polluted sources or fouled containers at each point of handling through collection and transport. UNICEF/WHO (2000) reported that water vendors use a range of sources both protected and unprotected, due to the unregulated nature of their work, most of the water sold to the public are not of portable quality, a situation that spurs up water borne diseases. Significant evidence which exist reveals that quality changes in such circumstances may be extreme and respond to the extent of handling (Quick, Venczel, Mintz, Soleto, Aparicio, Gironaz, Hutwagna, Greene, Bopp, Maloney, Chavez, Sobsey & Tauxe, 1999). Furthermore, in many cases, the consumers are not aware of the source of water and there may be significant concerns about the quality of water (Lloyd, Bartram, Rojas, Pardon, Wheeler and Wedgewood, 1991). For instance, Whittington *et al.* (1989) stated that many water vendors who purchase water from tanker trucks and water vendors who resell by buckets to individual are the ones who exacerbate the risks of contamination and reduction of the water quality. They further argued that on annual basis, households in Onitsha pay water vendors over twice the cost of piped water. In contrast, Solo (2003) reported vended water in Argentina to be less expensive than utility supply but thought to be inferior because of the sulphur content that had not been removed. Bichi & Amatobi (2013) posited that water quality was compromised at the private commercial supply, during hawker's distribution and in the household storage items in a related study carried out in Sabon Gari area of Kano State.

Empirical Review of Related Literatures

This section reviews some empirical studies on the contribution of water vendors and the challenges associated with water vending. The following reviewed literature exudes the significant role of water vendors in the supply of water for domestic use and the challenges associated with patronizing vended water.

Globally, water vending is common in many parts of the world where scarcity of supplies or lack of infrastructure limits access to suitable quantities and quality of drinking water (WHO & UNICEF, 2000). There is widespread recognition and acceptance that conventional water utilities have fallen short in providing adequate water services to populations especially the urban poor. Households therefore seek other alternative sources which in most cases are unsafe. Prominent among these sources is water vending (Olajuyigbe *et al.*, 2012). Water vending

is often taken as a symptom of a failure in piped water systems, which still plays significant roles in providing water to many urban dwellers in many parts of the world. This is often attributed to high concentration of human population, industrial and commercial activities which consume large quantity of water and this situation leaves majority of the residents to rely on water vendors and other sources of water supply to meet their water needs (Salahudeen, 2015). It is therefore believed that recognizing the role of water vendors as an integral part of the water system may help in the design and implementation of more comprehensive policies, which better serves the consumers. In this way, water vendors could be recognized as the extension of the piped system.

In this sense, there would be a better planning of investments and organization of the service and better coordination between the different stakeholders of the water sector so as to ensure that the quality of services received from vendors complies with certain standards and that those customers are not exploited. The distribution of water by vendors is expensive, whether the vehicles are powered by people, animals or engines. Households which are served by vendors generally pay more per month for 20-40litres per capita per day than those directly connected to a piped system that might use as much as 400litres per capita per day. In addition, vendors sometimes sell water from polluted sources or fouled containers. Therefore, water quality and prices have often been considered as the most common challenges faced by those that patronize vended water.

Whittington *et al.* (1989) conducted a study on Water Vending Activities in Developing Countries, which revealed that millions of people in developing countries obtain water from commercial vendors who deliver it to their homes, yet this phenomenon has received little attention from professionals in the water resources field. This describes water vending system which is in operation in Ukunda, Kenya, a town of about 5000 people south of Mombasa. In this community, 45% of water consumed by households is obtained from water vendors who deliver water in carts directly to people's homes. The prices vendors charge for water are high, but vendors are not making exorbitant profits; hauling water manually is simply expensive. People in Ukunda spend about 9% of their income on vended water, which suggests that there are situations in which households are willing and able to pay substantial amounts of money for water even when traditional sources are readily available.

Similarly, a study by Collignon and Vézina (2000) on Independent Water and Sanitation Providers in African Cities revealed that the majority of people living in poor urban neighborhoods and informal settlements in developing countries do not have adequate water and sanitation services. Over 75 percent of the urban poor get water directly from a range of private but small independent providers (push-cart vendors, water tankers, and network providers). The study further indicates that independent providers are creatively tackling the challenge of water and sanitation service delivery in a variety of ways, and may be the only option for many poor urban households. Interestingly enough, the entrance of the large-scale private operators into the water and sanitation sector has brought about a renewed interest in the small-scale private operators. Until now, little work has been done to understand or to develop the capacity of the alternative providers, since their activity was perceived as a temporary and marginal solution.

Onyenechere *et al.* (2012) conducted a study titled “The Dynamics of Domestic Water Vending in Enugu North L.G.A., Enugu State”. The primary data was obtained through the use of questionnaire. The data for this study were gathered from a sample survey of 200 households. Data obtained from the field were analyzed using descriptive statistics and chi-square test. The analysis revealed that almost all the residents of Enugu North L.G.A. obtain their water from independent water vending systems which are operated by the private sector. Majority of the respondents are low income earners who spend within the ranges of NGN500 ($3.33) and NGN1500 ($10) a month on water on the average. 50.0 percent of these respondents opined that vended water was expensive. From the chi-square test, it revealed also that there is significant difference in the unit cost of water sold by vendors in the various wards in Enugu North L.G.A.

Similarly, Ahmad (2017) on a study “The Role of Water Vendors in Water Service Delivery in Developing Countries: a case of Dala local government, Kano, Nigeria”. The study employed cross-sectional mixed method. It was stratified for sampling. The data was obtained through the use of questionnaire. Due to limited resources, 250 questionnaires were administered to the heads of households. The study revealed that price differs in different wards due to proximity of the sources (ease or difficulty by which vendors can get water) and seasons.

Households are already paying more for water because the price of vended water is almost 28 and 40 times that of in-house connection from KNSWB during rainy and dry season, respectively.

Also, Rahaman & Ahmed (2016) in a study titled "Water Pricing for Slums Dwellers in Dhaka Metropolitan Area". For this study, 150 respondents from the three selected slums were interviewed through questionnaire survey. The result revealed that slum dwellers are paying about 7 to 14 times higher than legal connection holders covered by Dhaka Water Supply and Sewerage Authority (DWASA). Slum dwellers are spending about 13% to 23% of their average monthly income for domestic water supply, whereas in most of the countries, legal connection holders are spending less than 5% of their average monthly income for the same purpose (Rahaman & Varis, 2005). It is also observed that laws to prevent environmental pollution are rarely enforced.

Again, Ishaku *et al*. (2010) in their study titled "Role of Private Water Vending in Nigerian Peri-urban Informal Settlements of Yola North in Adamawa State of Nigeria'. The study employed stratified sampling and a total of 300 households were surveyed with 100 observations from each settlement. The study revealed that the activities of water vendors are never regulated by any agency and this has economic consequences on the households. That is, the households end up paying more to obtain water from the itinerary vendors.

Furthermore, another study by Nura, Aminu, Ahmad, Abdulkadir & Mahmoud (2020) on "Water Vendors Participation in Domestic Water Supply in Unguwa Uku, Tarauni Local Government, Kano State, Nigeria" revealed that water vendors plays significant role in providing water especially to urban dwellers in many parts of developing countries, Nigeria inclusive. The majority of the respondents buy water from vendors on daily basis about 64%, while 12% are patronizing vendors on weekly basis and the rest buys water twice or thrice in a week. The price of vended water also varies in the area depending on the proximity to the source about 27%, insufficient water vendors 20% and high demand for water account for 41%.

Another study conducted by Kjellen & McGranahan (2006) titled "Informal Water Vendors and Urban Poor" revealed that given the prices that vendors often charge, many low-income households cannot afford to purchase sufficient water to meet their hygiene needs. But for the most part, high vendor prices are the symptom, not the cause, of insufficient water provision. The study further states that vendor's services could be improved through gaining more recognition.

In a study also by Dakyaga *et al*. (2018) titled "Domestic Water Sustainability under Informal Water Supply Markets in Dar es Salaam, Tanzania". The study employed a multi-stage sampling technique. A representative of 292 household's head or persons aged 18 and above were selected and interviewed. The data was collected through the use of questionnaire. The study revealed that while the poor can afford 200 liters of water from the tankers, tanker operators limit domestic water delivery to 10,000 liters which is wholly above the financial abilities of the urban poor. Poor quality of water serves as a major dis-incentive for domestic water access and consumption in the informal settlements. Even clean and safe water hauled from the public water reservoirs by the water sellers get deteriorated due to poor water handling and quality regulation. The quality of water supply by informal water sellers usually vary between seasons and are highly unsuitable for domestic consumption in the dry season due to water scarcity.

Based on sources, Olajuyigbe *et al.* (2012) in their study titled "Water Vending in Nigeria - A Case Study of Festac Town, Lagos, Nigeria"; employed stratified sampling technique. The town has 7 major Avenues and 3 Avenues were randomly chosen for the study. A sample size of 1,139 amounting to 5% of the total number of households in the 3 Avenues were considered. 10 out of the 27 registered vendors were selected for the study. There are 135 informal vendors in the study area out of which 47 were selected. To further avoid bias, questionnaires were administered on these randomly selected water vendors in all the major avenues in the study area. The study revealed that in the face of absolute neglect by the government with respect to water provision, the trauma that households would have passed through would have been enormous without the intervention of the water vendors. No doubt, this source is defined as unsafe, yet the greatest concern in this regard is the informal water vendors that largely obtain their supplies from unsafe sources. Despite the fact that NAFDAC is giving licenses to formal vendors, sustainable solutions need to be developed especially in the area of developing

mechanisms to incorporate informal water vendors that have been making significant contributions to water provision.

In conclusion, from the above empirical review it was revealed that the privatization of water systems mainly stems from the long-standing paucity of water in many areas as well as structural and geographical imbalance of investment in the piped system. This renders only a minority of the population able to rely directly on piped water services. Others rely on a multitude of alternative ways of accessing water. On one hand, experts lament the "myth" that water is a free good, but when people treat it as a normal economic commodity, this too is unacceptable. Given the prices that vendors often charge, many low-income households are already paying more than public stand-pipes and cannot afford to purchase sufficient water to meet their domestic needs. Whereas on the other hand, water vendors are also blamed for supplying unsafe water from unimproved sources which often lead to water-related diseases. Although, it is the poor who are most likely to depend upon unimproved water and sanitation services, and thus are most likely to suffer from water insecurity in household level.

SUMMARY OF LITERATURE REVIEW

Based on all the reviewed relevant literature, it reveals that there is no specific study/research carried out to assess the "Effects of Water Vendors as Supplementary Source of Domestic Water Supply" in the study area known to the researcher. This study therefore intends to fill this gap in the previous studies reviewed and to further show the significant role that water vendors plays in the supply of water for domestic use in Keffi town. Therefore, to ensure the validity and reliability of the results to be obtained, several methodologies for this similar study were employed by different authors. Previous studies on this phenomenon entirely made used of either case study, survey, descriptive, qualitative or ethnographic research strategy. A review of these studies revealed that these strategies are useful for taping the experiences and insight of the clients served but limited to depicting the proportion of urban households served by each of the informal water vendors. They also either made use of interview, Focus Group Discussion and / or questionnaire to obtain information from their respondents. Drawing lessons from the above methodological approaches, method used by Dakyaga *et al*. (2018) was adopted because it best suites the aim of this study.

Therefore, this study employed survey research method to investigate the contribution of informal water vendors, their capacities and clients' perspectives of vended water and the challenges of water vending, since it is used in determining present trends and solves current problems, as well as contributes to the advancement of knowledge as it affords penetrating insight into the nature of what one is dealing with. The study also, adopted a multi-stage sampling technique to ensure that all the respondents had equal chance of been selected. In this regard, the study draws largely on qualitative data to harness insights on the contribution of water vendors in domestic water supply, using the questionnaire method of data collection as substantial numbers of the respondents are literates. This strategy was useful for understanding the functionality of each informal water suppliers and the proportions of urban households served.

STUDY AREA AND METHODOLOGY

Study Area

Location, position and size

Keffi is both a Local Government Area and an historic town located in Nassarawa State, North -Central Geopolitical Zone of Nigeria. It lies between latitudes $8^0\,51^{'}$ and $8^0\,53^{'}$ North of the equator and longitudes $7^0\,50^{'}$ and $7^0\,51^{'}$ East of the Greenwich meridian. It is bounded by Karu and Kokona L.G.As of Nassarawa State. According to Marcus (2007), Keffi has a landmass of approximately 140.47km^2 which happens to be the smallest L.G.A in Nassarawa State. In comparison, Keffi is about 20 times smaller than Awe, Doma, Karu, Lafia and Toto L.G.As and about 41 times smaller than Nassarawa L.G.A, the largest in the State (See fig. 3.1 and 3.2 respectively).

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VII July 2026

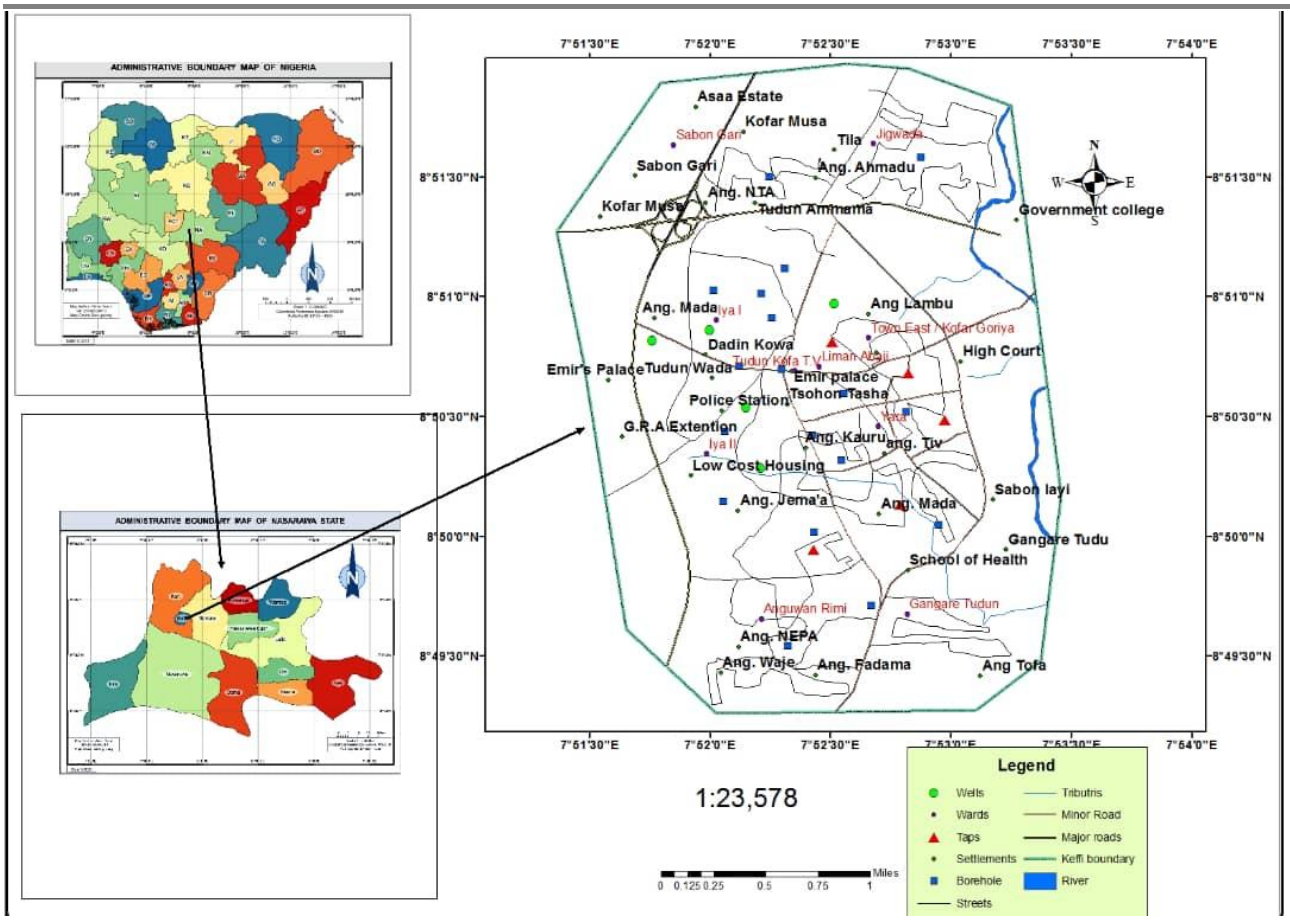

Figure 3.1: Map of Nigeria Showing the Study Area

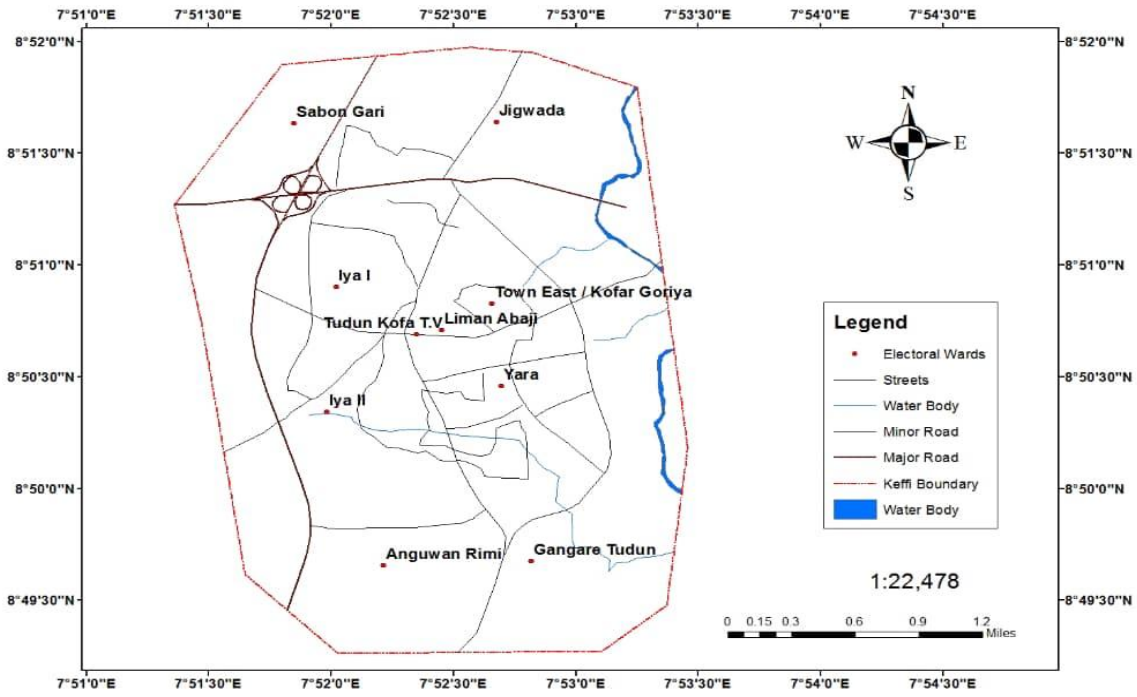

Figure 3.2: Map of Keffi Local Government Area Showing Electoral Wards

Source: Field Work (2024)

Climate

Keffi is characterized by a tropical sub-humid climate (Binbol, 2007:35 & Lyam, 2000:384). Temperatures are generally high in Keffi especially during the day, partly because of its location in the tropical sub-humid climate (Binbol, 2007 & Lyam, 2000). Weather conditions in Keffi are influenced by its location within the Niger-Benue trough on the windward side of the Jos Plateau and at the climate transition zone between the essentially 'humid' south and the 'sub-humid' north of the country. The high temperatures and the relative humidity in the Niger-Benue trough give Keffi a heating effect. Binbol (2007) observed that there is a gradual increase in temperature from January to March and that the onset of rains in April ushers in a noticeable decline in temperature. Average monthly temperatures ranges between 26.8^0C and 27.9^0C (Binbol, 2007 & Lyam 2000:385), with the hottest month being March/April and the coldest month being December/January (Lyam 2000:385). Unlike the other elements, wind velocity in this region is relatively steady. Temperatures are generally high during the day, particularly between the months of March and April (Binbol, 2007).

Keffi has two distinct seasons, namely the rainy season that begins around March and runs through October, and the dry season which begins from October and ends in March. The temperature value ranges between (23^0C-33^oC) while the humidity value ranges between (64%-96%). However, within these seasons is a brief harmattan season that is occasioned by the north east trade wind and the attendant dust haze, increased cold and dryness (NIMET, 2011). Binbol, (2007) added that rainfall occurrence are mostly in form of frontal and conventional nature. The rain comes with thunderstorms of high intensity, particularly at the beginning and towards the end of the rainy season (Lyam 2000:384). The annual rainfall is 602mm, which reflects Keffi's location on the windward side of the Jos Plateau while the monthly rainfall distribution intensifies during the months of July, August and September (NIMET, 2011).

Relief and Drainage

Keffi occur as part of the North Central Highland. Rocks found in this region are basically rocks of basement complex. The rocks are mostly igneous and metamorphic in nature. However, sedimentary rocks are also found. The Maloney Hill found in Keffi is a historic relief feature. It is located at an average altitude of 850m above sea level. Keffi is underlain by the Precambrian Basement Complex rocks and consists mainly of gneisses and schist with migmattite, granites and small occurrences of quartzite, pegmatite, amphiboles, granitic gneisses and diorites. The rocks date back to the Paleozoic era and boundaries between them are gradational.

The study area is also characterized by undulating terrain which is composed of low-lying lands towards the southern part of the area and a network of hills in the north. Thus, allowing the area to be drained by the Anto River and meanders through the interlocking dissection of the terrain (Binbol, 2007). Most of the rivers in Keffi are tributaries of other larger rivers. Water resources in the area include surface water and ground water. The surface water in the region is found in river channels and rivulets. The presence of water on the surface however varies in space and time. The amount of water available for human exploit is affected by climate and the geology of the area. Water in the area is usually seasonal. During the dry season, water becomes limited and can only be found in perennial streams and rivers. Surface water is further depleted in the dry season by high evaporation and seepage. The region is made up of basement complex rocks which are exposed to the surface and raised to meaningful heights thereby constituting the water-shed for most streams and rivers. River Anto, the major river in the area, flows from North to South providing water for drinking, washing and outlet of some marshy places for rice and sugarcane farming.

Soils

The predominant soil parent materials in Keffi are derived from the cretaceous sandstone, siltstone, shale and ironstone of the Precambrian to Cambrian (Samaila & Ezeaku, 2007). According to Lyam, (2000), the hilly areas in Keffi carry shallow skeletal soils and some parts of the region are heavily gulley. He added that since most of the inhabitants are farmers, extensive areas are also cleared for farming, thus exposing wide areas of land to sheet erosion. The soils are derived mainly from the basement complex formation and older sedimentary rocks. Lateritic crust occurs in extensive areas on soils on the basement complex while hydromorphic soils are common

along the Anto River and floodplains of major rivers. Soils in the area are generally deep and well drained with high fertility rating and variable run-off potential.

Vegetation

Keffi falls within the Southern Guinea Savanna Zone (Lyam 2000), with some characteristics of Northern Guinea Savanna (Aboki et al, 2007). However, the clearance of vegetation for farming, fuel wood extraction for domestic and cottage industrial uses and saw-milling has led to the development of regrowth vegetation at various levels of serial development. Aboki *et al* (2007) explains that the vegetation of Keffi, which lies in the Guinea Savanna is a derivative of the tropical deciduous forest that existed centuries ago. He added that the vegetation is characterized with interspersions of thickets, grassland tree savannah, and fringing woodland or gallery forests along the valleys.

The dominant woody species in this area include *terminalia laxiflora, albizia zygia, ficus exasperate, ficus syncomorous, khaya senegalesis, tarmarindus indica* (tsamiya*), parkia biglobosa (*Doruwa), *vitellaria pradoxa "Kadanya" (*Shear butter*), vitex doniana (*dinya*), Annona senegalensis* etc. (Aboki et al 2007). He listed the species of grasses that are found in Keffi as *penisetum, andropogan, monocymbium, ceressiformse, hyparrhernia, brancharia* and *aristida* among others. Lyam (2000) confirmed that the vegetation on the hilly parts of Keffi is composed mainly of grasses and isolated trees.

Geology and Hydrogeology

The geology of Keffi consists mostly of the Basement complex; Migmatite-Gneisses associated with the older granites. The Migmatite-Gneiss rocks in this region are made up of migmatites, gneisses, augen gneisses and porphyroblastic gneisses. The older granites are mainly biotite granites (Obaje et al 2007). Important solid minerals that are found in Keffi include clay, talc, Quartz, feldspar, laterite, mica granite and gemstone (Obaje *et al*, 2007 & Lyam 2000).

The occurrence of groundwater in Keffi shows that the northern part of the state, which is overlain by basement complex rocks, has an unpredictable quantity. It is therefore not surprising that most water schemes in the state are by river abstraction. The southern part of the state which is also underlain by basement complex rocks has appreciable layer of sedimentation, notably for water retention. In Keffi, water embedded in underground sources is also important for water supply. The groundwater also varies in time and space in terms of quantity and quality. This variation is attributed to the nature of rock, climate and other environmental factors. This groundwater is usually tapped through wells and boreholes. (Samaila & Binbol, 2007).

Population and Socio-economic Activities

The 2006 population census estimated the population of Keffi at 92,664 persons, with a distribution of 47,801 male and 44,863 female (NPC, 2006). The area has a population density of 661persons/km^2. Keffi has 10 electoral wards by Independent National Electoral Commission (INEC) which include Angwan Rimi, Angwan Iya I, Angwan Iya II, Gangare Tudu, Jigwada, Keffi Town East/Kofar Goriya, Liman Abaji, Sabon Gari, Tudun Kofa T.V and Yara wards respectively. The dominant Indigenous tribes in Keffi include Fulani, Hausa, Igbo, Eggon, Yeskwa, Gwandara and Yoruba (Dalat & Filaba, 2007). Traditional worshipers are widespread. However, the two leading religions (Christianity and Islam) have made a greater impact among the people (Lyam 2000). The social organization and culture are a reflection of their traditional religious affiliations. While Hausa and English are widely spoken in Keffi, Lyam (2000) explains that all ethnic groups in the area also have their own dialects or languages.

Crop production and rearing of animals are very common in this region. Keffi is one of the important Agricultural Zones in the State. Irrigation farming is also widely practiced in Keffi. The Ungwar Jarme Keffi TV- point, Tilla upland, Keffi, and Gwalada panda are all important irrigation schemes in the area. The main crops cultivated here includes maize, rice, guinea corn, millet, yam, sweet potatoes, beniseed, tomatoes and green vegetables etc. Livestock keeping and rearing are also largely carried out (Lyam, 2007). There are local industries like wood

carving, pottery, dyeing, cloth weaving and blacksmithing that also thrive in the area. Keffi Town is also one of the commercial centres in Nasarawa State. Its close proximity to the Federal Capital Territory (FCT) has led to development of hotels, business centers and shopping centers.

Also, Keffi is a home to a number of educational institutions, and famous among them are the Government College Keffi (GCK) and Nasarawa State University Keffi. Marcus (2007) summarized the distribution of educational institutions in Keffi as follows: 24 Public Primary Schools, 19 Private Primary Schools 4 Public Secondary Schools, 5 Private Secondary Schools only two tertiary institutions. He further summarized the list of health institutions in Keffi as 34 Private Primary Health Care (P.H.C), 21 Public PHC, 8 Private Secondary Health Care, 2 Public Secondary Care and 1 Tertiary Health Care which is the famous Federal Medical Centre (F.M.C), Keffi. He also added that Keffi has 35 Public Doctors, 7 Private Doctors, 2 Dentists, 166 Nurses and Midwives, 2 Radiographers, 12 Pharmacists and 11 Laboratories Scientist.

METHODOLOGY

Research Design

This study employed survey method, which is aimed at obtaining knowledge from the respondent's point of view, experience and opinion about the situation as it affects them. Based on the number of contact with the target population, the study employed cross-sectional approach as it draws largely on qualitative data. Specifically, it involves questionnaire method of data collection to acquire the personal experience of the respondents. It takes into cognizance the here and now, that is, the present conscious experiences of the populations under study.

Reconnaissance Survey

A reconnaissance survey was conducted so as to get acquainted with the environment and the people living in it. The objective of this survey was to observe and explore the water supply situation as well as the activities of water vendors in and around the study area. During this survey, oral interviews were conducted with some of the residents regarding issues relating to water demand and supply, and on water vending activities so as to ascertain the relevant issues to be addressed in the questionnaire.

Types and Sources of Data

The study draws largely on qualitative data. The data generated for this study were mainly data on the socio-economic characteristics of the residents and water vendors, sources and per capita consumption of vended water, and the challenges of water vending in the study area.

In order to achieve the aim and objectives of this study, the study employed both primary and secondary data sources. The primary data source involved the use of questionnaire to obtain information from the respondent's experiences. The secondary data sources were obtained from both national and international publications, including books, journals, conference papers, seminar papers, thesis, national survey reports and other research findings.

Sampling Technique and Sample Size

Firstly, Keffi town was purposively selected based on the prevalence of water vending activities and also due to it rate of urbanization and widespread of informal settlements (Andreasen & Møller-Jensen, 2015), since rapid urbanization has a relationship with informal settlements development and informal water services provision in Sub-Saharan Africa (Kombe, Ndezi & Hofmann, 2015). In this regard, a multi-stage sampling technique was employed to ensure that all the respondents had equal chance of been selected.

Secondly, the target population consists of water vendors and the residents (i.e. those who patronized water vendors) in the study area. The selection of the sampled population was based on electoral wards. There are 10

electoral wards apportioned by the Independent National Electoral Commission (INEC) in Keffi L.G.A, and five wards were randomly selected for sampling considering the homogeneity of the population in terms of water access experiences and the prevalence of water vending activities.

Thirdly, areas (settlements) within these wards were randomly selected and adults especially male/female head of the households were surveyed so as to ensure that the desired experiences of respondents were achieved. The households were selected systematically so as to ensure a fair and unbiased representation of the households in each of the selected area. Also, in order to determine the sample size of questionnaire to be administered, Krejcie & Morgan (1970) sample size table was used, which states that for a given population size more than 75,000 and less than 100,000 at confidence level of 95% and margin error of 5.0%; the required sample size for respondents is 383. In this regard, the sampled population was projected at 57,540. Therefore, given the above sample size 383, a total of 250 respondents were sampled due to limited time frame and resources. This was done considering the homogeneity of water access experiences and the distribution of vended water in the study area.

Table 3.1: Distribution of Sampled Populations Based on Wards

Ward	**Population**
Angwan Rimi	16,420
Angwan Iyayi	8,860
Liman Abaji	14,840
Kofar Goriya	5,420
Yara	12,000

Source: Modified from NPC (2024), as in Inarigu (2015)

Questionnaire Design and Administration

Two sets of semi-structured questionnaires were designed, both closed-ended and open-ended questions were administered to the residents and the water vendors. The questionnaire for the residents contained three (3) sections (A, B & C). Section A focused on the socioeconomic characteristics of households and this includes age, gender, marital status, level of education, period of stay, nature of households and average monthly income. Section B emphasized the per capita consumption of water which includes the major sources of water supply, water vendor's availability and patronage, amount of water bought and the amount spent on buying vended water. While section C is concerned about the challenges of patronizing water vendors. Also, the questionnaire for the water vendors contained two (2) sections (A & B). Section A, which emphasized the socioeconomic characteristics of water vendors and this includes nationality, state of origin, age, gender, period of residence, level of education, marital status, duration of time engaged in water vending and the average monthly income earned from selling water. Whereas section B focused on the challenges faced at sourcing and distributing vended water.

However, 200 questionnaires were administered to the resident's door posts with the help of three (3) enumerators whom were oriented and trained on how to interpret and distribute the questionnaires to the households. The questionnaires was administered to the head of the selected households and every detail explained to them and was left with the literate respondents for a minimum of three (3) days to allow adequate time for filling. For the unlearned ones, the researcher and three (3) enumerators had to fill the questionnaires in accordance with responses from them using the native language, Hausa.

Also, 50 questionnaires were administered to the vendors based on convenience by the researcher, interpreting the questions to them as majority of them have little or no formal education. This was also done considering the homogeneity and the mobile nature of the push-cart vendors, since they are often moving from place-to-place distributing water to their customers. It therefore means that 250 questionnaires were administered to the respondents.

Data Analysis

Data collected from the field were well recorded and categorized according to type. The acquired field data were then analyzed for adequate report. The Statistical Package for Social Scientists (SPSS) tool was used for the descriptive statistical data analysis (IBMS SPSS Statistics Version 21). It was used to generate descriptive outputs that were used to describe the characteristics of the respondents as well as water vending activities. The output was then visualized in text, percentages, tables and pie charts for interpretations and conclusions.

RESULTS AND DISCUSSION

Introduction

This chapter deals with the presentation and discussion of results gotten from the analysis of field data. The data presentation and discussion was carried out under the following themes; socioeconomic characteristics of the respondents; water vending in Keffi; sources of, quality and health issue associated with vended water; price and factors affecting the price of vended water; distribution pattern of water vendors; contribution of water vendors; challenges and solution of water vending.

Socio-Economic Characteristics of Respondents

Socio-economic Characteristics of Households

The socioeconomic characteristics of households have influence on domestic water access and distribution. In the study area, various households constitute a substantial number of males (59.2%) and of females too (40.8%). The age structure revealed that adults from the age 18 and above were surveyed for the study. This was to acquire reliable information from experienced and responsible individuals. According to table 4.1, majority of the respondents (31.6%) falls within the age group 29-38 years, followed by 39-48 years with (28.2%); while 18-28 years represents (18.3%) and 49-58 years (17.2%) of the study population. This implies that majority of the household heads in the study area are middle aged and not too old. Only a few (4.6%) respondents are old, between the ages 59 years and above.

Results on household's level of education as presented on figure 4.1 revealed that all the households interviewed have formal education. While 46.0% have acquired secondary school certificate, 26.3% attended tertiary institutions (which includes NCE, ND, HND and Bachelor's Degree). Those with primary education constitute (21.8%) of the population, while those with adult education constitute (5.7%) (See table 4.1). This means that most respondents are likely have positive attitudes towards hygiene and sanitation with regards to their domestic water sources and uses. This confirmed a study by Basani, Ishan & Reitlty (2008) where it was noted that education is positively associated with household choice of improved water source.

Table 4.1: Distribution of Household's Level of Education

Level of Education	Frequencies	Percentages (%)
Primary	38	21.8
Secondary	80	46.0
Tertiary	46	26.4
Adult Education	10	5.7
Total	**174**	**99.9**

Source: Field Survey (2024)

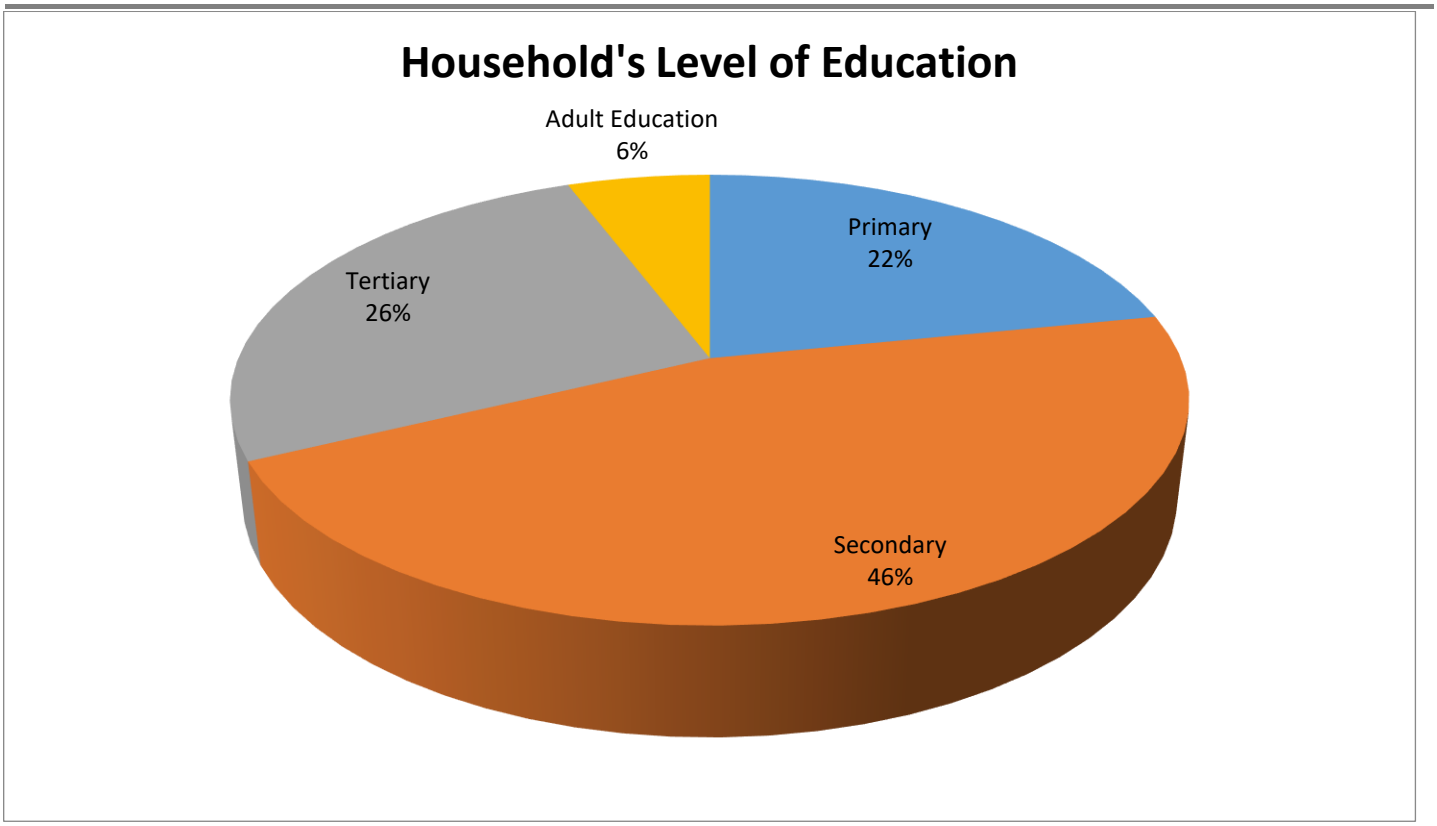

Figure 4.1: Household's Level of Education

As presented in table 4.3, it revealed that majority (69.0%) of the households are married, while 21.3% are single and 8.0% widowed; only 1.7% divorced. Most households are nuclear family (57.5%), while a good number also (42.5%) are extended family; with majority of the household size ranging from 0-4 persons (44.3%), followed by 5-9 persons (36.2%) and 10 persons and above (19.5%). This means that the sizes of most households is relatively large and are most likely to have high water consumption. This was also confirmed in a study by Cheesman, Benneth & Son (2008) where it was found that large household size increased household's water consumption by 50% in Vietnam. In addition, civil servants dominated the household's occupational status with 35.1%, while business/trade accounted for 22.9% and 11.5% artisans/labourers. Only minorities (8.6%) are military force, and 4.0% students. Majority (24.7%) of the household's monthly income ranged from ₦16,000-25,000; followed by those between ₦26,000-35,000 (21.8%), while those between the ranges ₦46,000-55,000 constitute (19.5%). Hence, a good number of the households can be considered to be low income earners since their monthly income is below the new national minimum wage (i.e. ₦70,000) as prescribed by the Federal Government for civil servants in Nigeria. It is therefore imperative that many households don't really earn enough that would enable them the opportunity to adequately and sufficiently obtain water that meet their domestic water need.

Table 4.2: Distribution of Household's Occupation

Occupation	**Frequency**	**Percentage (%)**
Force	15	8.6
Civil Servant	61	35.1
Farmer	31	17.8
Artisan/Labourer	20	11.5
Business/Trader	40	22.9
Student	7	4.0
Total	**174**	**99.9**

Source: Field Survey (2024)

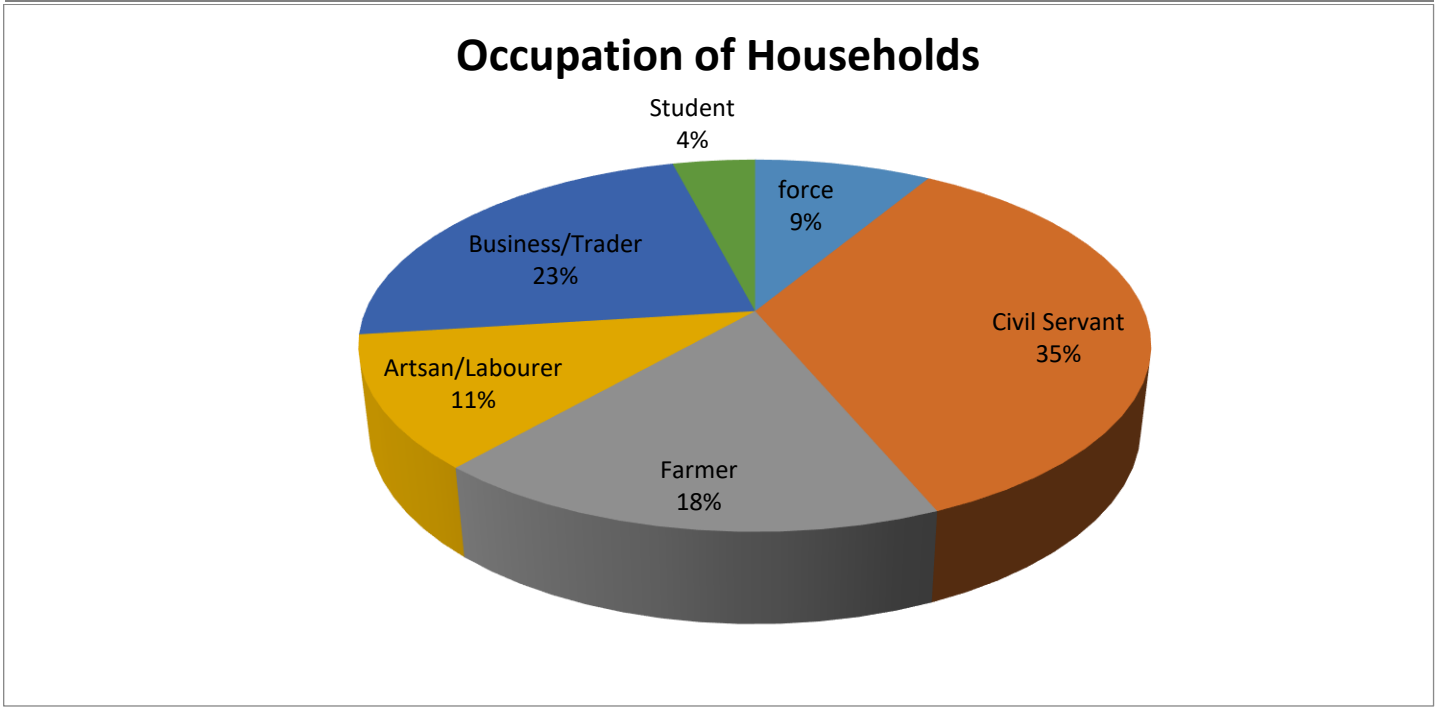

Figure 4.2: Households Occupation

Table 4.3 Other Socioeconomic Characteristics of Households

Parameters	**Frequencies**	**Percentages (%)**
Age		
18–28 years	32	18.3
29–38 years	55	31.6
39–48 years	49	28.2
49–58 years	30	17.2
59 and above	8	4.6
Gender		
Male	103	59.2
Female	71	40.8
Period of Residence		
1–5 years	38	21.8
6–10 years	52	29.9
11–15 years	30	17.2
16–20 years	32	18.4
21 years and above	22	12.6
Marital Status		
Single	37	21.3
Married	120	69.0
Divorced	3	1.7
Widowed	14	8.0
Monthly Income		
₦5,000–15,000	13	7.4
₦16,000–25,000	43	24.7
₦26,000–35,000	38	21.8
₦36,000–45,000	25	14.4
₦46,000–55,000	34	19.5
₦56,000 and above	21	12.1

Nature of Household		
Nuclear	100	57.5
Extended	74	42.5
Size of Household		
0–4 persons	77	44.3
5–9 persons	63	36.2
10 persons and above	34	19.5

Source: Field survey (2024)

Socio-economic Characteristics of Water Vendors

Vendor's nationality revealed that majority (96.0%) are Nigerians, with few (4.0%) from Niger Republic. Among the vendors from Nigeria, majority (38.0%) are non-indigene from Sokoto State, followed by those from Jigawa State (14.0%). Katsina State constitutes (18.0%), Bauchi State (6.0%), Gombe State (10.0%) and Kano State (6.0%). Only few (8.0%) are indigenes from Keffi (see table 4.4). This implies that most water vendors are solely there for business purpose, which in turn means that water vending is a means of livelihood (job) for many especially poor people who are not educated. Vendor's period of residence in Keffi as shown in table 4.4 revealed that majority (60.0%) of them have stayed for a period of 1-5 years, and a period of 6-10 years (32.0%), while only few have stayed for a period 16-20 (2.0%) and 21 years and above (6.0%) respectively. This means that over the years, there was an increase in the number of water vendors as water scarcity and demand keep increasing. Also, based on the level of education, 86.0% of the vendors have no formal education, while only few (14.0%) attended primary school. This implies that majority of the vendors have little or no formal education.

Also, the age structure revealed that majorities (76.0%) are between the ages 18-28 years, followed by those between the ages 29-38 years (22.0%). The least percentage (2.0%) of the age groups is 39-48 years. This implies that a good number of the water vendors are young and are energetic enough to cope with the physically challenging nature of the work. On the aspect of gender distribution, it is clear that in Keffi water vending activity is only carried out by men (100%). This finding is similar to studies by Salahudeen (2015) & Ahmad (2017) who reported that 100% of the sampled vendors were males.

Furthermore, vendor's marital status revealed that majority (82.0%) are married, while few (16.0%) are single. Vendor's years of vending experience also revealed that many (60.0%) have been in the business for 1-3 years, followed by those between 7-9 years (30.0%). While 28.0% are between 4-6 years, those with 10 years and above working experience in the business accounted 0.0%. Water vendor's monthly income shows that majority (36.0%) earn ₦51,000-70,000, followed by those with monthly income of ₦30,000-50,000 (30.0%). Income earners of ₦71,000-90,000 accounts for 24.0%, while those who earn ₦91,000-110,000 accounted for 4.0% and those who rarely earn ₦111,000 and above accounted for 6.0% respectively. This means that water vending which is often not considered and underrated by many, actually pays more than some civil servants whose monthly income are depended on government minimum wage.

Table 4.4 Socioeconomic Characteristics of Water Vendors

PARAMETERS	FREQUENCIES	PERCENTAGES (%)
Nationality		
Nigerian	48	96
Niger	2	4
Age		
18-28 years	38	76
29-38 years	11	22
39-48 years	1	2
49-58 years	0	0
59 and above	0	0

Gender		
Male	50	100
Female	0	0
Period of Residence		
1-5 years	30	60
6-10 years	16	32
11-15 yrs	0	0
16-20 yrs	1	2
21 yrs and above	3	6
Education		
No formal education	43	86
Primary	7	14
Secondary	0	0
Tertiary	0	0
Marital Status		
Single	8	16
Married	41	82
Divorced	1	2
Widowed	0	0
Period Engaged In Water Vending		
1-3 years	21	42
4-6 years	14	28
7-9 years	15	30
10 years and above	0	0
Average Monthly Income		
₦30,000-50,000	15	30
₦51,000-70,000	18	36
₦71,000-90,000	12	24
₦91,000-110,000	2	4
₦111,000 and above	3	6

Source: Field survey (2024)

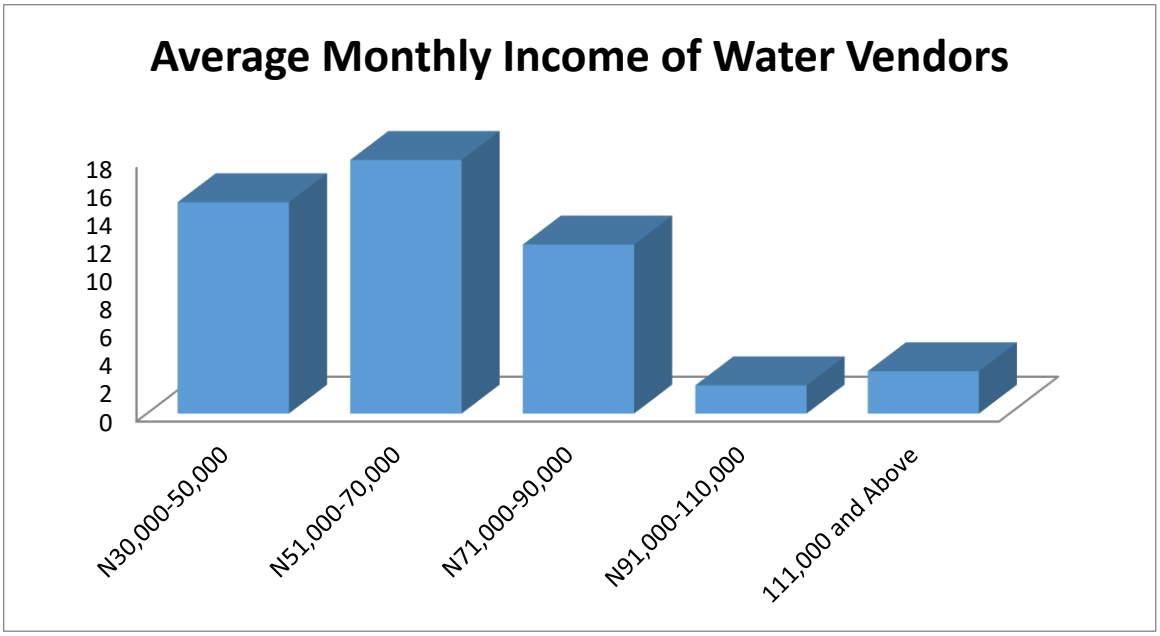

Figure 4.3: Average Monthly Income of Vendors

Water Vending in Keffi Town

In Keffi, water vendors are popularly known as “mai ruwa”. Due to seasonal variation in water access, water vending is usually seasonal with few water vendors often found during the rainy season. In the rainy season, the availability of water from rain water collection through rooftop harvesting and groundwater recharge in some of the few available wells tends to make people buy less or no water from the water vendors. The demand during rainy season is generally low since most households have enough rain water they have collected and stored. Whereas in the dry season, water vending is generally high with many water vendors distributing water to their customers. During this season, people often buy more from the vendors due to high water scarcity. This finding is similar to finding by Ahmad (2017), where most households also harvest and store rain water for future use during the wet season. As such water vending is usually more intense during the peak of dry season especially from the month of January to April.

Also, water vending in this area is informal having the three categories of vendors. The categories include wholesale vendors, direct vendors and distributing vendors. Majority of the wholesale vendors are unlicensed household water stand pipes (otherwise known as kiosks) staffed by an attendant, who sell bulk quantities of water to direct and distributing vendors. Of the eight wholesale vendors interviewed, none of them had any formal approval from NAFDAC or any agreement with Nassarawa State Water Board (NSWB) to sell water (after all the water is from private borehole not from NSWB) and their activities are not being monitored by government or any regulatory agency. Therefore, the management of water vending remains an individual business managed by the respective owners of water sources and the financial management also lies with the individual vendor. The direct vendors are those wholesale vendors who sell water directly to their customers who come to the source to purchase water. This is usually common in areas with few water sources or source points near their houses, and also areas where there is few or no distributing vendors like Jigwada, Hayin Waziri and Angwan Rimi respectively. In these areas, majority of the households live near or closer to water kiosks hence, people come to the source points to purchase water without having to buy from distributing vendors (specifically push-carts).

The distributing vendors usually interact with their consumers door-to-door, and make up the majority of the small water enterprises (Collignon & Vezina, 2000). They include truck tankers, motorized carts and push-carts. The water tankers are few in the study area and carry greater quantity of water to premises with larger storage capacities. The truck tankers were observed to be the lowest patronized water supply market and serve the largest segment of the middle-and high-income categories of households. It was revealed that the truck takers are owned by individuals and groups that are involved in water vending (i.e. they are privately owned). The motorized vendors on the other hand are also very few and carry about six to eight 25litre jerry-cans of water to their customers. Their services covers small portion of the population hence, they contribute less compared to push-cart vendors.

Majority of the distributing vendors are the push-cart vendors who tend to be young migrant men from rural areas who need little investment to get started. They distribute their water in carts drawn by hand (see plate 1). As in similar finding by Ahmad (2017), the proverbial vendors in the study area are the push-cart vendors who distribute water door-to-door to households with pushcarts. The push-cart vendors provide the largest percentage of households water needs in the community. Of the 50 push-cart vendors interviewed, it was revealed that majority are young men with little or no formal education commonly from Nigeria (96%), although those from Niger Republic (4%) were also found (See table 4.4). They buy water from water standpipes using a push-cart carrying 10 yellow, white or black 25litres jerry-cans. It was also revealed that majority of them (92%) hire the set (i.e. carts and the jerry-cans) at the rate of ₦3,500- ₦4000 per week respectively. The number of trips a vendor can have in a day is depended on the nature of patronage by consumers, although the average trip per day was found to be between 5-7 times a day by a vendor. This contrast similar findings by Ahmad (2017) where the maximum trips a vendor can have in a day was 3 due to long queue (average queuing time was 6 hours) encountered in almost all the water kiosks.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VII July 2026

Plate 4.1: A push-cart

Source: Field survey (2024)

Sources and Quality of Vended Water

Vendors Sources of Water

Figure 4.5 shows the location of water sources where water vendors obtain their water for onwards distribution to the end users/households. From the presentation in Figure 4.5 it shows that majority of the vendors obtain their water within the study area. While majority of the vendors obtain their water from boreholes, few obtain from covered wells and public taps located in areas within the LGA. This finding contrast a study conducted by Salahudeen (2015), where majority of the vendors obtain their water outside the study area from shallow wells/stand pumps located in Fagge L.G.A which is about 3 – 4 km far away from the study area.

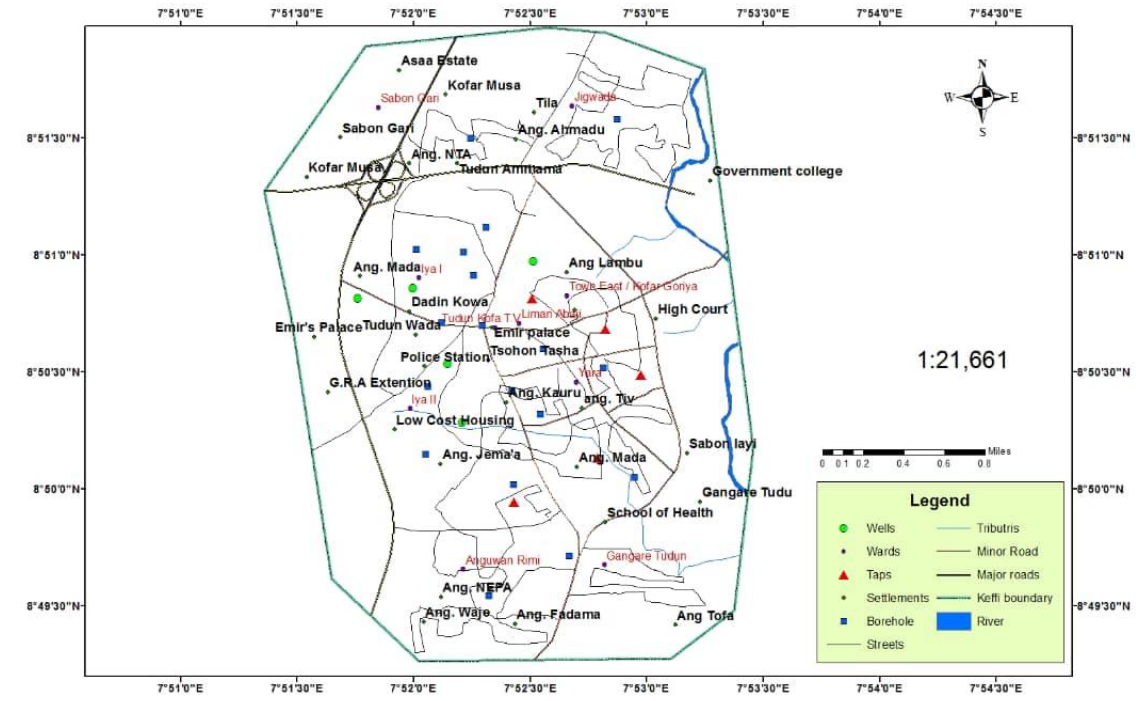

Figure 4.4: Map of Study Area Showing Sources of Vended Water

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VII July 2026

Plate 4.2: Sources of vended water

Source: Field survey (2024)

From the distribution of water sources in the study area, it is clear that majority (94.0%) of water sources found within the study area are boreholes/stand pumps; only few are wells (2.0%) and pipe-borne (4.0%) (See fig. 4.6). Wholesale water vendors sell water from privately owned commercialized boreholes popularly known as Water kiosk (Gidan Ruwa) (See plate 2) and not from piped distribution from NSWB; as it was the case in Kjellen (2000) where majority of vendors further distribute water supplied by public borehole. Similarly, majority (94.0%) of the distributing vendors prefers to obtained their water from borehole and distribute it to their customers (See table 4.5). Only insignificant proportion depends on other sources such as well (2.0%) and pipe borne water (4.0%). This finding contrast a study in Festac Town, Lagos, Nigeria by Olajuyigbe *et al.* (2012) which revealed that all the formal vendors obtain their water from boreholes which are more secured and hygienic. Whereas the informal vendors which provide the largest percentage of the household water needs, obtained water from uncovered wells. Similarly, a study conducted by Ahmad (2017) revealed that apart from the water kiosk where vendors obtain water, there are also a significant number of hand-dug wells scattered all over Duniyar Yangaruwa that sold water to vendors and some neighboring households. He further stated that people dug wells on plot of lands to sell water and hence the high number of these kind of wells. In many cases however, the vendors buy from both sources. Therefore, the choice of water source by vendors mostly depend on distance and to some extent on quality (whether soft or hard water).

Table 4.5: Water Vendors Sources of Water

Source of Water	**Frequency**	**Percentage (%)**
Borehole	47	94
Covered Well	1	2
Pipe Borne	2	4

Source: Field survey (2024)

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VII July 2026

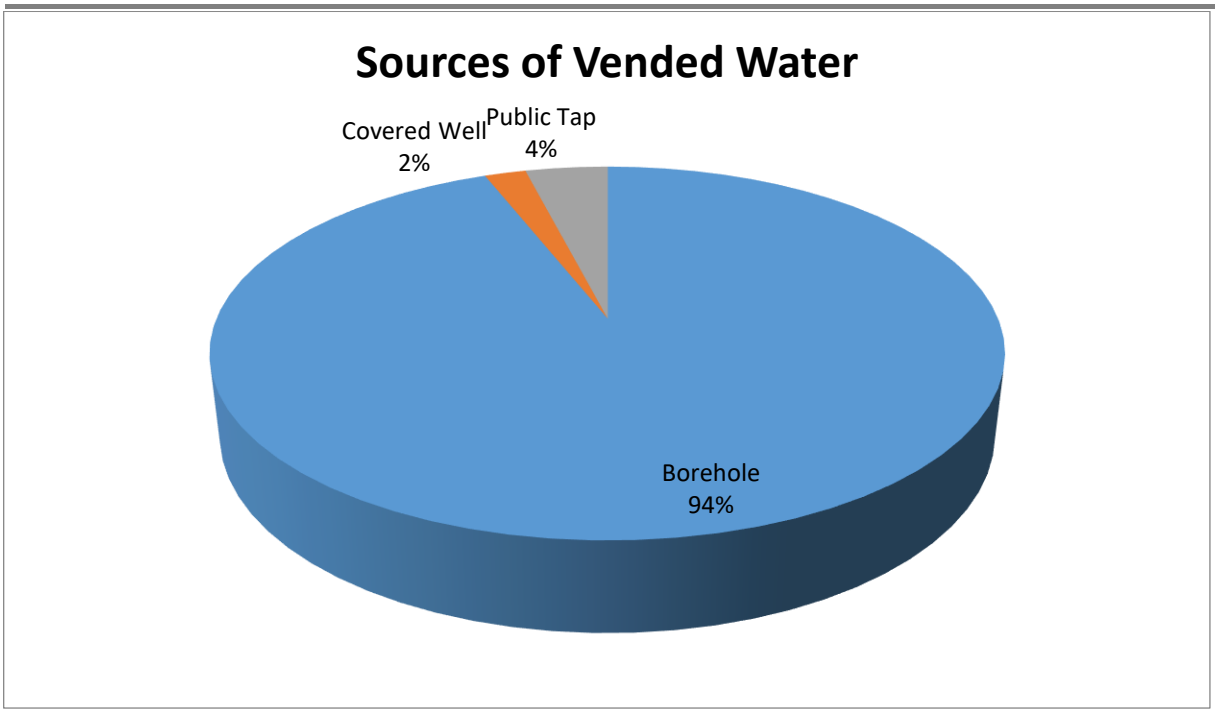

Figure 4.5: Proportion of Vended Water sources

Typically, water systems consist of 5000litres, 3000litres or 2000litres Gee-Pee tanks often fixed in the yard on a concrete platform. Most of the water kiosks used leister type diesel generator. Tanks range from 2 to more than 3 in some water kiosk, but can be less than in some places. Taps are connected to the tanks and fixed on the outer wall from where the vendors queue to wait for their turns (where there is a fence, otherwise just on the platforms) as can be seen in plate 3. Apart from water kiosk there was also few number of wells that vendors obtain water to sell to households. This source is generally inefficient as supplies from them are unreliable.

Plate 4.3: Water Vendors Obtaining Water from a Typical Water Kiosk

Source: Field survey (2024)

Quality of Vended Water

As in Ahmad (2017), there is general lack of water quality awareness among many water vendors; their perception on water quality is typically assessed by observing color, odor and taste of water. Thus, the quality of vended water is questionable in the study area—as it is the case in other parts of the world—leading to water-related disease. It is obvious that the incidence of diseases is due to the fact that vended water is usually susceptible to contamination arising from exposure during haulage. The cans are not regularly washed, and in some having greenish color in them (Spirogyra). The common reported water-related diseases by households in the study area are cholera, diarrhea and typhoid. In this regard, majority (36.8%) of the households don't use vended water for drinking, but for other domestic purposes which include cooking (78.2%), washing (60.9%), bathing (67.8%) and sanitation (55.7%) (See table 4.6).

Table 4.6: Quality of Vended Water

Water Uses	Frequency	Percentages
Drinking	64	36.8
Cooking	136	78.2
Washing	106	60.9
Bathing	118	67.8
Sanitation	97	55.7

Source: Field Work (2024)

Price and Factors Influencing the Price of Vended Water

Price of Vended Water

As stated in Kjellen (2000), the pricing of water by vendors have no fixing body or established basis and is generally left to the individual vendor. The price of water by wholesale vendors is the same throughout the study area. They sell ₦50 per gallon (i.e. one 25litres jerry-can) during the periods of water shortages (dry periods); whereas in the wet periods, many sources sell at the sum of ₦30; while others give water for free to the push-cart vendors. In the study area, all (100%) the push-cart vendors which constitute the largest percentage in the distribution of water pays to obtain water at source. They pay ₦50 per gallon and ₦500 for the ten gallons contained in the vendor's push-cart. Therefore, while the prices of wholesale vendors are the same in the study area, the prices of push-cart vendors is not the same. Most (70.0%) of the push-cart vendors affirmed that the price of vended water is not the same in the study area. Only few (30.0%) responded that the price of vended water is the same in the study area. Majority of the push-cart vendors sell their water at the rate of ₦150 (54.0%) and ₦140 (42.0%) per gallon amounting for ₦1,500 and ₦1,400 respectively. Only few (4.0%) seldom sell at the rate of ₦100 (amounting for ₦1000), which is often as a result of the customer's close proximity to the source point or customer's mutual relationship with the water vendors (see table 4.5).

Table 4.7: Different Prices for Push-cart Water Vendors

Price	Frequency	Percentages (%)
₦1000	2	4
₦1400	21	42
₦1500	27	54

Source: Field survey (2024)

Factors Influencing the Cost of Vended Water

To determine the price of water, vendors often respond to three factors-the topography of the delivery point (since Keffi is known to be hilly and undulating) (88.0%), demand for water at any given time (36.0%) and the distance between the water sources and delivery points (60.0%) (See table 4.8). Prices also depend on other factors such as water availability, water quality and customer's loyalty. Normally, prices are higher in periods of water shortages than at ordinary times. Although, the price to the consumers are typically determined by the cost and effort of procuring water, as well as the distance between the source point and the point of delivery. Generally, road conditions and topography of the household affect the effort that needs to be compensated by the consumers.

Table 4.8: Factors Influencing Prices of Vended Water

Factors	**Frequency**	**Percentages (%)**
Distance from the source points	30	60
Topography of the delivery points	44	88
High demand by households	18	36

Source: Field survey (2024)

From the household survey, it revealed that majority (50.0%) of the households spend more than ₦550 buying vended water every day (see table 4.9). As such, households which are served by retail vendors generally pay more per capita per month for 550litres than those directly connected to a piped system that might use as much as 400litres per capita per day. This implies that the distribution of water by water vendors is quite expensive, whether the vehicles are powered by people or engines.

Table 4.9: Amount Spent on Vended Water by Households Daily

Amount	Frequency	Percentage (%)
₦50-150	3	1.7
₦151-250	4	2.3
₦251-350	22	12.6
₦351-450	29	16.7
₦451-550	29	16.7
More than ₦551	87	50.0

Source: Field survey (2024)

However, the lack of unionized system of operation resulted to the lack of collective price-fixing body or established basis for a unit cost of clean and safe water. This finding contrasts a similar study in Bolivia by Wutich *et al*. (2016) where the informal water vendors formed an association as a basis for collective pricing of water. Even though mutuality and collective self-interest exists among vendors, it does not culminate in the communal water pricing, for affordable and reliable water supply to the urban poor. Rather, each water seller is self-motivated by profit determine water price based on the value consumers attach to the water, the scarcity of improved water and the distance of the water wholesaler. Therefore, it costs more to buy water from a door-to-door carrier and water supply from different sources will vary depending on rainfall, network down time, and other factors (Collignon and Vézina, 2000, p. 17).

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VII July 2026

Distribution Patterns of Vended Water

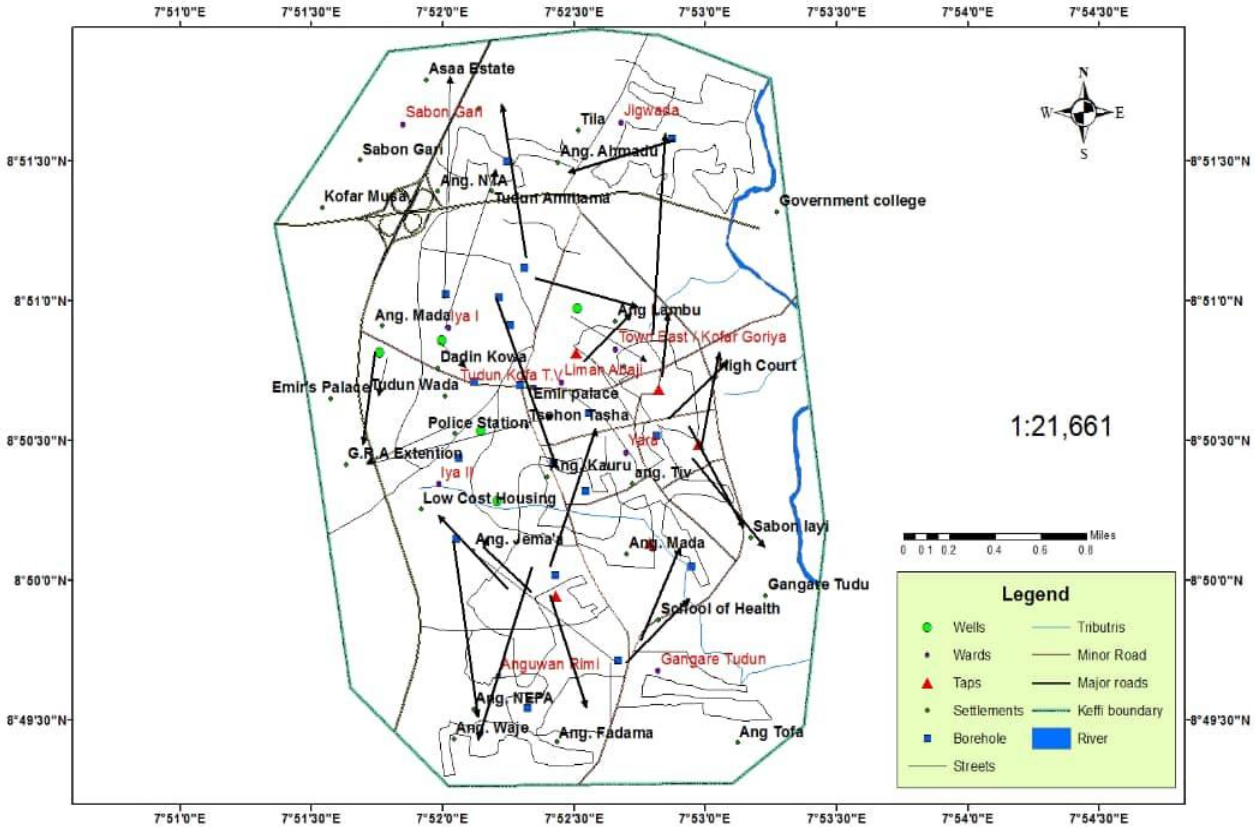

Figure 4.6: Distribution Pattern of Vended Water

This shows the location of water sources and the distribution pattern of vended water supplied by vendors in the study area. Usually, water vendors often obtain water from sources very far from their delivery points. Although, the distribution pattern of water is not common in all places where there is prevalence of water vending. In some places, water vendors obtain water within the area from either public and/or private stand-pipes, protected and unprotected dug-wells, boreholes, rivers, etc., and distribute it to their customers. While in some places, vendors obtain water outside the area and travel a long distance to distribute the water to their customer. According to Kjellen (2000), whether water vendors obtain water within or outside a particular area, the common thing is that they travel a substantial distance to distribute water.

From the presentation in fig. 4.7, it shows that the water supplied by vendors is obtained from locations within the study area. This contrast a study by Salahudeen (2015), where it was revealed that, the water supplied by the vendors is obtained from locations outside the study area. Various water vendors exist, but specifically, push-cart vendors play more significant roles in household water supply compared to other vendors. This is due to the fact that push-cart vendor's supply system, offers the poor the opportunity to buy water in more convenient and at affordable prices which helps to minimize time. In this regard, push-cart vendors usually travel few distances away from water sources to distribute water to various households or their customers within the water sources. That is; on one hand, a vendor can obtain water from a particular place and still distribute it to households within that particular place; whereas on the other hand, vendors sometimes travel as far as 1-2km to distribute water to their customers. For example, an interview with a push-cart vendor revealed that push-cart vendors may obtain from Dadin Kowa and still deliver it within Dadin Kowa. Also, water vendors obtain water from Angwan Jema'a and travel as far as Angwan NEPA to distribute the water or from Angwan Lambu to Tudun Amama. Wherein, they end up covering a long distance from the water source. This type of distribution pattern is common to most

distributing vendors especially small-scale providers like the animal-drawn, wheelbarrow, head-carriage and push-cart vendors.

Contributions of Water Vendors in Domestic Water Supply

This theme discusses the percentage of households patronizing water vendors, reasons for patronizing water vendors, household's major source of domestic water supply and frequency of vended water purchased from vendors in the study area. Usually, in cities of most developing countries, there is a variety of sources and modes of water supply. Many urban poor decides on a daily basis which sources to use depending on how much time and money is available, and on where water is available. Table 4.9 shows that majority of the households patronize water vendors, with reasons being that water vendors are more reliable and readily available (63.8%) and they are timely efficient in supply than other sources (52.3%). Other reasons include better quality of vended water compared to other sources (28.9%) and more affordable than pipe-borne sources (12.6%).

Table 4.10: Household's Patronage of Vended Water

Vended Water Patronage	**Frequency**	**Percentage (%)**
Do you patronize water vendors?		
Yes	112	64.0
No	62	35.6
Reasons for patronizing water vendors		
Timely efficiency in supply compared to other sources	91	52.3
More reliable and available in supply	111	63.8
More affordable than pipe-borne source	22	12.6
Better in terms of quality compared to other sources	45	28.9

Source: Fieldwork (2024)

From the presentation in table 4.10, it shows that most households (39.1%) depend on borehole and vended water (34%) water for their domestic needs. Only few households depend on water board (10.9%) and hand dug well (16.1%) (See plate 2). It is therefore clear that most households also depend on water vendors for their domestic needs. This can be attributed to irregularity in supply of piped borne and public water in the study area. As such, this finding confirmed a study by Ayoade and Oyebande (1983) where it was revealed that water supply at public taps are often irregular and of short durations and most residents of cities rely heavily on commercial borehole owners and itinerant water tanker drivers or water vendors for their daily supplies. This implies that despite the efforts of government, water agencies and individual household-connection in water supply, water vendors still play a significant role in providing households with their daily water needs.

Table 4.11: Household's Sources of Water

Sources of Water	**Frequency**	**Percentage (%)**
House connection	68	39.1
Water vendors	59	33.9
Well	19	10.9
Pipe-borne	28	16.1
Total	**174**	**100.0**

Source: Field survey (2024)

Table 4.11 shows that majority (67.2%) of the households affirm to always see water vendors. While only few (32.8%) affirmed to sometimes see water vendors in a day. During the periods of water shortages, vendors are always available to ensure the availability of water for the households since most (38.5%) of the households often buy water daily or thrice (36.2%) weekly from the vendors. Also, majority (33.3%) of the households buy more than 550litres per day from the vendors. Only insignificant proportions (10.4%) buy less than 250litres per

day. This therefore means that water vendors are really making a huge contribution in the provision and distribution of water in the study area, which in turn helps to ensure the availability of water in the study area, especially in the peak of dry seasons where water scarcity is very high. It therefore also implies that in the face of absolute neglect by the government with respect to water provision, the trauma that households would have passed through would have been enormous without the intervention of water vendors. As such, this implies that though the intervention of informal water vendors in the supply of domestic water is problematic, but their contribution in the provision and distribution of water in the study area is too sacrosanct to be ignored since they play a significant role in ensuring that water is readily available for domestic uses with less stress and short time. Therefore, even though most pushcart water vendors operate in poor areas, their clients are those with some form of income and ability to pay.

Table 4.12: Contribution of Water Vendors in Domestic Water Supply

Items/Parameters	Frequency	Percentage (%)
How often do you see vendors in a day		
Always		
Sometimes	117	67.2
Never	57	32.8
How often do you buy from water vendors	0	0.0
Daily		
Twice weekly		
Thrice weekly	67	38.5
Four times weekly	23	13.2
Five times weekly	63	36.2
How many litres do you often buy in a day	12	6.9
50-150litres	9	5.2
151-250litres		
251-350litres		
351-450litres	8	4.6
451-550litres	10	5.8
More than 551litres	37	21.3
	23	13.2
	38	21.8
	58	33.3

Source: Field survey (2024)

To this end, it is therefore imperative that water vendors are providing an important service to different households, considering the water scarcity and lack of access to sufficient portable water to carry out their day-to-day activities. Also, the contribution of these water vendors can be considered in terms of time, stress of going to source water and distance cover to obtain water various by various households. As such, the contribution of water vendors as supplementary source of domestic water has been accepted as an alternative source of water in the study area.

Challenges of Water Vending

Water quality and prices have often been considered as the most common challenges faced by those who patronize and sell vended water. It is generally believed that water does not cost the same everywhere; the price of water varies widely between cities and rural areas, and between economic sectors. However, the lack of unionized system of operation resulted to the lack of collective price-fixing body or established basis for a unit cost of clean and safe water (Wutich *et. al.*, 2016 & Ahmad, 2017).

Challenges faced by water vendors

Water carting, like water collection for own use, is a heavy and physically demanding activity. In the study area, the push-cart vendors affirmed the fact that water vending is labour intensive and are faced with numerous challenges in the process of carrying out their activities. Among these challenges are severe headaches, chest pain, body odour, changes in skin colour and texture. This is because many starts by renting their push-carts, as such they cannot start slowly but have to work full days, and this often results to them over-stressing themselves. In Dar es Salaam, pushcart vendors complain of pains in the chest and joints, and that they often fall sick with fever (Kjellén, 2000a).

Again, it was also revealed that most water vendors are often faced with some challenges when obtaining water at source. These vendors complained of water sources being situated in corners with bad accessible roads, shortages of supply at the source points, lack of frequent power supply to pump water and standing in long queue. These in turn limit the number of trips a vendor can have in a day, as the number of trips determined the income vendors often earn a day. That is, the higher the number of trips for a vendor, the higher the earnings for the vendor. They are also faced with some challenges in the process of selling water, some of which includes distance between the water source to the selling points, low pricing of water, buying of water on credit, late and incomplete payment of credit by consumers. All these pose a great challenge to the vendors as it made vending of water to be lucrative and/or affect the earnings of water vendors.

Challenges of buying vended water

Table 4.9 shows the major challenges faced by households when buying vended water. Usually, it was generally believed that the sources of vended water supplied by vendors are often from unimproved sources, which include both surface (such as rivers and streams) and groundwater sources (such as dug wells), only in rare cases from improved sources such as boreholes and taps. As shown above in table 4.3, it was revealed that majority (94.0%) of the vendors obtain their water from boreholes. Therefore, in regards to the quality vended water, majority (83.9%) of the water supplied by vendors in Keffi is perceived to be from protected sources. As such, most (70.7%) household's perception regarding the quality of water supplied by vendors was revealed to be portable. Only few (29.3%) percents perceived it to be not portable. This finding contrasts similar findings by (Ahmad, 2017; Kjellen, 2000; Salahudeen, 2015 & Olajuyigbe *et al.,* 2012) where the quality of vended water was questionable and it's often perceived to be unsafe. But despite the fact that the quality of vended water is perceived to be portable, there is no doubt that the water is usually unsafe due to the contamination arising from exposure during haulage. Also, as a result of the cans not being properly and regularly washed, and in some having greenish colour in them (Spirogyra).

Again, another challenge of buying vended water is the fact that the distribution of water by vendors is expensive, whether the vehicles are powered by people, animals or engines. Hence, table 4.9 revealed the different price of vended water, which revealed that the price of vended water is not the same in the study area. This is basically due to the differences in elevation of the delivery points, the demand for water and the distance between the source point and the delivery point (see table 4.6 above). Although, substantial (46.0%) number of households affirmed vended water to be affordable, majority (52.9%) held that vended water is expensive. Only insignificant percent (1.1%) believed that the water is cheap. This finding is similar to (Whittington *et al.,* 1989; Zaroff & Okun, 1984) where households which are served by vendors generally pay more per month for 20-40litres per capita per day than those directly connected to a piped system that might use as much as 400litres per capita per day. Households sometimes pay over 10% of their monthly income for vended water, as compared to 1-5% for most piped water systems.

Table 4.13: Household Challenges of Buying Vended Water

Parameters	Frequency	Percentages (%)
Is the water from protected sources		
Yes	146	83.9
No	28	16.1

Perception regarding the quality of water supply by vendors		
Portable	123	70.7
Not portable	51	29.3
Is the price the same		
Yes	43	24.7
No	131	75.3
Perception regarding the cost of vended water		
Cheap	2	1.1
Affordable	80	46.0
Expensive	92	52.9

Source: Field survey (2024)

Solution to the Challenges

Regarding the challenges of water vending, it is clear that the provision of more accessible water sources and frequent power supply will greatly help to reduce the challenges of standing in long queue and water shortages at source points, since most of the water sources require power supply to pump water. It is also imperative that government recognition and provision of good road networks will help to ease the stress of water distribution since hand push carts causes health issues. It also appears that over 80.0% of the water vendors pay ₦800-1000 to hire the push-carts and the 25litres jerry-cans they use for conveying water to their customers. As such, government can regulate this activity through the provision of these equiptments either at a subsidized rate or for free to help curb the problem of water price. Again, water vendors often look dirty and un-kept as well as their jerry-cans, and this often lead to the issue of poor sanitation. Hence, a committee can be set in place to inspect and ensure proper sanitation of vendors through regular bathing and washing of jerry-cans in order to improve the quality and reliability of vended water supplied by vendors. Also, the provision of public water sources by government, in which water vendors need not to pay to obtain water, will help reduce the cost of vended water. In addition, since the pricing of water by vendors have no fixing body or established basis and is generally left to the individual. The introduction of unionized system of operation will result to a collective price-fixing body or established basis for a unit cost of clean and safe water hence, controlling the high price of vended water.

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Introduction

This chapter describes the summary of the major findings, conclusion and recommendations derived from the findings of questionnaire survey.

Summary of Major Findings

Despite water vendors have been praised for their entrepreneurship as well as their ability to reach the poor and area that is difficult to develop with conventional infrastructure, still they are often scorned for exploiting people's absolute rights and basic need for water. Water vending which is often taken as a symptom of a failure in piped water system plays significant role in providing water to many urban dwellers in many parts of the world.

In Keffi, water vendors are popularly known as "mai ruwa". Water vending in this area is both formal and informal having three categories of vendors. The categories of water vendors identified were the wholesale vendors, direct vendors and the distributing vendors. The proverbial vendors in the study area are the push-cart vendors who distribute water door-to-door to households with pushcarts. The push-cart vendors provide the largest percentage of households water needs in the community. Of the 50 push-cart vendors surveyed, it was revealed that majority are young men with little or no formal education commonly from Nigeria (96%), although those from Niger Republic (4%) were also found. They buy water from water standpipes using a push-cart

carrying 10 yellow, white or black 25 litres jerry-cans. It was revealed that majority of them (92%) hire the set (cart with the jerry-cans) at the rate of ₦800- ₦1000 per week for the 10 jerry-can carrying cart respectively. The number of trips a vendor can have in a day is depended on the nature of patronage by consumers. The average trip per day was found to be 5 times by a vendor. As such, based on the results and analyses carried out, the following major findings were made:

1. In terms of the sources of vended water, it was revealed that majority of the water vendors obtain their water within the study area, especially from borehole which are more secured and hygienic. Only insignificant proportion depends on other sources such as covered well and pipe borne water. The study also revealed that most households depend on borehole and vended water for their domestic needs. Only few households depend on water board and hand dug well. This is basically as a result of the widespread recognition and acceptance that conventional water utilities have fallen short in providing adequate water services to populations especially the urban poor, and partly because of the hilly topography and geology of the study area which influence the availability of both surface and groundwater sources; hence, leading to increased water shortages. These justify the reason why there are more boreholes than wells in the study area. As such, majority of the populations obtain their water from borehole.

2. Analysis on the price of vended water revealed that the pricing of water by vendors have no fixing body or established basis and is generally left to the individual vendor. The price of wholesale water is the same throughout the study area, while the price of distributing vendors varies due to various factors. The wholesale vendors sell ₦10 per gallon (i.e. one 25litres jerry-can) during the periods of water shortages (dry periods); whereas in the wet periods, many sources sell at the sum of ₦5; while others give water for free to the push-cart vendors. In this regard, all (100%) the distributing (especially push-carts) vendors pay some money to obtain water at source from the wholesale vendors. They pay ₦10 per gallon and ₦100 for ten gallons contained in the vendor's push-cart. They often sell their water at the rate of ₦50, ₦40 and ₦30. It therefore implies that, while the prices of wholesale vendors are the same in the study area, the prices of push-cart vendors is not the same.

However, the push-cart vendors often respond to two factors; the elevation of the delivery point (household) and the distance between the water sources and delivery points. Prices also depend on other factors such as water availability, water quality and customer loyalty. Generally, road conditions and elevation of the household affect the effort that is often compensated by consumers. As such, households which are served by retail vendors generally pay more per capita per month for 550litres than those directly connected to a piped system that might use as much as 400litres per capita per day. This therefore implies that the distribution of water by water vendors is quite expensive, whether the vehicles are powered by people, animals or engines.

3. The study also revealed that despite the fact that buying water from vendors cost more than the cost of installing pipe borne water, and also their distribution of poor quality of water as a result of lack of disinfection, it is imperative that water vendors play a significant role in providing households with their daily domestic water needs. As such, although the intervention of informal water vendors in the supply of domestic water is problematic, but their contribution in the provision and distribution of water in Keffi is sacrosanct since they play a significant role in ensuring that water is readily available for domestic use with less stress and in short time. Therefore, even though most pushcart water vendors operate in poor areas, their clients are those with some form of income and ability to pay.

4. Although, water quality and prices have often been considered as the most common challenges faced by those who patronize and sell vended water. It is generally believed that water does not cost the same everywhere; the price of water varies widely between cities and rural areas, and between economic sectors. However, the lack of unionized system of operation resulted to the lack of collective price-fixing body or established basis for a unit cost of clean and safe water. Though, household's perception regarding the quality of vended water supplied by vendors was revealed to be portable. But the price of vended water is perceived to be high making it expensive.

Also, water carting, like water collection for own use, is a heavy and physically demanding activity. In Keffi, the push-cart vendors affirmed the fact that water vending is labour intensive and are faced with numerous challenges in the process of carrying out their business activities. Among these challenges are severe headaches,

chest pain, body odour, changes in skin colour and texture. Other challenges includes water sources being situated in corners with bad accessible roads, shortages of water at source points, lack of frequent power supply to pump water and standing in long queue. These in turn limit the number of trips a vendor can have in a day. Some challenges they encounter when selling water includes distance between the water source to the selling points, low pricing of water, buying of water on credit, late and incomplete payment of credit by consumers.

5. In relation to the challenges mentioned above, the study suggest that, provision of more accessible water sources and frequent power supply will greatly help to reduce the challenge of standing in long queue and water shortages at source points. Government recognition and provision of good road networks will help to ease the stress of water distribution since it causes health issues. Again, government can regulate this activity through the provision of necessary tools like push-carts either at a subsidized rate or for free. Also, the provision of water sources by government, in which water vendors need not to pay to obtain water, will help reduce the cost of vended water. Since the pricing of water by vendors have no fixing body or established basis and is generally left to the individual. The introduction of unionized system of operation will result to a collective price-fixing body or established basis for a unit cost of clean and safe water hence, controlling the high price of vended water.

Conclusion

It is imperative that the widespread recognition and acceptance that conventional water utilities have fallen short in providing adequate water services to populations especially the urban poor, has made the contribution of water vendors as supplementary sources of domestic water supply to be widely accepted not just as a supplement, but as an alternative source of water supply in the five wards studied. Results therefore revealed that water vending exists during rainy and dry season, although much of the activities occur during the dry season. Analysis on the price of vended water revealed that while the price of vended water by wholesale vendors is the same in the study area, the price of push-cart vendors is not the same. The price differs in different wards due to proximity of the sources (ease or difficulty by which vendors can get water) and elevation of households. This is because pricing of water by vendors have no fixing body or established basis and is generally left to the individual vendor. Despite household's perception regarding the quality of vended water was revealed to be portable, the cost of vended water is perceived to be high thus making it expensive.

In addition, despite the challenges of water vending arising from the provision of un-affordable water to the urban poor, poor quality of the water due to lack of disinfection, and low reliability of water supply, their contribution in the provision and distribution of water in the study area is sacrosanct, since they play a significant role in ensuring that water is readily available for domestic uses with less stress and in short time. In this regard, the study suggests that instead of considering water vending as an interim solution, government recognition and regulation through the introduction of unionized system of operation, provision of tools either at a subsidized rate or for free, more water sources and good road networks will help to ease the stress of water distribution. Therefore, the starting point in this process should be government recognizing the role of these small-scale water providers in water delivery and offer them necessary support that could enhance their performance.

Recommendations

Irrespective of the numerous challenges faced by vendors and consumers in the process of buying and selling of water, there is no doubt that water vendors are making an important efforts in meeting the needs of water demand in Keffi. Despite these numerous challenges, there are also ways of improving these services that can make an appreciable difference to the well-being of the urban poor. It was on these bases that the following recommendations were made;

1. Recognizing the role played by water vendors. This explains that, if governments or water authorities ignore or take a negative attitude towards water vending, and enforce strict regulations, they are likely to reduce the amount of water available to the urban poor, driving high prices up still further. But if they take a positive attitude towards water vending, this may still be seen as condoning a situation in which the poorest segment of the population has to pay the highest prices for water and sanitation. As such, the study suggests that recognizing the role played by vendors in water supply by designing and implementing effective policy and intervention

initiatives that will support water vending and integrate it into mainstream water supply system in form of public private partnership, will greatly help to make water available as well as reducing the costs of supply so that consumers would receive more and safer water at a lower price.

2. Recognizing water vendors as an integral part of the water system. Allowing water vendors to be a recognized as an extension of the piped system will bring out the real outcome of policies and investment decisions which may be better predicted and directed. Bringing drainage, sewerage and sanitary services into the picture hence, increasing the chances of holistic policies as well as environmental and health improvements.

3. Formalizing the informal water vendors. Formal registration of water vendors can be done through NAFDAC and establishment of unions which will provide an avenue for regular monitoring of their activities so as to ensure water quality management and controlled pricing of informal water supply.

4. Addressing the existing challenges in the informal water markets. A major problem for consumers is the high price of water on many informal water markets. In order to understand how to bring down the price of water, it is necessary to understand how the local market is operating. Regulating the price charged by itinerant and wholesale vendors can be very difficult, especially if there is no community support for such regulation. Even if prices at sources are reduced, there is no guarantee that the benefits will be passed on to consumers; they may just as well lead to long queues. However, it is possible to remove the challenges that keep prices high. These challenges may be water shortages at sources, bad road networks, high cost of hired push-carts, lack of unionized system of operation, and power supply among others. As such, addressing these challenges will greatly help to bring down the price of vended water. If however, the underlying problem is not supply constraints but the price at wholesale vendors sold to vendors, then this cost constraint must be addressed directly.

5. Establishing strong relationship between water vendors, consumers and water utilities. Another useful way to address these issues could come from the mere establishment of forum for discussion. This is because officially recognized associations of vendors as well as consumers can help to voice concerns of these groups and improve the quality of water services.

This study also recommends that further study should be conducted to assess the "Contribution of Truck Tankers Water Vendors in the Supply of Domestic Water in Keffi Town".

Declaration

I declare that the work in this dissertation titled "Contribution of water vendors in mitigating water scarcity in keffi town, keffi Local Government Area, Nasarawa State" has been carried out by me in the Department of Geography, Nasarawa State University, Keffi. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this dissertation was previously presented for another degree or diploma at this or any other institution.

---------- ----------

DOGARA ADAMU AHMAD

AMS23ERM0075

CERTIFICATION

This is to certify that the dissertation entitled Contribution of water vendors in mitigating water scarcity in keffi town, keffi Local Government Area, Nasarawa State by Dogara Adamu Ahmad, AMS23ERM0075. In the partial fulfillment for the award of master of science in environmental resource management at the department of Geography, Nasarawa state university, keffi is a benefited record of work during the period of study.

---------- ----------**Name**

Date

Supervisor(s)

---------- ----------

Name **Date**

Head of Department

---------- ----------

Name **Date**

Internal Examiner

---------- ----------

Name **Date**

External Examiner

---------- ----------**Name**

DateDean, School of Postgraduate Studies

Dedication

To the experiences we never expected, and the paths that were redirected . To the friends and family we found along the way.

ACKNOWLEDGEMENT

I would like to acknowledge and give my warmest thanks to my supervisor, Dr. Joshua Ibrahim Magaji who made this work possible. His guidance and advice carried me through all the stages of writing my dissertation. I would all like to thanks the entire lecturers in the department of Geography, Prof. K.S Ishaya, Prof. D.U Sangari, Prof. A. Mahmud, Prof. N.D Markus, Prof. N.M Idris, Prof. A.T Ogah, Dr. S.Y Kpalo, Dr. U.S Lay, Dr. Salamatu H. Ekpo, Dr. M. Aminu, Dr. M. Alkali, Mr. Kefas Sale, Mr. Nasir Umar for letting my defense be an enjoyable moment, and for their brilliant comments and suggestions, thanks to you all.

My profound gratitude equally goes to my family and all the well-wishers for their continuous support and understanding when undertaking my dissertation. Your prayers for me was what sustained me this far.

Finally, I would like to thank God, for letting me through all the difficulties. I have experienced your guidance day by day. You are the one who let me finish my master of science in Environmental Resource Management. I will keep on trusting you for my future.

REFERENCE

1. Abubakar I.R. (2016). Quality dimensions of public water services in Abuja, Nigeria. Util Policy 38:43–51Aboki P.M, Mailafiya M.A & Osabo A.P. (2007): Vegetation and forest resources. In Akwa V.L, Binbol N.L, Samaila K.I and Marcus N. D (eds).
2. Geographyical perspective on Nasarawa State. A publication of the Department of Geography Nasarawa State University Keffi. Onaivi printing and publishing Co Ltd, Keffi.
3. Acey C. (2008). Neighbourhood effects and household responses to water supply problems in Nigerian cities. J Transdiscipl Res South Afr 4(1):123–156
4. ADB, (2003).Connecting East Asia: A New Framework for Infrastructure. Manila: ADB; Washington, DC: World Bank; Tokyo: Japan Bank for International Cooperation.

5. Ahmad, T. M. (2017). The role of water vendors in water service delivery in developing countries: A Case of
6. Dala Local Government, Kano, Nigeria. Appl. Water Sci, 7, 1191–1201.
7. Albert, J., Aristanti, C. & Sudjarwo, H. (2008). Operational and Performance Assessment of Small-scale safe water providers in Central Java, Indonesia.Unpublished study in Aquaya Institute and the Dian Desa Foundation.
8. Anan, K. (2001). Message of UN Secretary-General Kofi Anan on World Water Day.
9. Andreasen, H. M., & Møller-Jensen, L. (2015). Beyond the networks: Self-help services and post - Settlement Network Extensions in the periphery of Dar es Salaam. Habitat International, 39-47.
10. Angueletou-Marteau, A. (2007). Informal Water Suppliers Meeting Water needs in the Peri-urban Territories of Mumbai, an Indian perspective. LEPII, Université de Grenoble, CNRS.
11. Ayalew M, Chenoweth J, Malcolm R, Mulugetta Y, Okotto LG, & Pedley S. (2014) Small independent water providers: their position in the regulatory framework for the supply of water in Kenya and Ethiopia. J Environ Law 26:105–128. doi:10.1093/ jel/eqt028
12. Ayoade, J. O. & Oyebande, B. L. (1983).Water Resources.In Oguntoyinbo, J. S., Areola, O. O. & Filani, M. (Eds).A Geography of Nigeria Development (Second Edition). Ibadan: Heinemann Educational Books (Nigeria).
13. Baisa, B., Davis, L., Salant S. W. & Wilcox, W., (2008).The Welfare Costs of Unreliable Water Service. Unpublished MPRA Paper, http://www.mpra.ub.uni-muenchen.de/9812
14. Baker, J. L., (2006). Opportunities and Challenges for Small Scale Private Service Providers in Electricity and
15. Water Supply Evidence from Bangladesh, Cambodia, Kenya, and the Philippines. World Bank.
16. Basani, J. I. & Reilly, B. (2008). "The Determinants of Water Connection and Water Consumption: Empirical evidence from a Cambodian household survey", World Development, vol. 36, no. 5, pp. 953—968.
17. Benneh, G., Songsore, J., Nabila, J. S., Amuzu, A. T., Tutu, K. A., Yangyuoru, Y. & McGranahan, G. (1993)
18. Environmental Problems and the Urban Household in the Greater Accra Metropolitan Area (GAMA) – Ghana. Stockholm Environment Institute, Stockholm.
19. Bichi, M.H. & Amatobi, D.A. (2013). Assessment of the Quality of Water Supplied By Water Vendors to Households in Sabon-Gari Area of Kano, Northern Nigeria.International Journal Of Engineering And Science (IJES), 2(1), 09-17.
20. Binbol, N.L (2007): Climate. in Akwa V.L, Binbol. N.L, Samaila K.I and Marcus N.D (eds) Geographical perspectives on Nasarawa State. A publication of the Department of Geography, Nasarawa State University, Keffi. Onaivi Printing and Publishing Co Ltd, Keffi.
21. Cheesman, J., Benneth, J & Son, T.V.H. (2008).Estimating Household Demand Using Revealed and Contigent Behaviour.Evidence from Viet Nam.Water Resource Research. 44, 11-42.
22. Collignon, B., & Vézina, M., (2000).Independant Water and Sanitation Providers in African Cities.Full report of a ten-country study, Water and Sanitation Program, Washington D.C., p. 64.
23. Daily News (2010). End of Dar es Salaam water blues in sight. Daily News, Dar es Salaam Tanzania.
24. Dakyaga, Alphonce G. Kyessi & Joel M. Msami (2018). Water Access Today and Tomorrow: Domestic Water Sustainabilityunder Informal Water Supply Markets in Dar es Salaam, Tanzania. Journal of Sustainable Development; 11(6): ISSN 1913-9063 E-ISSN 1913-9071
25. Dalat G.D & Filaba M.A (2007): Historical Background. In Akwa V.L, Binbol N.L Samaila K.I and Marcus N.D (eds) Geographical perspective on Nasarawa State. A publication of the Department of Geography, Nasarawa State University, Keffi. Onaivi printing and publishing Co. Ltd, Keffi.
26. Dauda SA, Yacob MR & Radam A (2015). Household's willingness to pay for heterogeneous attributes of drinking water quality and services improvement: an application of choice experiment. Appl Water Sci 5:253–259. doi:10.1007/s13201-014-0186-6
27. FRN, WSS (2000) Federal Republic of Nigeria (FRN), Water Supply & Sanitation (WSS) Interim Strategy Note.
28. Gasson, C. (2017). A new model for water access, Global blueprint for innovation. Global Agenda Councils. Retrieved from http://www.globalwaterleaders.org/water_leaders.pdf.

29. Hutin Y, Luby S, & Paquet C. (2003) A large cholera outbreak in Kano City, Nigeria: the importance of hand washing with soap and dangers of street-vended water. J Water Health 1(1):45–52
30. Ishaku, H.T, Peters, A.A, Haruna, A. & Dama, F.M (2010). The Role of Private Water Vending in Nigeian Peri-Urban Informal Settlements: Implication for Policy Makers, Journal of Water Resource and Protection, 2, 1082-1087
31. Kariuki, M. & Schwartz.J. (2005). Small Scale Private Service Providers of Water Supply and Electricity: A Review of Incidence, Structure, Pricing and Operating Characteristics, World Bank Policy.
32. Katko, T. S. (1991). Reselling and vending water, Journal of the American Water Works Association 83(6): 63–69.
33. Kjellén, M. (2000). Complementary water systems in Dar es Salaam, Tanzania: the case of water vending, Water Resources Development 16(1): 143–154.
34. Kjellén M., & McGranahan, G., (2006). Informal Water Vendors and the Urban Poor, IIED, Human Settlements Discussion Paper Series, Theme: water -3, p. 26.
35. Kombe, W., Ndezi, T., & Hofmann, P. (2015). Water Justice City Profile: Dar es Salaam, Tanzania. London: University College London.
36. Krejcie, R.V. & Morgan, D.W. (1970). Determining sample size for research activities, educational and
37. psychological measurement, 30, pp 607-610
38. Lloyd, B., Bartram, J., Rojas, R., Pardon, M., Wheeler, D. & Wedgewood, K. (1991).Surveillance and Improvement of Peruvian and Drinking Water Supplies.University of Surrey, Guildford, UK.
39. Lyam, A. (2000). Nasarawa State. In Mamman A.B, Oyebaji, J.O. and Peters S.W. (eds)Nigeria: A people United, a future assured. Survey of States. V0l 2 No2- Millennium edition, Abuja, Federal Ministry for Information: 382-392
40. Marcus, N.D & Binbol, N.L, (2007). “In Geographic Perspectives of Nasarawa State”. A Publication of the Department of Geography, Nasarawa State University, Keffi-Nigeria. Onaivi publisher, Keffi.
41. Metwally, A. M., Ibrahim, N.A., Saad & Abu El-Ela, M.H. (2006). Improving the Roles of Rural Women in Health and Environmental Issues. International Journal of Environmental Health Research, 16(2), 133-144. doi:10.1080/09603120500539208
42. McGranahan, G., Njiru, C., Albu, M., Smith, M., & Mitlin, D. (2006).How Small Water Enterprises can contribute to the Millennium Development Goals. Evidence from Dar es Salaam, Khartoum and Accra.WEDC, Loughborough University, Uk.1.
43. McIntosh, A. (2003) Asian Water Supplies: Reaching the Urban Poor. Asian Development Bank (http://www.adb.org/Documents/Books/Asian_Water_Supplies/asian_water_supplies.pdf, accessed 3 March 2012).
44. Ndabula, C. & Jiduana G.G., (2010). Domestic Water Use in Selected Settlements in the Sudano-Sahelian Region of Nigeria. .International Journal of Water and Soil Resources Research, Vol. 1 Nos. 1 – 3.Nigerian Industrial Standard (2007). Nigerian standard for drinking water quality (NIS 554: 2007). Standards Organisation of Nigeria, Abuja
45. Njiru C (2004) Utility-small water enterprise partnerships: serving informal urban settlements in Africa. Water Policy 6(5):443–452
46. Njiru, C. & Albu, M. (2004) Improving access to water through support to small water-providing enterprises,
47. Small Enterprise Development 15(2): 30–36.
48. NPC (2006). National Population Commission: 2006 Census Results. Federal Government of Nigeria.
49. Ntouda, J., Sikodf, F., Ibrahim, M. & Abba, I. (2013). Access to Drinking Water and Health of Populations in Sub-
50. Saharan Africa. Comptes Rendus Biologies, 336(5-6), 305-309. doi:http://dx.doi.org/10.1016/j.crvi.2013.06.001.
51. Nura I. B., Aminu S., Ahmad S. A., Abdulkadir B. & Mahmoud Z. I. (2020). Water Vendors Participation In Domestic Water Supply In Unguwa Uku, Tarauni Local Government, Kano State, Nigeria. FUDMA Journal of Sciences (FJS) Vol. 4 No. 4, December, 2020, pp 252 – 258 ISSN online: 2616-1370 -ISSN print: 2645 - 2944. DOI: https://doi.org/10.33003/fjs-2020-0404-509

52. Obaje, N.G, Lar, U.A, Nzegbuna, A.I, Moumouni, A, Chaanda, M.S. & Goki, N. G, (2007). Geology and Mineral Resources of Nasarawa State. (Preliminary Investigation):"In Geographic Perspectives of Nasarawa State".
53. A Publication of the Department of Geography, Nasarawa State University, Keffi-Nigeria. Onaivi Publisher, Keffi.
54. Olajuyigbe AE, Rotowa OO, & Adewumi IJ (2012) Water vending in Nigeria—a case study of Festac Town, Lagos. Nigeria. Mediterr J Soc Sci 3(1):229–239. doi:10.5901/mjss.2012.03.01.229
55. Onyenechere CO, Eleazu EI, Azuwike OD, Osuji S. & Igwe CF (2012) The dynamics of domestic water vending in Enugu North L.G.A. of Enugu State, Nigeria. J Water Resour Prot 4:224–230. doi:10.4236/jwarp.2012.44025
56. Opryszko MC, Huang H, Soderlund K, & Schwab KJ (2009). Data gaps in evidence-based research on small water enterprises in developing countries. J Water Health 7(4):609–622.
57. Oyemade, A., Omokhodion, F. O., Olawuyi, J. F., Sridhar, M. K. & Olaseha, I. O. (1998). Environmental and hygiene practices: risk factors for diarrhoea among children of Nigerian market women, Journal of Diarrhoeal Disease Research 16: 241–247.
58. Quick, R.E., Venczel, L.V., Mintz, E.D., Soleto, L., Aparicio, J., Gironaz, M., Hutwagna, L., Greene, k., Bopp, C., Maloney, K., Chavez, D., Sobsey, M., and Tauxe, R. V. (1999). Diarrhea prevention in Bolivia through point-of-use water treatment and safe storage: a promising new strategy. Epidemiology and Infection 122: 83-90.
59. Rahaman MM. & Ahmed TS (2016) Affordable water pricing for slums dwellers in Dhaka Metropolitan Area: the case of three slums. J Water Resour Eng Manag 3(1):15–33
60. Rahaman MM. & Varis O. (2005). Integrated Water Resources Management: Evolution, Prospects and Future Challenges. Sustainability: Science, Practice and Policy (SSPP). 1(1): 15–21p.
61. Salahudeen, H. (2015). The Role of Water Vendors in Domestic Water Supply in Nassarawa Local Government Area of Kano state, Nigeria. MSc Thesis Submitted to the Department of Geography, ABU Zaria.
62. Samaila K.I & Binbol, N.L. (2007). Hydrology and Water Resources of Nasarawa State."Geographic Perspectives of Nasarawa State".A Publication of the Department of Geography, Nasarawa State University, Keffi-Nigeria.Onaivi publisher, Keffi.
63. Samaila K.I & Ezeaku P.I (2007). Soils and Erosion. In AKwa V.L, Binbol N.L, Samaila K.I, and Marcus N.D. (eds) Geographical perspective on Nasarawa State. A publication of the Department of Geography, Nasarawa State University, Keffi. Onaivi printing and publishing Co. Ltd, Keffi.
64. Sansom K., & Bos A. (2008). Utility and non-state water service provision for the urban poor. Int. J Water 4(3/4):290–303.
65. Sheshe M.U. & Magashi A.M (2014). Assessment of physicochemical quality of sachet water produced in selected local Government areas of Kano Metropolis, Kano State, Nigeria. Bayero J Pure Appl. Sci. 7(2):31–35
66. Snell, S. (1998). Water and Sanitation Services for the Urban Poor. Small-scale Providers: Typology & Profiles. Working Paper Series, Water and Sanitation Program, World BanK (http://europeandcis.undp.org/WaterWiki/ images/f/f5/Informal_sector_providers.pdf, (Accessed 10 June 2014).
67. Solo T.M. (2003). Independent water entrepreneurs in Latin America. The other private sector in water services, World Bank, Washington D.C., p. 34.
68. Solo, T. M. (1999). Small-scale Entrepreneurs in the Urban Water and Sanitation Market, Environment and Urbanization, 11 (1):117-131.
69. Thompson, J., Porras, I. T., Tumwine, J. K., Mujwahuzi, M. R., Katui-Katua, M., Johnstone, N.& Wood, L. (2001).
70. Drawers of Water II. 30 Years of Change in Domestic Water Use & Environmental Health in East Africa. Summary. IIED, London.
71. Tumwine, J. K., Thompson, J., Katua-Katua, M., Mujwahuzi, M., Johnstone, N., Wood, E. &
72. Porras, I. (2002). Diarrhoea and effects of different water sources, sanitation and hygiene behaviour in East Africa, Tropical Medicine and International Health 7(9): 750–756.

73. UN-HABITAT (2003) Water and Sanitation in the World's Cities. Local Action for Global Goals. Earthscan, London.
74. UNICEF & WHO (2000). Global water supply and sanitation assessment 2000 report. United Nations Children Fund and World Health Organization.
75. United Nations (1977). Report of the United Nations Water Conference, Mar del Plata, March 14-25, 1977. New York: United Nations.
76. United Nations Development Programme. (2011). Small-Scale Water Providers in Kenya: Pioneers or Predators?New York, NY 10017 USA.Van Dijk, M. P. (2008). The role of small-scale independent providers in water and sanitation. Int. J. Water,4(3/4), 275–289.
77. Water Utility Partnership (2001–2003) "Toolkit. A Practitioner's Companion." The Water Utility Partnership. (http://web.mit.edu/urbanupgrading/waterandsanitation/home.html)
78. Whittington, D., Lauria, D. T. & Mu, X. (1989a). Paying for Urban Services: a Study of Water Vending and Willingness to Pay for Water in Onitsha, Nigeria. Report INU 40. Infrastructure and Urban Development Department, World Bank, Washington D.C.
79. WHO (2006) "Progress on Drinking Water and Sanitation, a 2008 Millennium Development Goal MDG Assessment on progress for Children: A Report Card." www.childinfo.org/water.html
80. WHO-UNICEF. (2015). Progress on sanitation and drinking water-2015 update and MDG assessment, World Health Organisation, Geneva.
81. WHO & UNICEF (2010). Progress on sanitation and drinking water: 2010, WHO Press, Geneva, Switzerland.
82. Wutich, A., Beresford, M., & Carvajal, C. (2016). Can Informal Water Vendors Deliver on the Promise of aHuman Right to Water? Results from Cochabamba, Bolivia. World Development, 79, 14–24.http://dx.doi.org/10.1016/j.worlddev.2015.10.043
83. Zaroff B., & Okun D.A., (1984). Water vending in developing countries.Aqua, 5, pg. 289-295.Kjellén M., (2000). Complementary water systems in Dar es Salaam, Tanzania: the case of water vending. Water Resources Development, 16 (1), 143-154.