# THE ROLE OF WATER VENDORS IN DOMESTIC WATER SUPPLY IN NASSARAWA LOCAL GOVERNMENT AREA OF KANO STATE, NIGERIA

**BY**

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## DECLARATION

I hereby declare that this dissertationtitled "**The Role of Water Vendors in Domestic Water Supply in Nassarawa Local Government Area of Kano State, Nigeria"** was written by me and it is a product of my research effort. It has not been presented in any previous application for any degree or diploma. All quotations are indicated and the sources of information are acknowledged by means of references.

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**SALAHUDEEN Hajarat(Signature) (Date)**

## CERTIFICATION

This dissertation titled**, "The Role of Water Vendors in Domestic Water Supply in Nassarawa Local Government Area of Kano State, Nigeria**" by **SALAHUDEEN Hajarat** meets the regulations that govern the award of Degree in Masters of Science Geography of Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

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## DEDICATION

This research work is dedicated to the memory of my late father Mallam Hassan Salahudeen,my late brother Barrister Suleiman H. Salahudeen may almighty Allah grants them aljanat Firdausi (Amin). And my loving mother Mrs. HunmmuaniSalahudeen for her prayer and support to my family.

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## ABSTRACT

Water vending is often taken as a symptom of a failure in piped water systems, It still play significant roles in providing water to many urban dwellers in many parts of the world Kano State inclusive.Therefore this study examined the role of water vendors in domestic water supply in Nassarawa LGA of Kano State. The specific objectives were to identify and map out the main water pumps used by vendors for water supply in the study area,examine the factors responsible for the involvement of water vendors in meeting household water needs, assess the pattern of vended water distribution in the study area and to identify the challenges of patronising vended water in the study area. Both systematic and purposive sampling techniques were used to select the sampled areas in the study area as well as the respondents. A total of 384 respondents were sampled, out of which 284 residents and 100 water vendors were sampled respectively. The study showed that majority of the vended water is sourced from outside Nasarawa LGA and mostly from shallow wells/stand pumps located at the extreme north western part of the study area borderingFagge LGA and Ungongo, and Kumbotso LGAs which is about 3 – 4 km away from Nasarawa LGA. It was also found that majority (64.1%) the residents in the study area patronise the services of water vendor, with majority (81.3%) buying their water from wheel barrow vendors/handcarts, while 15.4% buy theirs from tanker truck vendors and the least patronised were head carriage vendors. Daily patronage of vendor service dominated the frequency of respondent's patronage of vended water supply. It was found that most households (51.0%) are not connected to pipe borne water network connection. Among those connected, majority (45.3%) receives duration of water flow from the tap between 1.5-6hours. Seasonal variation in vended water demand/supply patterns exists in the study area, with dry season accounting for the highest water demand and most supplies are made during the morning and evening hours. Based on the challenges faced in buying vended water, lack of water quality guarantee dominated with 29.7%, followed by high charges from vendors (price) with 25.3%, lack of guaranteed services by vendor accounted for 20.9%. The study recommended that vendors should be recognised as an integral part of the water system as this may help in the design (and implementation) of more comprehensive policies that better serve (poor) end-users, by ensuring greater reliabilities and affordability of water vendors service. In addition, efforts should be made by government to expand pipe borne network coverage to every household in the study area and in the case of inabilities of the authorities to achieve 100% household connection alternative efforts too should be made to strategically and randomly construct public water stations, boreholes to serve remote areas.

# CHAPTER ONE: INTRODUCTION

## 1.1 BACKGROUND TO THE STUDY

"Water is life" is a common term that is often used to describe the important role of water to man. Amongst the diverse resources with which mankind has been blessed, water ranks the highest in importance. According to Clark (1991), water is the most fundamental in making life possible on earth. Water represents a unique and significant feature in any settlement; for drinking, sanitation, washing, planting, recreation, industrial process and the list continue like that (Aderogba, 2005). Irrespective of the sources, its availability and quantity often affect or determine the type of use. Thus, water use (demand) is a function of availability (supply).

However, based on the use by man, water can broadly be divided into three major categories: domestic, industrial and agricultural (Newton, 2003). For the purpose of this study, domestic water use is considered and it simply mean the use/demand for water by household for use at the household level for various purposes which ranges from drinking, washing, cooking to among others. Consequent to the unaccomplished modern ideal of uninterrupted tap water supply inside every house, many urban and rural dwellers adopt a variety of strategies to secure water, many resorts to a choice between purchasing water from a water vendor and consuming water from the taps of their neighbours.

Water vending on the other hand is referred to any form of sale of water. It is also referred to the reselling or onward distribution of utility water, or water from other sources (Kjellén and McGrahanan, 2006). Zaroff and Okun (1984) defined water vending as the sale and distribution of water by container, it ranges from the delivery of water by tank trucks to the carrying of containers by individuals. 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. Vendors may either sell directly to consumers or act as middlemen, selling water to carriers who in turn serve the consumers.

Generally, water is so essential to man that it is recognized as a basic human right (Anan, 2001). Despite its basic importance, safe 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. The Nigerian Environmental Study/Action Team (NEST) (1991) affirmed that water forms the largest part of most living matter. Human beings can survive longer without food than without water. An average man is two-thirds water and would weigh only 13 kg when completely without water (i.e., dry weight). Also, Ayoade and Oyebande (1983) noted an average man requires 1.5 liters of water daily for drinking, and about 380 liters (100 gallons) for daily domestic uses. Studies by (UNICEF/WHO, 2004; UNDP, 2006) have pointed out that the way people secure their drinking water has a direct impact on their health and on the economic status of the family units. Water is considered a renewable resource but in many parts of the world, water resources have become so depleted or contaminated that they are unable to meet ever-increasing demands (UNEP, 2004). WHO and UNICEF (2008) estimated that 1.1 billion people (17% of the global population) lack access to water resources, where access is defined as the availability of at least 20 liters of water per person per day from an improved water source within a distance of 1 km.

According to United Nations estimates, by the year 2025, up to 20% of the world's population could live in countries where water is in short supply (WWDR, 2003). Steep increase in population, rise in consumption and the desire for a better living has placed a

greater strain on the security of freshwater supply. Freshwater scarcity manifests in the form of rising demands or water depletion and water pollution. It is estimated that water use for human purposes has increased six-fold in the past 100 years (UNEP, 2004). Not surprising, reports indicate that the water problem is worse in poor countries, more especially in sub-Saharan Africa (Population Reports, 1998; UNICEF /WHO, 2000).

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 (Wikipedia, 2008). Population Reports (1998) mentioned Nigeria among the countries likely to face water shortages by the year 2025. The drinking water availability ranking published in NationMaster.com, placed Nigeria at 116th position out of 147 countries. In the same report, the Nigeria's 62% availability was below the global weighted average of 79% (UNICEF/WHO (2000)), cited in NationMaster.com (2008). Matsuura (2003) also reported that water demand in Nigeria far exceeds sustainable supply. In a survey conducted by the Federal Ministry of Health, only 15% of villages in Nigeria have adequate and potable drinking water.

The situation in urban areas is also not cheerful as less than 50% of the 85 million urban dwellers have "reasonable access to reliable water supply (Federal Ministry of Water Resources and World Bank, 2000). Salama and Okafor (2003) put the water balance or budget in the sahelian regions on the deficit, which signifies scarcity and also attributed it to the climatic trends of persistent drought and population increase in the region. The total domestic water needs in homes with piped water and inside sanitation is at least 115 liters per head per day. The actual amount used may be greater depending on the ease and convenience of supply (Ayoade and Oyebande, 1983). According to World Health Organization, 75 liters/capital of

water a day is necessary to protect against household diseases and 50 liters/capital a day necessary for basic family sanitation. According to the international consumption figures released by the 4th World Water Forum (March, 2006), it indicated that a person living in an urban area, uses an average of 250 liters/day; however, individual consumption varies widely around the globe.

The number of people who rely on the earth's limited freshwater reserves is increasing every day. Moreso, even as the world's population grows, the limited easily accessible freshwater resources in rivers, lakes and shallow groundwater aquifers are dwindling as a result of over-exploitation and water quality degradation (International Atomic Energy Agency, 2004). The UN predicted that by 2025, two-thirds of the world population will experience water scarcities, with severe lack of water blighting the lives and livelihoods of 1.8 billion. According to the UN World Water Assessment Programme, by 2050, 7 billion people in 60 countries may have to cope with water scarcity (Chenoweth, 2008). People in many parts of the world today are faced with the problem of water paucity and insecurity (Udoh and Etim, 2007). The most obvious concern about an unsafe water supply is the health risk to the people.

According to IMF (2003) growing water scarcities and water pollution in developing and developed countries alike have plunged the world into a water crisis. For instance in Nigeria, successive governments have been pursuing with vigour aggressive water supply Programmes and donor agencies also have been making their impacts in the sector through expansion of water supply infrastructures. Despite these efforts, the public are still disenchanted because access to safe water and sanitation is not improving (Emoabino and Alayande, 2007). Ibiam (2008) also reported that drinking water supply in Nigeria is grossly

inadequate especially in the rural areas. Many households, often the poorest, end up purchasing water from private 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.

In Kano state like in many parts of Nigeria the problems of water shortages follows the national trend, as both rural and urban areas experience water shortages. According to Kazuare, (2005), less than 20% of the wards in the metropolitan areas of Kano state have access to potable drinking water. According to Kano State Economic Empowerment and Development Strategy (K-SEEDS) (1997) reports, the human water consumption requirement in Kano for rural areas is put at 40-70 litres/day/ca, 70-120 litres/day/ca for semi-urban supplies and a value of up to 150 litres/day/ca for urban areas. The demand is estimated at anywhere from 500-600 million liters per day. The total capacity of the system is about 200 million liters per day. However, the system does not operate at design capacity, and production is believed to be in the order of 100-150 million liters per day (Fullbrook, Maycher, Bappah and Olowokure, 2005).

## 1.2 STATEMENT OF THE RESEARCH PROBLEM

Water is a natural resource of fundamental importance. It supports all forms of life and creates jobs and wealth in the water sector, tourism, recreation and fisheries (Ntengwe, 2005). Without water life as it exists on our planet is impossible (Asthana and Asthana, 2001). From the recent past till date, the supply of potable water for domestic use is a major challenge for the developmental efforts in Nigerian cities. Unfortunately, the increasing gap in the demand and supply of water has acquired crisis proportions. Most of Nigeria's State Water Agencies

(SWAs) are grappling with the multiple problems of erratic power supply, poor maintenance culture, faulty distribution systems, and the topography of the area. In addition to the aforementioned factors, population growth and bad-housing in some towns and cities have meant that most public water facilities put in place by the SWA are over-stretched and incapable of efficient water delivery to the people. Consequently, water supply at public water 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 (Ayoade and Oyebande, 1983).

At the national levels, efforts have been made to address the challenges of water crisis in Nigeria, many water projects have been embarked upon by previous governments and it gave rise to the provision of so many dams. Almost 150 dams consisting of large ones with height of above 15 metres and small to medium ones have been constructed or are under construction (Oyebande, 1981). Despite the existence of these dams, much is still left to be done in meeting the water needs of many Nigerians. Also presently, Kano state has the highest number of dams in Nigeria. Some of the dams located in the state are Challawa Gorge dam, Tiga dam, Thomas, Watari dam, and Kussalla dam (Mbagwu, 1994). The two larger rivers found in Kano contain water throughout the year while most of the streams are seasonal in nature. Tiga and Challawa dams are among the largest dams in Africa. These two dams were constructed by Kano state government in the 1970s. These rivers are dammed to store huge amount of water in surface reservoirs for various purposes.

Despite the existence of these dams, water supply situation in Kano State is not far-fetched from the national trend. The situation is poor and has been deteriorating for many years in both urban and rural areas due to rapid population growth and uncoordinated and

ineffective approaches to water supply delivery, combined with inadequate funding of the sector (Fullbrook, Maycher, Bappah and Olowokure, 2005). At present, Kano state has more than 18 Water Works with production capacity of more than 350 million litres daily to the state and its environs. In terms of Performance, The Kano State Water Board lack enough infrastructural facilities to satisfy this water demand as, only less than 60% of the demand has been met. This is further affirmed by Fullbrook*et al,* (2005) as it indicated that somewhere in the order of 4.8 million to 6.7 million people in Kano State are without adequate water supply and most of these are in the rural areas.

Additionally, within the metropolitan areas of the state, Challawa, Tamburawa and Watari treatment plants with a total production capacity of 415 million liter per day have been designed to supply water to the 8 metropolitan local government areas (Bello and Abdullahi, 2014). According to Parkman (2003) and Wardrop (1997) the water demand for Kano metropolis was estimated at approximately between 500-600 million liters per day and the total capacity of the system is about 200 million liters per day. However, the system does not operate at design capacity, and production is believed to be in the order of 100-150 million liters per day. Mostly attributable to none compliance with the payment of water bills by users, hence, the Board's expenditures always exceed its revenues and its systems suffer because there are insufficient funds for proper operation and regular maintenance, which are in addition to rapid population growth, urbanization, budgetary constraints, corruption, and imperatives of development and social equity. Rapid population increase in the study area is as a result of natural increase i.e. birth rate and migration from rural areas into Kano metropolitan and other urban centers in the state from different rural areas within and outside

the state which lead to high concentration of people in the Kano metropolitan, which in turn affects water demand tremendously.

Consequently, a dependency culture is created. In urban and semi-urban areas where state government systems do not provide service, people have to buy water from vendors and often pay exorbitant prices because there is no other choice. Prices fluctuate with supply and demand and normally increase significantly in the dry season. Due to the low level of service of existing systems many people obtain their water from private vendors.

In furtherance, several researches have been carried out in relation to water supply and its related issues within and outside the state. For instance, the study by Ndabula and Jidauna (2010) examined the coping strategy being adopted and the level of intensity of water stress experience vis-à-vis domestic water use. Through the use of systematic sampling techniques three Settlements in Sudano-Sahalian Region of Nigeria were selected and field tools include a well-structured questionnaire and Focus Group Discussion (FGD). The study found that the perception of the local dwellers was that there is increased water scarcity and most of the reasons include long distance mileage to available sources of water, multiple re-use, and multiple water sources. Therefore rain harvesting, conjunctive water uses, sinking of deeper boreholes, among others were recommended for the region.

In Kano state, Bichi and Amatobi (2013) assessed the quality of water supplied by water vendors to the households in Sabon Gari area of Kano. The quality of the water was assessed at commercial sales points, water vendor's distribution Jeri-cans and household storage tanks. Ninety (90) water samples were collected at 10 locations spread across Sabon-gari and analyzed for physico-chemical and bacteriological parameters. The results obtained were compared with standards recommended by the World Health Organization (WHO), the

Nigerian Standard for Drinking Water Quality (NSDWQ) and the European Community (EC). Total Hardness (as $CaCo_3$); Electrical Conductivity and Free Chlorine values were not within acceptable limits in most of the samples. Colonies of microorganism were in excess amounts in 9 samples while coliform organism was detected in 19 samples. Thus it was concluded that water quality was compromised at the private commercial supply, during hawker's distribution and in the household storage. It is recommended that the activities of the water vendors need to be regulated and monitored in order to ensure the protection of the public health.

Studies have shown that water scarcity is a serious problem in most developing countries with Nigeria inclusive and Kano state in particular (Ndabula and Jidauna2010, Bichi and Amatobi 2013)is also not left out. This scarcity however is more severe in most states within the sahelian region in Nigeria which usually experience low annual rainfall, and high rate of surface water evaporation. Kano state being part of the states within the sahelian region shares a similar experience of environmentally induced water scarcity, coupled with rapid population increase, increase in income levels which also brought about improvement in living standards, which in return lead to high water demand and consumption which consequently exerted high pressure on the available water resources and infrastructural facilities used for water supply, thereby resulting in a situation of water supply crisis. More so, even if there were enough supply available, the distribution pipelines are simply too small in number (coverage) to transport reasonable quantities of water to the northern ends of the system (Wardrop, 1997) it was also reported that an estimated 30%-50% of the metropolitan Kano population receive a reasonable supply from the Kano distribution network, in addition, there are about 600,000 people in the metropolitan Kano area who do not live in areas where

the distribution network exists. Hence, many people resort to alternative sources of water to meet their daily needs.

Finally, to the best of the researcher's knowledge, no study has been carried out on the role of water vendor in domestic water supply in Kano state. As the study by Ndabula and Jidauna (2010) was focused on the examination of coping strategy adopted by households and the level of intensity of water stress experience vis-à-vis domestic water use, while Bichi and Amatobi (2013) concentrated on the quality of water supplied by water vendors to the households in SabonGari area of Kano. It is therefore against this backdrop that the studyintends to fill this gap in knowledge.

The research addressed the following questions;

1 What is the main source and location of vended water supply in Kano metropolis?

2 What are the factors responsible for the involvement of water vendors in domestic water supply?

3 What is the pattern of vended water supply distribution in the metropolitan area?

4 What are the challenges of patronising vended waters?

## 1.3 AIM AND OBJECTIVES

The aim of the study is to examine the role of water vendors in domestic water supply in Kano metropolis. This aim will be achieved through the following specific objectives, which are to:

i. identify and map out the main sources and location of water used by vendors for domestic water supply in the study area

ii. examine the factors responsible for the involvement of water vendors in meeting household water needs

iii. assess the pattern of vended water distribution in the study area

iv. identify the challenges of patronising vended water in the study area

## 1.4 **JUSTIFICATION OF THE STUDY**

Watervending is a contemporary issue in human society and trade, now often taken as a symptom of failure in these piped systems, which still provide water to many urban dwellers in many parts of the world (Kjellen and Mcgranaham, 2006). When collecting international statistics on access to water, those who buy their water fromvendors are classified as not having reasonable access to improved water supply, along with people who get their water from unimproved wells or surface water sources and many urban centres in developing countries still do not have this reasonable access to improved water supply and Kano metropolitan area is not an exception. According to Bello and Abdullahi (2014), Kano state metropolis, has a total water demand estimated at about 550 million liters per day but the whole water presently supply treated water to the metropolitan area is only at a rate of 200 million litres per day, which is about 36% of the demand. It is very clear that the demand is far away from the supply. This is due to reasons that range from high concentration human population, industrial and commercial activities which consume large quantity of water. For example, in Kano metropolitan there are over 300 large and small scale industries, these industries directly or indirectly consume water in their daily production processes.

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 consumers. It will also lead to a rethinking of the usual regulatory mechanisms, in terms of quantity and quality, in order to promote safe water supply. In a way, vendors could be recognised as the extension of the piped system. In this sense, there would

be a better planning of investments and organisation of the service and better coordination between the different stakeholders of the water sector as well as ensure that the quality of services received from vendors complies with certain standards and that customers are not exploited within the state in particular and Nigeria in general.

Lastly the finding from this research is expected to provide the much needed information to various stakeholders involved in water resource management in Kano state in particular and Nigeria in general in understanding the various dimensions of water supply challenges faced by the residents so as to improve on better service delivery as well as provide a baseline data for future researchers in water related issues within the state, Nigeria and world in general especially in developing countries.

## 1.5 SCOPE OF THE STUDY

The importance of water to man's survival cannot be over-emphasised and in an attempt to ensure adequate availability for household use, many resort to different means for water sourcing which is a normal scenario in the study area. This study is restricted to the assessment of the role of water vendors in domestic water supply inNassarawa Local Government Area of Kano state. Nassarawa Local Government Area comprises of eleven wards, namely; Dakata, Gama, Gawuna, Giginyu, Gwagwaruwa, Hotoro North, Hotoro South, Kawaji, Kauragoje, Tudunmurtala, Tudunwada.

The specific issues to be addressed in this study include, sources of household water supply, daily quantity of household water needs, level of water vendor patronage by residents, relative availability of vended water, cost and time spent to patronising vended water, possible variation in seasonal demands for vended water supply, relative cost to season variation of vended water as well as general challenges of patronising and supplying vended water by the

residents and water vendors alike. More so the temporal scope of this study covered a period of six months after proposal defence (March to August 2015) covering the end of dry season which is of importance to water vending and onset of raining season.

# CHAPTER TWO: CONCEPTUAL ISSUES AND LITERATURE REVIEW

## 2.1 Conceptual Issues of Water Vendor

The WHO Guidelines for Drinking Water Quality (WHO, 2002, 2006) do not include bottled water or packaged water in its category or definition of vended water. However, 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, operators, suppliers, water vendors, resellers…. 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 niche markets, depending upon local circumstances such as water resources, topography, utility service levels and the regulatory framework (McGranahan*et al.*, 2006).

Different types of informal water providers usually operate in parallel within the same city or settlement, serving different categories of customer (Kjellén, andMcGranahan, 2004). Water vending is referred to as any form of sale of water. In the context of this study, water vending implies private vending of water for domestic use, but does not include bottled or packaged water or water sold in bottles. In the water literature, vending refers to the reselling or onward distribution of utility water, or water from other sources (Kjellén, andMcGrahanan, 2006). Zaroff and Okun (1984) defined water vending "as the sale and distribution of water by container, ranges from the delivery of water by tank trucks … to the carrying of containers by individuals … 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.

Vendors may either sell directly to consumers or act as middlemen, selling water to carriers who in turn serve the consumers. 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 come and fetch it as well as pay the stipulated amount". Typically it refers to households selling water (unofficially) from their own utility connections, but it also refers to itinerant vending.

For the purpose of this study, various concepts were used to describe the meaning of water vendor which ranges from the sourcing point, distribution and ownership of water source, and were limited to trucks or car tankers and push cart/wheelbarrow street vendors.

## 2.2 Water Vendors Categories

Different types of classification exist for water vending activities, depending on the classification criteria. Just as there are many forms of water vending, there are several ways of labelling and categorizing the different practices. Collignon and Vezina (2000); McGranahan*et al*. (2006) described water vending using three broad categories: wholesale vendors, distributing vendors and direct vendors

### 2.2.1 Wholesale Vendors

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.

### 2.2.2 Distributing Vendors

Distributing vendors interact with the consumers usually door to- door, and make up the majority of the small water enterprises (Collignon and 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 once abundant throughout many low-income cities, vendors hauling water by hand are declining in number as more use carts to haul the water (Collignon and Vezina, 2000). 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 varying from bucketful's to 20-litre jerry-cans to their consumers.

Tankers or Car tankers may also be used by 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 drinking water. 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).

### 2.2.3 Direct Vendors

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.

Water kiosks are another type of direct vendor commonly found in Africa and Asia (Kjellen and McGranahan, 2006; McGranahan*et al.*, 2006). There is a variety of kiosk models presented in the literature although 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 and 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 and 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 and Schwartz (2005) further outlined the organizational forms of small scale water providers/ water vending to include:

Piped networks operators with smaller networks of 5 to 50 connections 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.

i. 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.

ii. 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.

Collignon and Vézina (2000) further divided vended water operators into three categories which were based on the degree of investment, legality and recognition:

- Standpipe vendors are small entrepreneurs, who operate standpipes installed by the city water concessionaire,

- Licensed water resellers are micro entrepreneurs contracted to resell water piped to their homes and who may invest in standpipe installation and network extension

- Unlicensed household water resellers, who are not seen as professionals, although they do provide water to a major share of the market.

For the purpose of this study, the three forms or categories of water vending described by Collignon and Vezina (2000); McGranahan*et al*. (2006); Kariuki and Schwartz (2005); Collignon and Vézina (2000) were considered and used to improve on the quality of the work.

## 2.3 Global Overview of Piped Water Supply System

For roughly 3 billion people in the developing world, access to improved water through piped water supply with in-home connections is still out of reach (JMP, 2006). Some 1.1 billion of these people lack access to any form of improved water supply, relying instead on surface water sources, unprotected wells, or water delivered by vendors. The other 1.8 billion have access to shared taps or bore wells, protected springs, or dug wells. While generally providing a safe source of supply, these types of service often require considerable investments of time and effort from household members.

The World Health Organization (2000) estimates that about 20-30% of urban residents in Latin America, Africa, and Asia lack access to potable water, a situation that causes a greater percentage of the urban population to rely on vended water as the alternative source of water. For some African cities, vended water has become the major mode of access to drinking water. A bore well located one kilometer away from the home, for example, is still considered "improved water supply" by internationally accepted standards. While access to improved water supply continues to expand globally, access to water supply through house connections increased from just 26% to 30% in rural areas between 1990 and 2004, and actually decreased from 80% to 78% in urban areas (JMP, 2006). Moreso, apart from the African cities, governments worldwide are now recognizing, accepting and, in some cases, encouraging the vital role water vendor's play in providing access to drinking water to some of the most vulnerable populations (Crane, 1994; Moran &Batley, 2004).

This reflects the relatively higher per capita cost of individual connections relative to standpipes and other shared services. At the same time, evidence suggests that health benefits from piped water supply are maximized when households have sufficient volumes of water for personal hygiene, and this level of supply is only feasible when the water source is within a few yards of the dwelling. In addition, a considerable literature exists suggesting that, at least in some settings, households are often willing and able to pay for individual water supply services. For example, it is estimated that 2–3% of the populations of Cambodia, Kenya, and the Philippines are served by small scale water providers (water vendors), that is, some 3 million persons across the three countries (Economisti Associate, 2007).

To this end, it is worth to note that in urban settlements of low- and middle-income countries, water supply provisioning typically leaves a lot to be desired. Poorly functioning systems and low coverage inconvenience the inhabitants and allow infectious diseases to spread. Women bear a disproportionate share of the inconvenience, while infants and small children bear a disproportionate share of the burden of disease (Kjellen and Mcgranahan, 2006).

The reasons for this problematic situation are many. Poverty is of course an underlying problem in virtually all urban areas where water and sanitation inadequacies are severe. Poor governance is an increasingly popular explanation for bad water management (World Water Assessment Programme, 2003). Rapid urban growth exacerbates the problem. Not everyone suffers, however. The wealthier segments of urban populations in developing countries often enjoy service levels similar to those in wealthy countries, or in any case substantially better than those available to their poorer co-inhabitants (McGranahan*et al*., 2001). Great differences within low income cities give room for parallel systems and variegated supply conditions. It is

the urban poor who have to make do with the worst options. There may be cases, however, where improving services from unacceptable options (including water vendors) can make a bigger difference to the well-being of the most deprived than can striving for 'ideal' solutions, such as universal piped water connections.

The most convenient water supply, which is standard for all urban dwellers in wealthy countries, is water piped into the house from a reliable piped-water network. Such supplies rarely serve the urban poor of Africa, Asia and parts of Latin America. A piped connection to the yard, however, can also constitute a fairly convenient service and may as long as the water is forthcoming, support good hygiene practices and, given adequate drainage, safe water environments. In-house or yard connections are estimated to reach some 43% of the urban population in Africa, and 77% in both Asia and Latin America (UNICEF and WHO, 2000).

According to Cairncross and Kinnear (1990), those without functioning water connections or wells (in many cities both water connections and wells are of intermittent reliability) have to venture out to collect water from other sources, and often need to negotiate with other people. It is in this scramble to secure daily water needs where alternative systems of water resale and vending come in. Moreso, given intermittent supply and low coverage of utility networks in many low-income cities, there is great scope for alternative means of water provisioning. Small-scale private water providers are especially inclined to proliferate in (unserviced) informal areas, and in cities with low connection rates and low levels of service (Conan and Paniagua, 2003). The most common type of private initiative appears to be water vendors, including "direct" vendors or resellers selling water to consumers from standpipes or household connections, as well as distributing vendors, delivering water to people's homes. In urban areas in Africa and Asia, water kiosks – stationary water sales points – are particularly

important (UN-HABITAT, 2003). It is difficult to say even roughly what share of the water market these vendors supply. Njiru (2004) opined that developing utility of small scale water provision partnerships can improve the operating environment and the level of service among those un-served or under-served by the utilities and in doing so, will contribute to achievement of the Millennium Development Goals for water.

Worthy to note is the fact that often times, statistics simply omit all of these vendors, even in urban centres with areas where vending is ubiquitous. Also, as the different modalities of water provisioning overlap, they also compete. If piped service were to expand rapidly, water vendors would be likely to go out of business. Conversely, while vendors typically operate as an extension of the piped system into undeveloped areas, they also supplement the piped system in areas where it is deteriorating. Indeed, many piped systems in developing countries have not only had problems in matching population growth and urban sprawl, but are also having problems with the maintenance and operations of existing distribution networks (Kjellen and Mcgranahan, 2006). Vendors often perform a parallel service, drawing water from higher-pressure mains and conveying it along the piped network into areas with low pressure or intermittent supply, and where water volumes in the system are insufficient to keep adequate pressure, vendors may actually be part of undermining the proper functioning of the piped system (Collignon and Vézina, 2000).

### 2.4 Water Supply Coverage and Levels of Service in Kano State

Water supply coverage refers to the areas that are served by existing water supply schemes and based on this, water supply coverage in the state can be sub-divided into three categories: Kano Urban (Greater Kano Area), Semi-Urban or Small Towns and, Rural Areas

### 2.4.1 Greater Kano Area

The Kano Urban or Greater Kano Area is defined as an area with a radius of 30km measured from the centre of Kano (measured from the Emir's Palace). The Greater Kano Area is served by an extensive water supply system that includes three conventional water treatment plants at Challawa having a combined installed capacity of approximately 200-220 MLD and a distribution system that covers most of the area. The initial system was constructed in the 1930s and has undergone several expansions since then. The supply for Kano is also supplemented by smaller treatment plants at Tamburawa (35 MLD capacity) and Joda (12 MLD capacity) (Fullbrrok*et al,* 2005).

These schemes supply their surrounding areas, with remaining water being pumped into the Kano distribution network. The Wudil system is intended to supply Wudil and the surrounding area, with excess water feeding into the Greater Kano distribution network; but little or no water ever reaches Kano (Fullbrrok*et al*, 2005).

Wardrop (1997) in an attempt to determine the nature of water supply situation in Kano state, showed that people near the south end of the distribution system (all water treatment plants feeding Kano, except for Joda which is a very small source, are located on the southern side of Kano) receives water regularly, and as one moves further away from the sources of supply, the level of service declines. In areas located towards the centre of Greater Kano, the service was good to intermittent depending on the size of the pipeline feeding the area, and at the northern, north-eastern and north-western parts of the distribution network, there is essentially no service at all (perhaps occasionally).

According to Fullbrook*et al* (2005) this above scenario is a reflection of two things. First, the supply is not adequate to serve all customers, so consumers on the southern side of the system get served first and consume all the water before it reaches the northern ends of the system. This is easily seen by comparing supply against demand. The demand is estimated at anywhere from 500-600 MLD. The total capacity of the system is about 200 MLD. However, the system does not operate at design capacity, and production is believed to be in the order of 100-150MLD.

Secondly, even if there were enough supply available, the distribution piping is simply too small to transport reasonable quantities of water to the northern ends of the system. Similarly, it was also projected in the same study that in 2005 an estimated 30%-50% of the greater Kano population was receiving a 'reasonable supply' from the Kano distribution network. This equates to about 1.6million people. But in addition, there are about 600,000 people in the Greater Kano area who do not live in areas where the distribution network exists (Fullbrook*et al*, 2005).

### 2.4.2 Semi-Urban or Small Towns Water Schemes

There are 16 regional water supply schemes in the state that serve the semi-urban or small towns in the LGAs outside of the Greater Kano area. These regional schemes serve one or a combination of 2-3 LGA Headquarters and the villages located along or near the transmission mains between the LGA Headquarters. For example, Kusalla Regional Scheme serves part of Karaye, Kiru, and Gwarzo LGAs and is planned for extension to Shanono in the future (SEEDS, 2005).

### 2.4.3 Rural

This includes the areas outside of the Greater Kano area and outside of the areas served by the semi-urban schemes. Rural water supply in the state is generally handled by RUWASSA, but many other entities are also involved. Based on estimated by Rural Water Supply and Sanitation Agency (RUWASSA) there are roughly 500 boreholes in each LGA which would mean there are roughly 20,000 boreholes in the entire state. This include boreholes that have been installed by various agencies over the years, and many of these would have been put in long ago and would not be expected to be working now. There is no estimation of how many boreholes RUWASSA alone has installed over the years and there is no estimate of the number of working boreholes either by RUWASSA or the LGAs (Fullbrook*et al,* 2005). The above water supply coverage and level of service is further elaborated in Table 2.1.

**Table 2.1 Population and Water Supply Statistics**

| S/N | Items | Low Value | High Value |
|---|---|---|---|
| 1 | Estimated total state population | 8,600,000 | 12,000,000 |
| 2 | Population outside of Greater Kano (75%) | 6,450,000 | 9,000,000 |
| 3 | Greater Kano area population (1-2) | 2,150,000 | 3,000,000 |
| 4 | Semi-urban population (30% of 2) | 1,935,000 | 2,700,000 |
| 5 | Rural Population (2-4) | 4,515,000 | 6,300,000 |
| 6 | Population served Greater Kano (50%) | 1,075,000 | 1,500,000 |
| 7 | Population not served Greater Kano area | 1,075,000 | 1,500,000 |
| 8 | Population served semi-urban (50%) | 967,500 | 1,350,000 |
| 9 | Population not served semi-urban | 967,500 | 1,350,000 |
| 10 | Population served rural (39%) | 1,760,000 | 2,457,000 |
| 11 | Population not served rural | 2,754,000 | 3,843,000 |
| 12 | Total population served | 3,803,000<br>44% | 5,307,000<br>(44%) |
| 13 | Total population not served | 4,797,000 | 6,693,000 |

Source: Adopted from Fullbrook*et al,* 2005.

## 2.5 Water Vendor 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 toAngueletou-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 IndiaAngueletou-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 20-40 litres 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 the researcher, 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.

## 2.6 Water Vending and Distribution Issues

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. While those who are verypoor have no choice but to stand in these long queues to collect water, those who can afford theexpense purchase water from the vendors who deliver water to their doorsteps. McIntosh (2003) opined that water obtained from vendors is mainlyused for drinking and, in some cases, for cooking also, not all households purchase water every day, some purchase water only onceevery 2 or 3 days and use stored water for the remaining days. 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, Azuwike1, Osuji and Igwe, 2012).

In some areas, vendors use donkey or horse-carts. For instance, in Karachi (Pakistan) McIntosh (2003) observed that 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 and Vézina, 2000).

Paid water carriers “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 and Mcgranahan, 2006).

Pushcarts/wheel barrows 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 Vezina (2000) in contrast to parastatals or multinational companies that seek new urban service concessions, these independent entrepreneurs reap no monopolistic benefits or rents. They must win their customers' loyalty and maintain their equipment on a daily basis. They must be ready to innovate and adapt in order to stay in business in this competitive market.

As illustrated by Kjellen (2000) the price to 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. The researcher went on to emphasize in a related study in Philippine, that pushcart vendors complain of pains in the chest and joints, and 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.

The researcher further summarized the activities of water vendor in the following way, starts work each day as early as 3:00 a.m., 7 days a week. He buys water from the concessionaire at 1 peso per 16-liter container and distributes it by pushcart (a bicycle with a large sidecar) to an average 20 customers, covering an average of 2 kilometres from the water collection point to the supplying points. He sells 40 containers per day at 5 pesos per

container. Working for an estimated 84-hour per week, earns 5,000 pesos per month (equivalent of ₦22,252), whereas the poverty line is more than 9,000 pesos per month.

### 2.7 Challenges of Patronising Water Vendors

Water quality and prices have often been considered as the most common challenges faced by those that patronise vended water. For instance, 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 and 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, Lauria and Mu (1989)showed 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 1,000 litres of water and N2500 ($16.7) to procure 500 litres from tanker vendors (wholesale). While in the case of retail (cart/wheel barrow vendors), it costs N30 to procure 20 litres (1 gallon) of water.

Additionally, 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 neighbouring areas beyond the water lines (Zaroff and Okun, 1984). This is further supported by Kariuki and 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 several studies account for the higher cost of vended water over utility supplied water due to the labour-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 programmes, 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 and 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 potable quality, a situation that spurs up water borne diseases. Significant evidence which exists show that quality changes in such circumstances may be extreme and respond to the extent of handling (Quick *et al.,* 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, Lauria and Mu (1989) stated that many water vendors who purchase water from tanker trucks and water vendors 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 and 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 SabonGari area of Kano State.

# CHAPTER THREE: STUDY AREA AND RESEARCH METHODOLOGY

## 3.1 STUDY AREA

### 3.1.1Location, Position and Size of Kano State

Kano State is located in the northern part of Nigeria. It lies between latitude $10^{o}$ 05″N – $12^{o}$ 45″ N and $7^{o}$ 45″ E -$9^{o}$ 75″ E of the Greenwich Meridian. The state has a total land mass of 20,131 $km^2$. It is bounded by Katsina State on the west, by Kaduna State on the south-west and by Jigawa and Bauchi States on east and southeast respectively. The state has 44 Local Government Areas and divided into three different senatorial zones, named as Kano Central, Kano South and Kano North. Out of the 44 Local Government Areas, 36 are in the rural areas of the state, while 8 are in the urban areas and are known as Metropolitan Kano (Research and Documentation Directorate Kano, 2009). The state has the highest population in Nigeria, with population of 9,383,682 and population density of 470 per/sq km (NPC, 2006). The Kano metropolitan area has a population of 2,163,225 with population growth of 2.9% per annum (NPC, 2006).Nassarawa local government area (Study area) is the most populated local government in the state and is surrounded by Ungongo LGA in the north central, Gazewa LGA in north-east, Warawa LGA in the South-east, Kumbotso and Tarauni LGAs to the south-west and Fagge LGA to the north-west (See Figures 3.1 and 3.2).

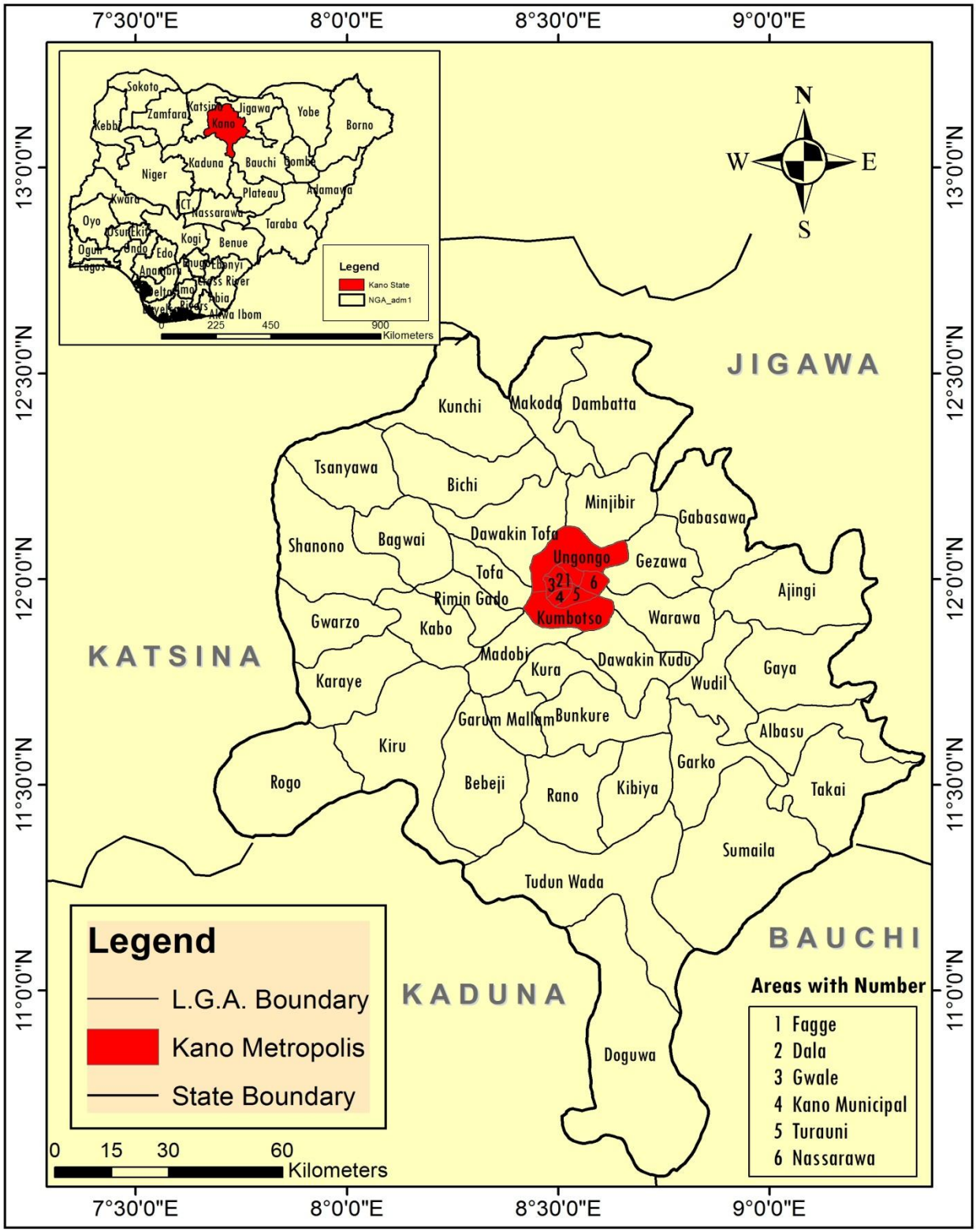


**FIG. 3.1: KANO STATE SHOWING THE METROPLITAN AREA**

Source: Kano State Geographic Information System, 2014.

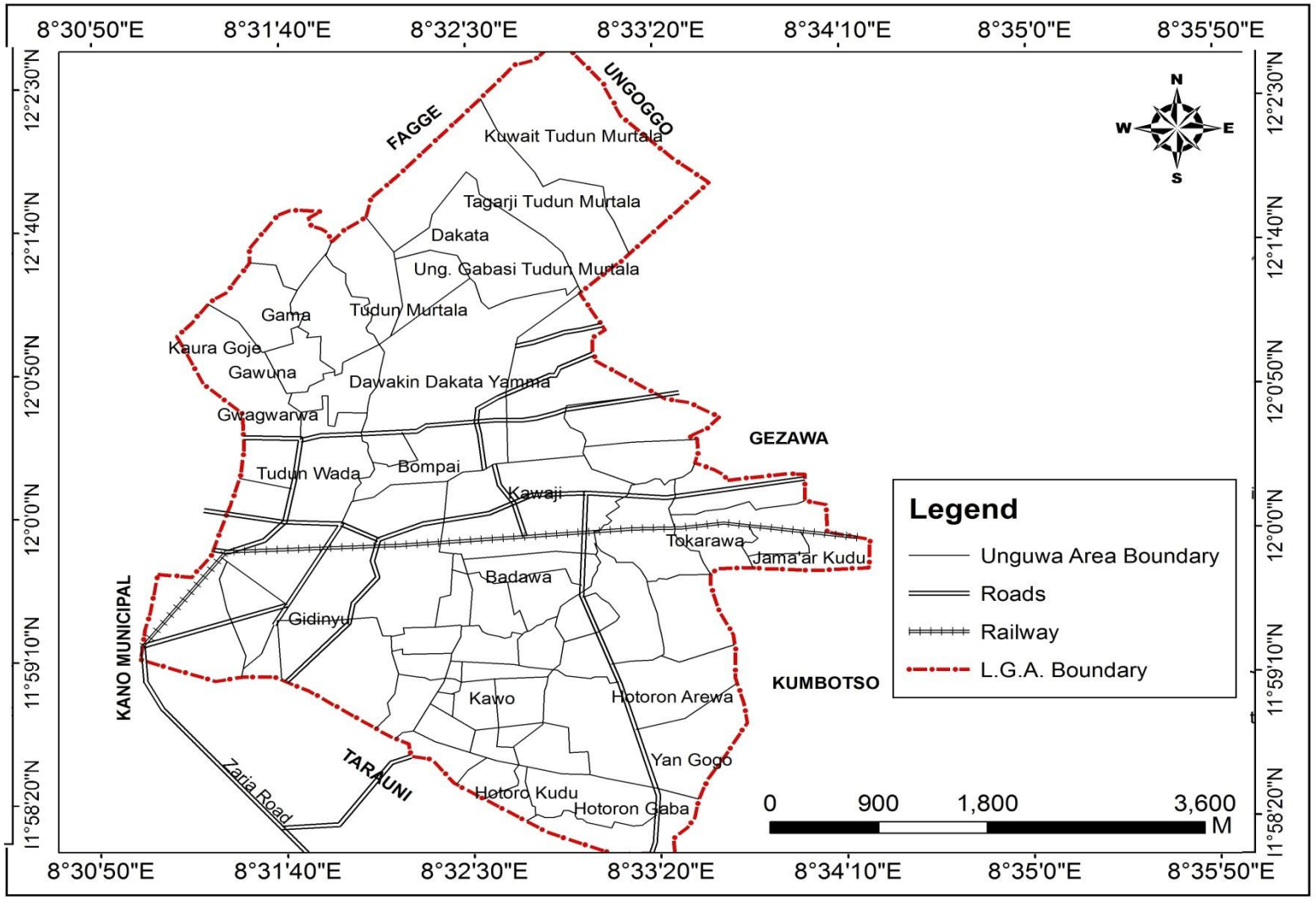


**FIG. 3.2: MAP OF NASSARAWA LOCAL GOVERNMENT AREA.**

Source: Kano State Geographic Information System, 2014.

### 3.1.2 Geology

Geology of Kano state is made up of three major rock formations namely, the basement complex rocks comprising of crystalline igneous and metamorphic rocks dating back to the Precambrian age. Younger granite rocks were intruded later in the Jurassic. The youngest formation is the Chad sediment deposited from the quaternary including recent deposits (Ahmed, 2011). The basement complex underlines over 70% of the Kano environment. The rock types in the area are older granites, metasediments and older basement. The older basement is composed of migmatite, biotitegneiss, and blended gneiss. Migmalite is composite gneiss produced by injection of granite magma in to schist host. Gneiss is metamorphosed granite and is granitic in composition while biotite gneiss is a foliated crystalline rock with high biotite content. Banded gneiss has light and dark bands with a light fraction of quartz while the dark fraction or band consists of biotite, plagioclase and quartz minerals. The ancient metasedimentary rocks result from the weak metamor###hism of sedimentary rock. Rock types include Phyllite which is derived from metamorphism of clayey sediments. It is intermediate in metamorphism between slate and schist. Quartzite metasediments results from cementation or fussion of quartz grains of sandstone. Older granites are commonly biotite granite and granordiorite.Biotite granite is an acid igneous rock with high content of biotite mineral while a granordiorite has a composition which is intermediate between a diorite (an intermediate igneous rock) and granite. Joints and fractures in the Basement complex rocks are better developed in the granites and quartzite and less in the gneisses, and migmatites, Joints rarely extend to depths greater than 90 metres (Oyawoye, 1964; Ahmed, 2011).

The occurrence of Younger Granite corresponds to basement joints and fracture system. The systems guided volcanic eruptions and the granite intruded as high level magma chambers

beneath volcanic centers. It is for this reason that the younger granite ring-complex structure formed. Large quantities of volcanic rhyolite lava are still preserved in southern part of Kano state. Rhyolite has the same mineral composition as granite (quartz, feldspar, and mica) but it has minute crystals due to rapid cooling of magma.Besides rhyollite extrusive there are also intrusions of granite-porphyry and biotite granite. The intrusions form the ring-complex and are more resistant to erosion than most of the rocks of the basement complex. This is the reason they form a series of hill massifs rising over 1000 meters above sealevel (Ahmed, 2011).

The younger granites have low magnesium content and this facilitated the crystallization of iron bearing minerals such as fayalite and olivine, hedenbergite as pyroxene and riebeckite and amphibole. Cassiterite or tin is abundant and associated with the biotite-granite. Erosion concentrated the tin in colluvial deposits to provide sources for the tin mining industry.The younger granites are strongly jointed arising from regional compression with the stress producing fractures which break outcrops into blocks. These vertical or near vertical joints are usually independent of the local instrusive structure.

Chad sedimentation rocks are freshwater sediments of lacustive and fluviatile clays, sandy clays and silts with beds and lenses of sand and gravel at various levels. These are overlain by more recent sand drift and alluvium. Chad sediments are found in the northeast where unconsolidated aelolian sand form a drift plain. The alluvial sediment is related to the channel of the Rivers Hadejia, Jakara, Thomas and Gari. In the former causes of these rivers the ancient alluvium is almost overlain by drift material while recent alluvium occurs along the existing water causes (Research and Documentation Directorate Kano report, 2009).

### 3.1.3 Hydrology and Drainage

The study area is underlain by the Basement Complex rocks which are hard and impervious in nature with rivers that flow in north-south direction. Ahmed (2003) reported that there is a considerable relationship between groundwater and drainage pattern with the highest network of rivers in the Basement Complex areas. However the small areas of Chad sediments in Dambatta and Gaya Local Government Areas are expected to have more groundwater and limited Channel development.

In the basement complex areas of Kano state two hydrological areas can be identified by USDA (1968) as reported by Ahmed (2003) that hydrological areas of Kano state are upland areas such areas include rivers like River Kano, River Challawa, River Iggi and Gaya. The second hydrological areas include the Gari area which comprises of River Gari, Thomas and Jakara. The Jakara River flows in a south-west to north-east direction in a gently sloping river bed (Musa, 1990). Along the Jakara drainage basin, the highest point is 495m (at the dam outlet near Kwata village) while the lowest point is at the dam inlet (near Bela Village) at 424m above sea level.

Several dams have been constructed to meet the rural water supply demands. About 25 small to large including those at: Gari dam, Wasai dam, Kafin-Ciri dam, Challawa Gorge dams, Ruwan-Kanya dam, Watari dam, Kanye dam, Gudedam and the Bagauda Lake dam (Ahmed, 2003). Together with such rivers as R. Kano, R. Watari, R. Challawa, R. Wudil, R. Dudduru Gaya.They form the major hydrological systems that have the potential for rural water supply development. The stream flow in Kano state is characterised by seasonality, flash flours with flow rising in response to rainfall occurrences. The high flash flows exceeded 10% of the times

are recorded mainly in July and August in response to rainfall events 30mm or more (Ahmed, 2003).

In Kano region groundwater regime was more favourable in both urban and rural areas in those days according to history. It is reported by Ahmed (2003) that groundwater regime was more favourable before the decades 1960s to 1980s. Level of well is between 10-12m deep in uplands mostly southern parts of Kano and about 2m in the lowland fadama areas but now 20-25m in uplands and 8m in low land fadama areas mostly northern parts of Kano state.

Also, surface stripping and slope replacement have led to the formation of erosion residuals, with boulder slopes (7-15m), rubble slopes (4-70m) and lower concave slopes (2-40m). Granite hills are common in the Iggi and Dogwalo headstream while mesas are common in the Thomas and Gariheadstream areas. The average slope is 40 while drainage densities reach $2km^2$ with a hypsometric integral below 50%. Erosion hazard is rated as high because of the considerable relief and moderately steep slopes.

### 3.1.4 Climate

The climate of Kano is described as Aw by Koppen, with both annual and seasonal variabilities...wet years and dry years may record between 850 and 750mm (Olofin, 1987). The temperatures are characterised by warm to hot seasons with the occurrence of the Harmattan between November and February. The climate is determined by the movement of two air masses, a moist rather cool southerly mass known as south-westerly and a hot and dry northern air called the north-easterly. The moist southern air forms a wedge under the lighter dry air and the region where the two air masses meet is primarily an area of pronounced moisture gradient. The humidity gradient is called the intertropical discontinuity (ITD). The annual motion of the ITD is

northwards between February and August and southwards between September and January. The north-south movement of the ITD influences weather pattern. Maximum rainfall is recorded in an area of considerable disturbance (air movement) 8 to 90 southwards of the ITD. However, when disturbance is limited or when the northward movement of the ITD is restricted drought is recorded. The level of disturbance and the northward movement of the ITD are influenced by the global pattern of pressure and winds as well as the interaction of the surface air and the upper air mass (the jetstreams). When the ITD is southwards, the state is under the north easterlies and there is weather change. The weather changes arising from the movement of the ITD give four seasons (Ahmed, 2011).

(i) Hot and Dry Season (Rani)

The ITD starts its southward movement in February and between March and May it has no considerable influence in the state and the weather is hot and dry during rani season. The mean temperature is 28 to $30^0$c while this is the season when the "false" start of the rain is recorded in May. Few rainfallsare recorded in May and rain days are separated by days of dry spell and less than 1% of the annual rainfall is recorded in May.

(ii) Warm and Wet Season (Damina)

The ITD has by now made considerable advance northward and there is widespread rainfall in the state. Rainfall occurs mainly in the evenings for periods of one to three hours and considerable heavy rainfall (high intensity) is recorded in the first forty minutes of rainfall occurrences. Over 90% of the annual rainfall is recorded in this season. This is the humid period when surface runoff is available for stream flow and soil moisture in sufficient for plant growth. Damina is the crop growing season when grains and legume are grown. Temperature drops to an

average of $24^0$-$29^0$c while evaporation is lower because of the higher relative humidity of the moist south westerly air. This is why the runoff-coefficient is highest during this season.

(iii) Warm and dry Season (Kaka)

The ITD is now in its southward retreat and only a few showers may be recorded in October accounting for less than 8% of the annual rainfall. This is the harvest season between October and November when farmers are busy harvesting crops and traders are buying what is offered.Average temperature is 28-$29^0$c and this is a dry season as evaporation is in excess of rainfall. This is a season when soil moisture is depleted and stream flow recedes.

(iv) Cool and Dry Season (Bazara)

The ITD reaches it southern limit during this season and the state is under the influence of the north easterly wind which brings a cool and dusty weather called 'Harmattan" between December and February, the dry air from the north brings no railnfall but the transported harmattan dust is deposited to replenish soil nutrient. The depth of the windrift material varies from an average of 1 to 2m.This is the cool season when temperature is 25 to $27^0$c. The skin dries up during this period (Ahmed, 2011).

### 3.1.5 Soil and Vegetation

The soils are generally matured on the plain but seriously altered due to human settlements. The influence of topography, wind drift (materials from the desert) and climate are what shaped the aggregate of the soil. The matured soils are said to be latosols of ferruginous type (Olofin, 1987). The soil is however well drained, brown to reddish in colour. Along the

floodable area of river channels, hydromorphic soils are found. These are dark in colour and have high clay content. 'Intensive use of soils and addition of manure and chemical fertilizers have altered their character, profile, texture, structure and chemical characteristics' (Falola, 2000).

The soils in the Jakara plain are typical of the weakly developed soils as described by the Commission for Technical Cooperation in Africa (CCTA) map; it may probably compose of lithosol which are alluvial colluvial soils directly overlying a weathered substratum or what is called "Rotten Rock" (Musa, 1990). The soils are good for agriculture - especially fadama cultivation that is practiced in the area due to their clayey-loamy nature. However, the erosion of these soils is known to be the major factor of the increasing sediment discharge of the Jakara River, and consequently the siltation of the reservoir. Remnants of farm products as well as wastes from various urban activities make significant contribution to the sediment load.

In addition, the study area lies within the Sudan Savannah zone and form part of the human settlement in which vegetation is seriously depleted through construction process. It comprises both tall and short grasses with scattered trees most of which are semi-natural, planted for shade and their economic values. The natural vegetation has been cleared especially for cultivation purposes. Very few natural vegetation species are often found and these do not exceed 20 metres in height consisting of trees like *Acacia Albida, Tamarindus .Indica, ButyospernumParkii, ParkiaClappertonia*and a handful of others. Grasses are hardly found, except in scanty patches. These hardly reach 1metre high at maturity, and tend to dry up in the dry season. Cultural vegetation has replaced the natural vegetation in the area where exotic species predominate.

### 3.1.6 Population

Kano state population is predominantly Hausa-Fulani. The Nupe and Kanuri "natives" occupy distinct tracts of the old city. Yoruba and Igbo follow the Hausa-Fulani in number, but almost all other tribes of Nigeria are found in the State. Foreigners like Arabs particularly the Lebanese have been assimilated into the culture of the Kanawa because of their affinity in trade and Islamic backgrounds (Ajayi, 1999).

The state has the highest population in Nigeria, with population of 9,383,682 and population density of 470 per/sq km (NPC, 2006). The metropolitan Kano has a population of 2,826,307 with about 2.9% growth rate, contributing 30.1% of the entire state population. Within the 8 local governments that make up the metropolitan Kano, Nassarawa local government has the highest population of 595,411 which is 21.1% contribution to the metropolitan population (NPC, 2006).

### 3.1.7 Land use and Human Activities

Kano metropolis has grown tremendously, especially since 1970s' (Falola, 2000).The space is dominated by residential land-use divided between the old walled city (Birni), migrant centres and new layouts. In the metropolitan Kano, thirty-four residential, thirteen commercial, and four industrial layouts were created by the KASEPPA (now KANUPDA). Like population, the Land uses in the urban Kano have witnessed rapid growth and changes. The ancient part of the metropolis has grown originally without proper planning and control of development. It is therefore characterized by narrow streets, which are mostly inaccessible to vehicle, mixed land uses, and inadequate provision of social amenities and infrastructure.

Kano has a long history of crafts and cottage industries in leather works, calabash design, textiles, weaving and dyeing. In the modem manufacturing sector, it is second only to Lagos (Falola, 2000). Most of these are located in Bompai industrial estate.

Aside crafts and cottage, majority of the populace especially in the rural areas mostly engages in agricultural activities. This is because Kano state has high potential for agricultural development owing to the abundant land and plentiful sunshine. Agricultural production is limited by the rainfall variability and the need to improve and sustain soil fertility. The intensification of rain-fed agriculture is possible through organic farming based on the mixed application of inorganic fertilizer and manure as well as agroforestry and irrigation practices (Ahmed, 2011).

## 3.2 METHODOLOGY

### 3.2.1 Reconnaissance Survey

Before embarking on this research, a reconnaissance survey was carried out to observe and explore the water supply situation as well as the activities of water vendors in and around the state. During the brief visit, oral interview was carried out on some residents on issues relating to water supply in general and water vending activities so as to ascertain the relevant issues to be addressed in the questionnaire. The survey also helped to determine the sampling techniques to be employed in selecting the sampling areas.

### 3.2.3 Types and Sources of Data Acquired

In order to achieve the aim of objective of this study, this study used both primary and secondary data sources.

### 3.2.2.1 Primary Data Sources

The main research instrument here is the questionnaire which was administered in different locations of the study area. Two sets ofquestionnaire were designed as structured and open ended and administered, one to residents and the other to the water vendors interpreting to the vendors as most are illiterates. The questions included information like sex, age, level of education attained, income levels, place of residence, household composition, sources of domestic water, household per capita water consumption, and challenges of patronizing water from vendors among others, amount per gallon of water, daily income from selling water, distance covered to and from collection and supply points etc.

### 3.2.3.2 Secondary Data Sources

This data includes the existing official and unofficial water related articles from both national and international publications, including books, journals, conference papers, thesis, dissertations and national survey reports, where literatures on water supply related issues in general were obtained from, so as to further enrich the quality of the research.

### 3.2.3 Sampling Techniques

Nassarawa Local Government Area was purposively selected based on the fact that Nassarawa LGA is the most populous in terms human and by households or housing unit, not just within the metropolitan area, but in the whole state at large. Hence it has the highest incidence of population increase induced water stress within the state as reconnaissance survey revealed. Moreso, the selection of Nassarawa LGA was done considering the time frame and financial constraints required for the work as well as the fact that this area possesses the commercial, educational, administrative and residential attributes of the state.

In the second stage, in order to determine the sampling size of questionnaire to be administered, Krejcie and Morgan (1970) formula for sample size selection which state that for a population less than 1,000000, the sample size for respondents is 384. Since the housing unit population of the selected LGA (Nassarawa LGA) is 104,429, therefore 384 sample size was drawn.

Finally, to determine the proportion of respondents to be sampled, due to the absence of population according to wards and or sub-settlements in Kano state which will enable a proportional questionnaire distribution, the population of housing unit according to NPC 2006 report was used. This is because the study is limited to the role of water vendors on domestic water supply inNassarawa Local Government Area of Kano state. Hence the housing units were purposively identified and the respondents, especially adult or male/female head of the households were sampled. This was done systematically so as to ensure an unbiased and equal spatial coverage of responses across the eleven wards in the study area (see Table 3.1). To arrive at this, Yamene 1976 sample size formulae was used, which states thus;

$$\frac{n\ x\ 384}{N}$$

Where n=Total population of each selected LGA

N=Total population of the entire population under study.

However, using the above sample size formulae 384 respondents were sampled. To accommodate responses from the residents and water vendors, a total of 284 residents found in the selected type of residential building, while 100 water vendors were also sampled. In all, 384 respondents were sampled. The sampling of 100 water vendors is informed by the researcher's

estimation of the total possible number of sample able water vendors within the study area based on a careful observations made during the reconnaissance survey carried out.

**Table 1.1 Distribution of Households by Type of Housing Units and Proportion of Respondents to be Sample**

| S/N | Type of Housing Unit * | Housing Units Populations * | Proportion of Samples ** |
|---|---|---|---|
| 1 | Separate stand house | 40,883 | 111 |
| 2 | Hut structure made of traditional material | 2713 | 7 |
| 3 | Flat in block of flats | 10,843 | 30 |
| 4 | Semi-detached house | 21,525 | 59 |
| 5 | Room/let in house | 16,669 | 45 |
| 6 | Informal/improvised dwelling | 2664 | 7 |
| 7 | Others | 9132 | 25 |
| **Total** | | **104,429** | **284** |

*Source: Adopted from NPC 2006 Housing Population Census Report

** Source=Field Survey, 2015.

### 3.2.4 Data Analysis

The first step in data analysis was the selection of all valid questionnaires and encoding them into a computer and analyzing them using SPSS/PC+ software.

The second step was to analyze and present the information from the questionnaire by means of descriptive and inferential statistics. Descriptive statistical technique was used to interpret the various information obtained inform of frequency distribution, as well as the

presentations of results in percentages, tables, cross tabulations, bar charts pie charts. All tests were carried out at 0.5 levels of significance.

To achieve objective I,

Questionnaires was carefully designed and administered to the water vendors to elicit their responses on the locations of the main water pumps from where the sellers obtain water from before distributing to the buyers and a GPRS was used to obtain the absolute location of the pumps and the points were overlaid on the map of the study area to show the distribution.

To achieve objective II, and V

Carefully designed questionnaire was also administered to the respondents (House occupants and water vendors) to elicit information on the factors responsible for the involvement of water vendors in meeting household demands, variation in vended as well as the challenges encountered by residents in patronising water vendor's services. The data was analysed using SPSS Version 20 and the results were presented in form of Tables and charts.

To achieve objective III

To determine the pattern of vended water distribution in the area, simple flow charts was used to show the pattern of movement of water from the purchase to the sale points, time of the day movement and distance coverage of vended water within the study area.

# CHAPTER FOUR: PRESENTATION AND ANALYSIS OF DATA

## 4.1Introduction

This chapter presents the analysis of data and interpretation of findings based on the objectives as outlined in chapter 1 of this study. The analysis and presentation of results is divided into sub-sections. The first section is focused on the socioeconomic characteristics respondents who are the residents and the second on the water vendors. Section three, four, five, six and seven are focused on the objectives of the study.

## 4.2 Socioeconomic Characteristics of Residents and Water Vendors

### 4.2.1 Socioeconomic attributes of respondent

This section shows the general background characteristics of the respondents sampled in the study area. The emphasis here as presented in Table 4.1a/b are age groups, gender, nature of household, householdsize, ownership of household, number of rooms in the houses, educational levels, occupation and monthly income.

From the presentation in Table 4.1a/b, it reveals that respondents between the ages of 30-39 years constitute the majority with 37.0%, followed by those aged 19-29 years with 23.9%. Those aged 40-49 years, 50-59 years, 60-69 years and 70 years above follow with 21.5%, 14.1%, 2.1% and 1.4% in that order. This finding shows that respondents are adults and hence are in better position to provide reliable responses to the issues addressed in the questionnaire.

On the gender of the respondents, males with 64.8% outnumbered their female counterparts with 35.2%. The representation of both male and female among the sampled respondents helped to accommodate the possible variation of opinion on issues explored in the study. Nature of respondent's households shows that majority (62.7%) are from nuclear type of household, while 37.3% are from extended households.

**Table 4.1a: Socioeconomic Characteristics of Respondents**

| Age Groups | Frequency | Percentage |
|---|---|---|
| 19-29 | 68 | 23.9 |
| 30-39 | 105 | 37.0 |
| 40-49 | 61 | 21.5 |
| 50-59 | 40 | 14.1 |
| 60-69 | 6 | 2.1 |
| 70 above | 4 | 1.4 |
| **Total** | **284** | **100** |
| **Gender** | | |
| Male | 184 | 64.8 |
| Female | 100 | 35.2 |
| **Total** | **284** | **100** |
| **Nature of Household** | | |
| Nuclear | 178 | 62.7 |
| Extended | 106 | 37.3 |
| **Total** | **284** | **100** |
| **Household Size** | | |
| 0-4 | 97 | 34.2 |
| 5-9 | 101 | 35.6 |
| 10 and above | 86 | 30.3 |
| **Total** | **284** | **100** |
| **Ownership of Accommodation** | | |
| Self-owned family house | 153 | 53.9 |
| Rented | 79 | 27.8 |
| Official | 28 | 9.9 |
| Squatting | 18 | 6.3 |
| Others | 6 | |
| **Total** | **284** | **100** |
| **Number of Rooms in the House** | | 5.6 |
| 1 Bedroom apartment | 16 | |
| 2 Bedroom apartment | 62 | 21.8 |
| 3 Bedroom apartment | 103 | 36.3 |
| 4 Bedroom apartment | 76 | 26.8 |
| Others | 27 | 9.5 |
| **Total** | **284** | **100** |

Source: Field Survey, 2015.

**Table 4.1b: Distribution of Respondents Background**

| **Educational Levels** | **Frequency** | **Percentage** |
|---|---|---|
| No formal education | 6 | 2.1 |
| Quranic education | 37 | 13.0 |
| Primary | 6 | 2.1 |
| Secondary | 34 | 12.0 |
| Tertiary | 201 | 70.8 |
| **Total** | **284** | **100** |
| **Occupations** | | |
| Civil servant | 115 | 40.5 |
| Farmers | 14 | 4.9 |
| Full time house wife | 39 | 13.7 |
| Artisan/Labourer | 48 | 16.9 |
| Others | 68 | 23.9 |
| **Total** | **284** | **100** |
| **Monthly Income** | | |
| ₦100 - ₦18,000 | 55 | 19.4 |
| ₦18,100 - ₦37,000 | 40 | 14.1 |
| ₦37,100-₦56,000 | 46 | 16.2 |
| ₦75,000 and above | 143 | 50.4 |
| **Total** | **284** | **100** |

Source: Field survey, 2015.

On the respondent's household size, the study shows that those from household size of 5-9 members dominated with 35.6%, followed by those with 0-4 members with 34.2% and respondents from household of 10 and above members comprise of 30.3%. This suggeststhat most respondents are from relatively large households, hence are most likely to have high water consumption. This is further buttressed in a study by Cheesman*et al* (2008) where it was found that doubling the number of residents in the household increased household consumption from piped network by 50% in a related study in Vietnam.

Results on the ownership of accommodation, shows that majority of the respondents that comprise of 53.9% live in self-owned family house, followed by those that live in rented apartments with 27.8%. Those residing in official and squatters accommodations accounted for

9.9% and 6.3% respectively. “Others” on the ownership of accommodation such as temporal inhabitants accounted for 2.1%. The dominance of those living in self-owned apartments among respondents shows that respondents are likely to make adequate possible provisions in meeting the household water needs such as the construction of boreholes, wells among others, unlike those living either in rented or official apartments.

On the other hand, analysis on the number of rooms in respondent’s house shows that 3 bedroom apartments dominated with 36.3%, followed by those living in 4 bedroom apartments that constitute 26.8%. Respondents living in 2 bedroom and 1 bedroom apartments accounted for 21.8% and 5.6%. “Others” living in apartments such as 5 bedrooms and 5 bedrooms and above comprise of 9.5%.

Educational level of respondents shows that most (70.8%) respondents have tertiary education qualifications, followed by those with Quaranic education qualifications that accounted for 13.0%. Those with secondary education qualification accounted for 12.8%. This means that most respondents are likely have positive attitudes towards hygienic practices with regards to their domestic water sources and uses. This is confirmed in a study by Basani, Ishan andReitlty(2008) where it was noted that education is positively associated with household choice of improved water source.

Also, civil servants dominated respondent’s occupational status with 40.5%. Artisans/labourers, full time house wife and farmers accounted for 16.9%, 13.7% and 4.9% in that order. “Others” on the category of respondent’s occupation like lawyer, business and medical doctor accounted for 23.9%. The highest monthly income earned by respondents is between ₦75,000 and above which consists of 50.4%, followed by those with monthly income of ₦100 - ₦18,000. The least monthly earned income by the respondents is ₦18,100 - ₦37,000.

The dominance of those with monthly earning of ₦75,000 and above is attributable to the level of educational attainments; this is so as it is generally believed that high educational attainment increases the chances of gaining better paid employments.

4.2.2Socioeconomic Characteristics of Water Vendors

Table 4.2 shows the distribution of water vendors background characteristics. The presentation on age reveals that majority of the vendors (44.0%) are aged between 19-29 years, followed by those aged between 30-39 years that constitutes 24.0%. The least age groups of vendors are 60-69 years which accounted for 8.0%. The age group distribution of vendors shows that majority are still within their reproductive ages, hence are still energetic enough to cope with the physical challenging nature of the work.

On the gender distribution, it is clear from the presentation in Table 4.2 that water vending activities is mostly carried out by males. This is indicated where 100% of the sampled vendors were males. On the other hand, analysis on the vendor's nationality shows that majority (62.0%) are Nigerians, while 38.0% are from Niger Republic. Among the vendors with Nigeria nationality, Majority (42.0%) are indigenes of Kano State, followed by those from Jigawa State with 38.0%. Katsina, Niger, Bauchi and Kogi States origins accounted for 9.0%, 6.0%, 4.0% and 1.0% in that order.

Presentation on the vendor's number of years of experience in water vending activities reveals that majority that constitutes 59.0% have been in the business between 5 years and above. Those with 3-4 years, 1-2 years and less than 1 years of experience in the business accounted for 32.0%, 7.0% and 2.0% in that order.

**Table 4.2: Water Vendors Background Characteristics**

| Age Groups(Years) | Frequency | Percentage |
|---|---|---|
| 19-29 | 44 | 44.0 |
| 30-39 | 24 | 24.0 |
| 40-49 | 15 | 15.0 |
| 50-59 | 9 | 9.0 |
| 60-69 | 8 | 8.0 |
| **TOTAL** | **100** | **100** |
| Gender | | |
| Males | 100 | 100.0 |
| Female | 0 | 0.0 |
| **TOTAL** | **100** | **100** |
| **Nationality** | | |
| Niger Republic | 38 | 38.0 |
| Nigeria | 62 | 62.0 |
| **TOTAL** | **100** | **100** |
| **State of Origin** | | |
| Jigawa | 38 | 38.0 |
| Bauchi | 4 | 4.0 |
| Kano | 42 | 42.0 |
| Katsina | 9 | 9.0 |
| Kogi | 1 | 1.0 |
| Niger | 6 | 6.0 |
| **TOTAL** | **100** | **100** |
| **Years in Water Vending Business** | | |
| < 1 year | 2 | 2.0 |
| 1-2 years | 7 | 7.0 |
| 3-4 years | 32 | 32.0 |
| 5years and above | 59 | 59.0 |
| **TOTAL** | **100** | **100** |
| **Monthly Income** | | |
| ₦100-₦18,000 | 2 | 2.0 |
| ₦18,100-₦36,000 | 60 | 60.0 |
| ₦36,100-₦54,000 | 21 | 21.0 |
| ₦54,100 and above | 17 | 17.0 |
| **TOTAL** | **100** | **100** |

Source: Field Survey, 2015.

In addition, water vendors monthly income distribution shows that majority with 60.0% earn ₦18,100 - ₦36,000, followed by those with monthly income of ₦36,100 - ₦54,000 that

accounted for 21.0%. Income earners of ₦54,100 and above and ₦100 - ₦18,000 among the vendors accounted for 17.0% and 2.0% respectively.

### 4.3 Location of Main Water Sources Used by Vendors for Water Supply

Figure 4.1 shows the location of water sources from where water vendors obtain their water for onwards supply to the end users/households. From the presentation in Figure 4.1, it shows that majority of the vendors source their water from outside Nasarawa LGA. Majority sourcing their water from shallow wells/stand pumps located in Fagge LGA which is about 3 – 4 km from away from Nasarawa LGA. However, some shallow wells/stand pumps are located in the north western part of the study area and around the GRA, one (1) water works station and some hand dug wells are also located inKawaji ward (which serve their water demands) which are both public and privately owned inthe study area from where vendors buy obtain their water from, for onwards distribution to households/settlements within and outside the local government. Also, one water works (pipe borne distribution sub- station) is located around the northwestern part of the study area (Kauragoje ward).

From the distribution of water vendors supply locations in the study area, it is clear that most sources found within the study area are hand dug wells and few shallow wells/stand pumps. And 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 located outside the study area to satisfy their customers

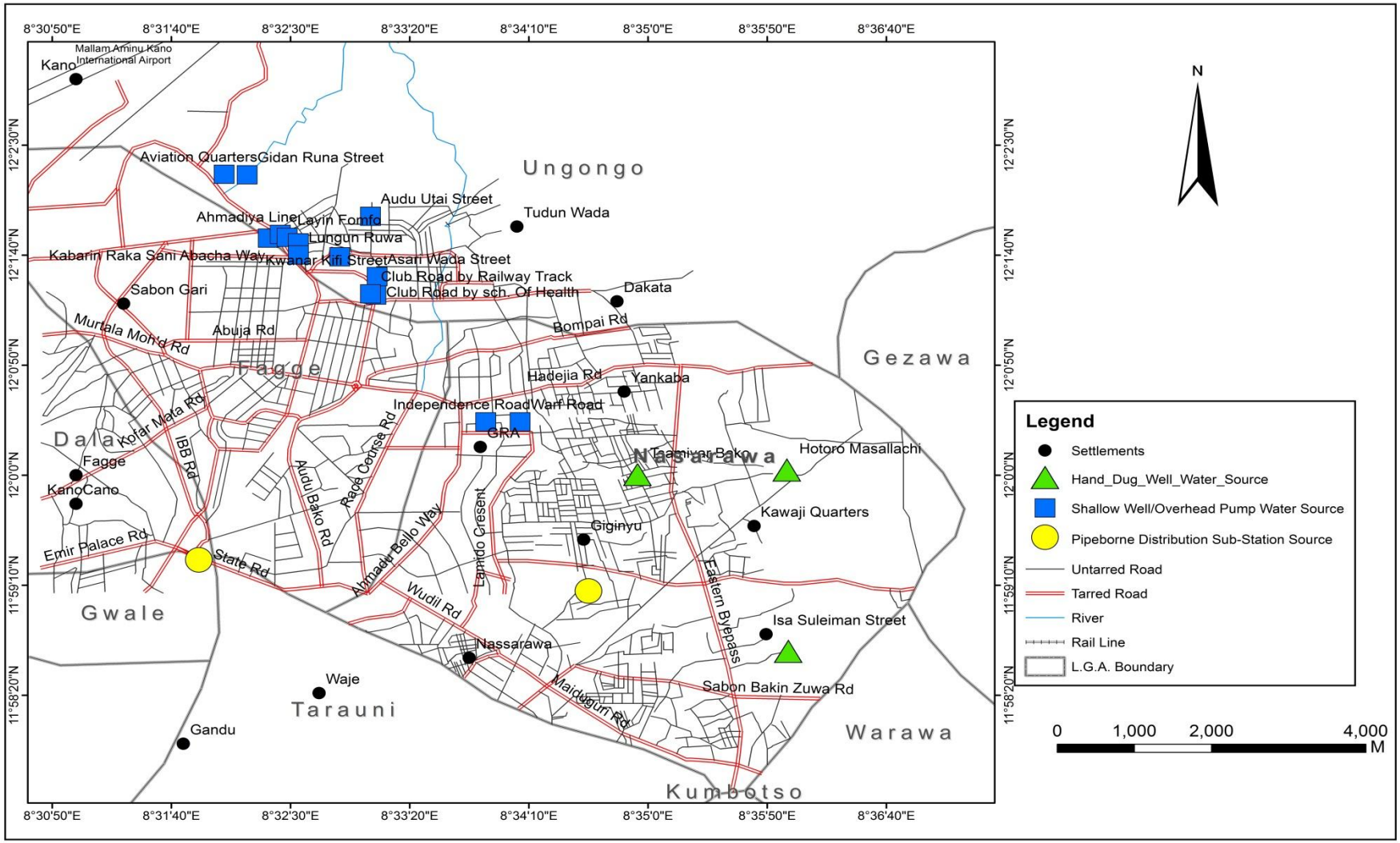


**Figure 4.1: Locations of Vended Water Sources in the Study Area**

**Source: Field Survey, 2015.**

### 4.4 Role of water Vendors in Domestic Water Supply

Issues addressed in this section includes percentage of respondents patronising water vendors, types of vendors patronised, household major source of domestic water supply, frequency of vended water patronage and household use(s) of water purchased from vendors in the study area.

4.4.1 Patronage of Water Vendors by Type of Vendors

Table 4.3 shows that water vendors play significant roles in providing households with their daily household water needs. This is indicated that among the respondents sampled in the study area, majority (64.1%) attests to their patronage of water vendor services, while only about 35.9% attests to non-patronage of water vendor's services.

**Table 4.2: Vended Water Patronage by Type of Vendors**

| Patronage of Vended Water | Frequency | Percentage |
|---|---|---|
| Yes | 182 | 64.1 |
| No | 102 | 35.9 |
| **Total** | **284** | **100** |
| **Type of Vendors** | | |
| Tanker Trucks | 28 | 15.4 |
| Handcart/Wheelbarrow Vendors | 148 | 81.3 |
| Head Carriage Vendors | 6 | 3.3 |
| **Total** | **182** | **100** |

Source: Field Survey, 2015

Among the respondentspatronising the services of water vendors, majority buys water from hand carts vendors. While 15.4% buy theirs from tanker truck vendors and the least types of water vendors patronised by respondents is head carriage vendors with 3.3%. It is clear that most respondents source their household water from the vendors and this can be attributable to poor service coverage, irregularity in supply of piped borne water in the study area. This is in agreement with Ayoade and Oyebande (1983) studies where it was pointed that water supply

atpublic 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.

4.4.2 Major Source of Domestic Water

Table 4.3 shows the distribution of respondent's major source of water supply. Out of the various sources, water vendor's source dominated with 45%, followed by deep boreholes and pipe borne water respectively.

**Table 4.3: Distribution of Major Source of Domestic Water Supply**

| Major Source of Domestic Water Supply | Frequency | Percentage |
|---|---|---|
| Deep bore hole | 80 | 28 |
| Protected spring/river water | 03 | 1.0 |
| Hand dug wells | 20 | 7.0 |
| Water vendors | 127 | 45 |
| Pipe borne water | 54 | 19 |
| **Total** | **284** | **100** |

Source: Field Survey, 2015.

From the study, it is clear that the contribution of water vendors in meeting household water needs cannot be overemphasized. This is shown where most respondents indicated water from vendors as their major source of household water supply.

**4.4.3**Frequency of Vended water Patronage among residents

Table 4.4 shows that daily patronage accounted for the most (45.6%) as the frequency of respondent's patronage of vended water supply. Twice weekly accounted for 22.0% as frequency of water vendor's patronage by the respondents.

**Table 4.4: Distribution on Frequency of Vended water Patronage by Respondents**

| Frequency of Patronage | Frequency | Percentage |
|---|---|---|
| Daily | 130 | 45.6 |
| Twice weekly | 62 | 22.0 |
| Thrice weekly | 42 | 14.8 |
| Monthly | 36 | 12.6 |
| Others | 14 | 4.9 |
| **Total** | **284** | **100** |

Source: Filed Survey, 2015.

Furthermore, respondents who purchase water from vendors thrice weekly and monthly comprise of 14.8% and 12.6% respectively. "Others" with water vendor patronage that ranges from any day, four times a week, twice monthly accounted for 4.9%. The purchase of by most respondents from vendors on daily basis can be justified with suggestion by Onyenechere, *et al.*, (2012) that 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.

4.4.4Household Uses of Vended Water

Table 4.5 shows that majority of respondents which accounted for 57.1% use water purchased from vendors for all household purposes, followed by those that use it for cooking purposes with 22.0%.

**Table 4.5: Distribution of Household Uses for Vended Water**

| Household Uses for Vended Water | Frequency | Percentage |
|---|---|---|
| Cooking | 40 | 22.0 |
| Drinking | 20 | 11.0 |
| Laundry | 16 | 8.8 |
| All of the above | 104 | 57.1 |
| Others | 2 | 1.1 |
| Total | 182 | 100.0 |

Source: Field Survey, 2015.

Further analysis shows that the use of water from vendors by the respondents for drinking purpose accounted for 11.0%, this is associated to the quality of the water which poses as a challenge to the respondents, while the use for laundry accounted for 8.8%. “Others” of usage categories include watering flowers/gardens, livestock drinking accounted for 1.1%. This is similar to McIntosh (2003) who opined that water obtained from vendors is mainlyused for drinking and, in some cases, for cooking as well as for laundry purposes.

## 4.5 Factors Responsible for the Involvement of Water Vendors in Domestic Water Supply

Various factors are responsible for the involvement of water vendors in meeting household water needs. This section is focused on exploring the reasons for respondent’s patronage of water vendors, household connection to pipe borne water network and the cross-tabulation of hours of pipe borne water supply with the frequency of the supply.

### **4.5.1** Reasons for Patronage of Vended Water

Table 4.6 shows the distribution of various reasons giving by respondents for patronising water vendor’s services. Among the reasons given, more reliability and availability of supply dominated with 40.7%, followed by respondents with reasons like timely and efficiency in supply compared to others sources that accounted for 20.3%.

**Table 4.6: Distribution of Respondent's Reasons for Patronage of Vended Water**

| Reasons for Patronage of Vended Water | Frequency | Percentage |
|---|---|---|
| More affordable than pipe borne source | 30 | 16.5 |
| More reliable and available in supply | 74 | 40.7 |
| More better in terms of quality compared to other sources | 17 | 9.3 |
| Timely and efficiency in supply compared to others sources | 37 | 20.3 |
| Household not connected to pipe borne water supply | 13 | 7.1 |
| Due to water crisis/scarcity during the dry season | 11 | 6.0 |
| **Total** | **182** | **100.0** |

Source: Field Survey, 2015

On the other hand, respondents with reasons such as more affordability of vended water than pipe borne source constitutes 16.5%, Despite the fact that buying water from vendors cost more than the cost of installing pipe borne water because it cost the respondents ₦1700/week to about ₦6-₦7000/month at the rate of ₦25-₦30/25 litre as compared to pipe borne water from SWAs at a flat rate between ₦1500-₦5000 depending on the number of points connected to orthe type of the household, while those with reasons that ranges from more better in terms of quality compared to other sources, household not connected to pipe borne water supply, and due to water crisis/charges during the dry season accounted for 9.3%, 7.1% respectively. The dominance of more reliability/availability of pipe borne water supply and timely/efficiency of

vended water supply compared to other sources may not be unconnected to the finding by Ibiam (2008) who reported that drinking water supply in Nigeria is grossly inadequate especially in the rural areas, many households, often the poorest, end up purchasing water from private vendors much more expensively than from the public supply, more so that where pipe borne water supply exists, they are often unreliable and of low quality and are not sustainable because of difficulties in management, operation and pricing, and failure to recover costs.

### 4.5.2 Households Connected to Pipe Borne Water Network

Presentation in Figure 4.2 shows the percentage distribution of respondents with household's connection to pipe borne water network. Out of the entire sampled respondents, those without household pipe borne water network connection with 51.0% out-numbered those with Households connected to pipe borne water network with 49.0%.

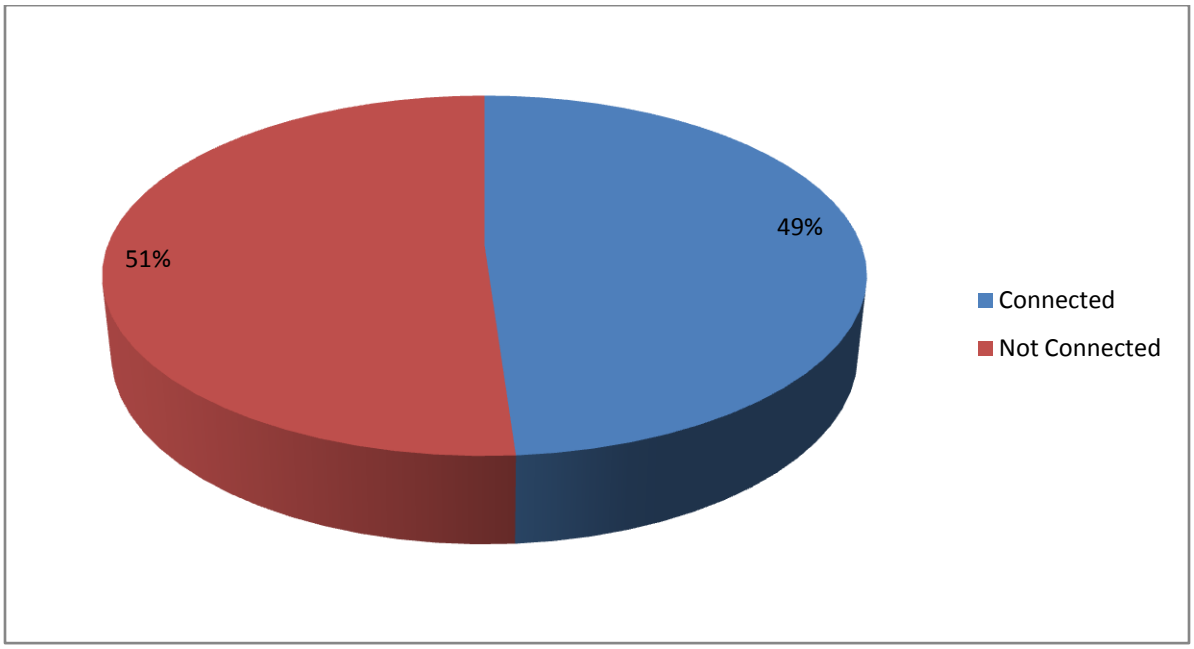


**Figure 4.2: Percentage of Households Connected to Pipe Borne Water Network**

Source: Field Survey, 2015.

It is obvious from the presentation in Figure 4.2 that half of the households sampled in the study area are not connected to pipe borne water supply network. This may be responsible for the high percentage of respondents patronizing the services of water vendors so as to fill the gap created as a result of non-availability of pipe borne water services. On the other hand, the dominance of households without pipe borne water connections among respondents in the study area is not surprising because, based on the report by UNICEF and WHO (2000) study, in-house or yard connections of pipe borne water system are estimated to reach some 43% of the urban population in Africa (Nigeria and Kano state inclusive) and 77% in both Asia and Latin America.

### 4.5.3 Frequency of Pipe Borne Water Supply by Hours of Supply

Table 4.7 shows that out of the entire respondents connected to pipe borne water network, majority (45.3%) receives duration of water flow from the tap between 1:30m-6hours, followed by those that receives the supply between 7 hours- 12 hours.

**Table 4.7: Distribution of Frequency of Pipe Borne Water Supply by Hours of Supply**

| Hours of Supply | Frequency of Pipe Borne Water Supply | | | | | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Daily | | Twice weekly | | Thrice weekly | | Monthly | | Others | | | |
| | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| < 1 hr. | 6 | 4.3 | 2 | 1.4 | 4 | 2.9 | 4 | 2.9 | 1 | .7 | 17 | 12.2 |
| 1:30-6 hrs. | 14 | 10.1 | 17 | 12.2 | 17 | 12.2 | 6 | 4.3 | 9 | 6.5 | 63 | 45.3 |
| 7 hrs. -12 hrs. | 12 | 8.6 | 7 | 5.0 | 7 | 5.0 | 2 | 1.4 | 2 | 1.4 | 30 | 21.6 |
| 13 hrs. - 24 hrs. | 15 | 10.8 | 0 | .0 | 3 | 2.2 | 3 | 2.2 | 0 | .0 | 21 | 15.1 |
| Others | 1 | .7 | 0 | .0 | 0 | .0 | 0 | .0 | 7 | 5.0 | 8 | 5.8 |
| Total | 48 | 34.5 | 26 | 18.7 | 31 | 22.3 | 15 | 10.8 | 19 | 13.7 | 139 | 100.0 |

Source: Field Survey, 2015.

On the other hand, daily supply dominated the frequency of pipe borne water supply with 34.5%, followed by those with thrice weekly supply that constitutes 22.3%. It is obvious from the study that daily supply dominated the frequency of water supply in the area. However, the

time duration of time shows a short duration (1:30-6 hrs.). It is worth to note that the duration of supply is below the international standard of 24 hours daily.

In addition, a comparative analysis on the number of hours to frequency of supply differentials shows that among those with daily supply, majority receives pipe borne water 1:30-6 hours duration. Those with water supply frequency of twice weekly, thrice weekly and monthly all have 1:30 – 6 hours duration as the dominant number of hours for water flow which accounted for 12.2%, 12.2% and 4.3% in that order.

Notably also, among those with timely durations between 13 hours – 24 hours, daily supply dominated the frequency of water supply with 10.8%, followed by those with twice weekly and thrice weekly frequencies which comprise of 2.2% each. It is needful to assume at this juncture that respondents enjoying this level of services are those that are likely to have locational advantages. This is elaborated further by Fullbrook*et al* (2005) who hinted that in Kano metropolitan areas, the supply is not adequate to serve all customers, so consumers on the southern side of the system get served first and consume all the water before it reaches the northern ends of the system and secondly, even if there were enough supply available, the distribution piping (coverage/no of pipes) is simply too small to transport reasonable quantities of water to the northern ends of the system.

### 4.6 Pattern of Vended Water Distribution

Issues discussed under this section includes the locational distribution of vended water sources, distribution pattern of vended water, dry season distribution pattern, rainy reason distribution pattern, morning, afternoon and evening distribution patterns in and around the study area.

### 4.6.1 Locational Distribution Pattern of Vended Water Sources

Figure 4.3 shows the locational distribution of vended water in the study area. From the presentation, it shows that the water supplied by the vendors are sourced from locations outside Nasarawa LGAs, Areas like Kumbotso and Kano Municipal Local Government Areas On the other hand,the handcarts/wheelbarrow water vendors (mostly patronized about 40-45%) travel between 2-3km as far from Airport road, in Fagge LGA, Lungunruwa(Kauragoje ward) to settlements/wards around Gwagwaruwa, Gawuna street in Nasarawa LGA to supply their water to theircustomers. Furthermore, wheel barrow vendors play more significant roles in household water supply compared to tanker vendors. This is attributable to the fact that wheel barrow vendors water supply system, offers poor households the opportunity to buy water in more convenient and at affordable prices which helps to minimize wastages and cost burthens.

Notably also, is the fact that water sourced from hand dug well have less coverage,only found in Kawaji and Hotoro North wards in the study area as compared to those from pipe borne distribution sub-stations and shallow wells/deep bore holes, while tanker vendors on the other hand covers more far distance between 3-6kms which often times extends far into the surrounding LGAs of Kumbotso, and Kano Municipal.

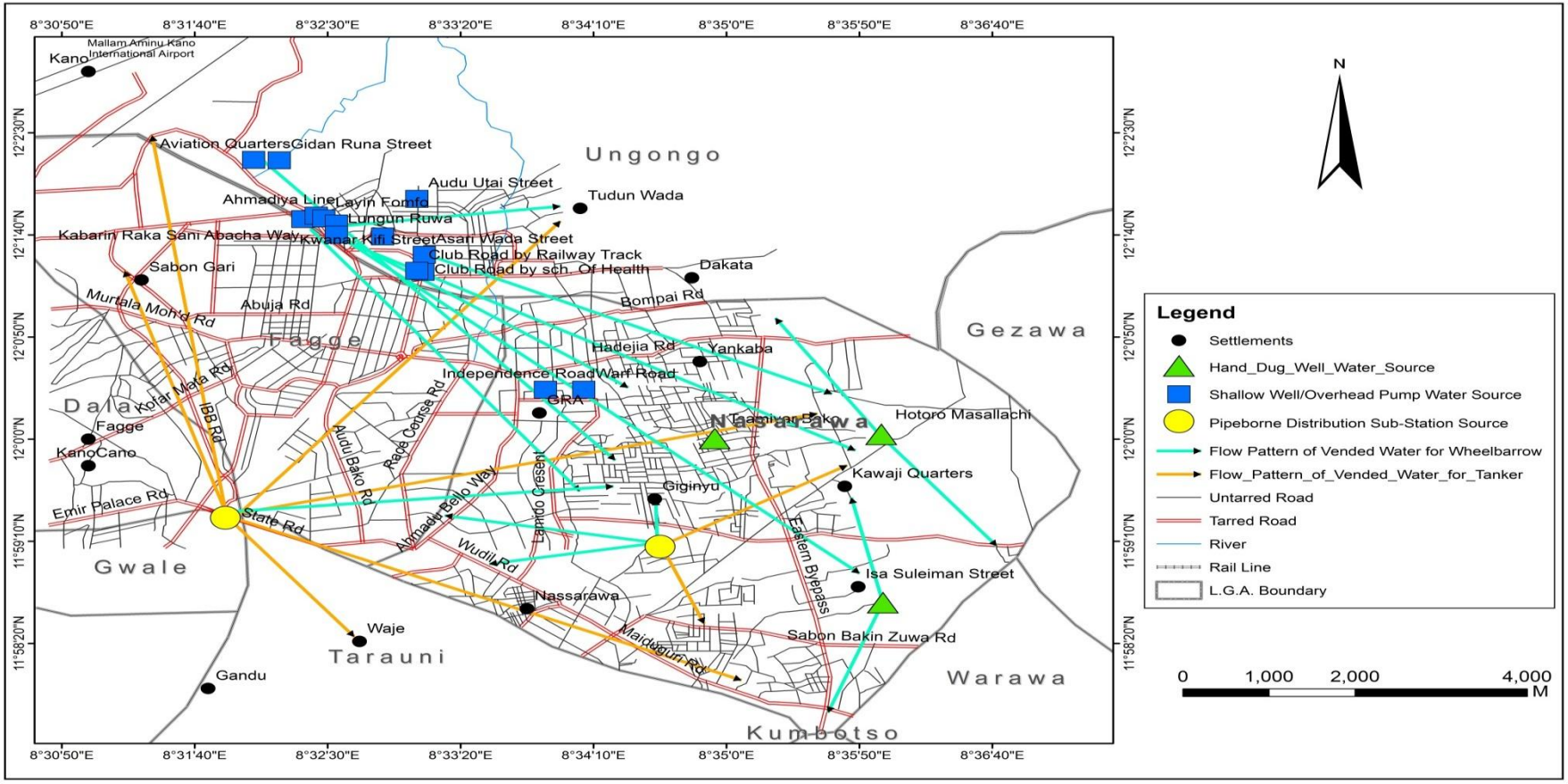


**Figure 4.3: Locations and Distribution Network of Vended Water Sources in the Study Area**

Source: Field Survey, 2015.

### 4.6.2 Dry Season Distribution Pattern

Figure 4.4 shows the dry season distribution of vended water in the study area. Tanker vendors that source their water from pipe borne sub-station located in Nassarawa LGA during the dry seasons travels as far as Tudunwada, Gwagwaruwa, and Gawuna wards to supply water to settlements around the area. Meanwhile, Tanker vendors that source their water from water works sub-station in Kumbotso LGA travel as far as towards settlements around Kawaji quarters, wudil road, and Maiduguriroad in Hotora North.

Furthermore, wheel barrow vendors sourcing their water from shallow wells/ overhead pumps around independent and Warf road move towards settlements around Isa Suleiman streets, Wudil road and Giginyu areas in Nassarawa LGA. Those sourcing their water from shallow wells/ overhead pumps in Ungongo LGA from located at Club road by rail track, club road by School of Health Technology and lungunruwa move as far as settlements aroundDakata,Hadejia road, Yankaba, Giginyu and GRA.

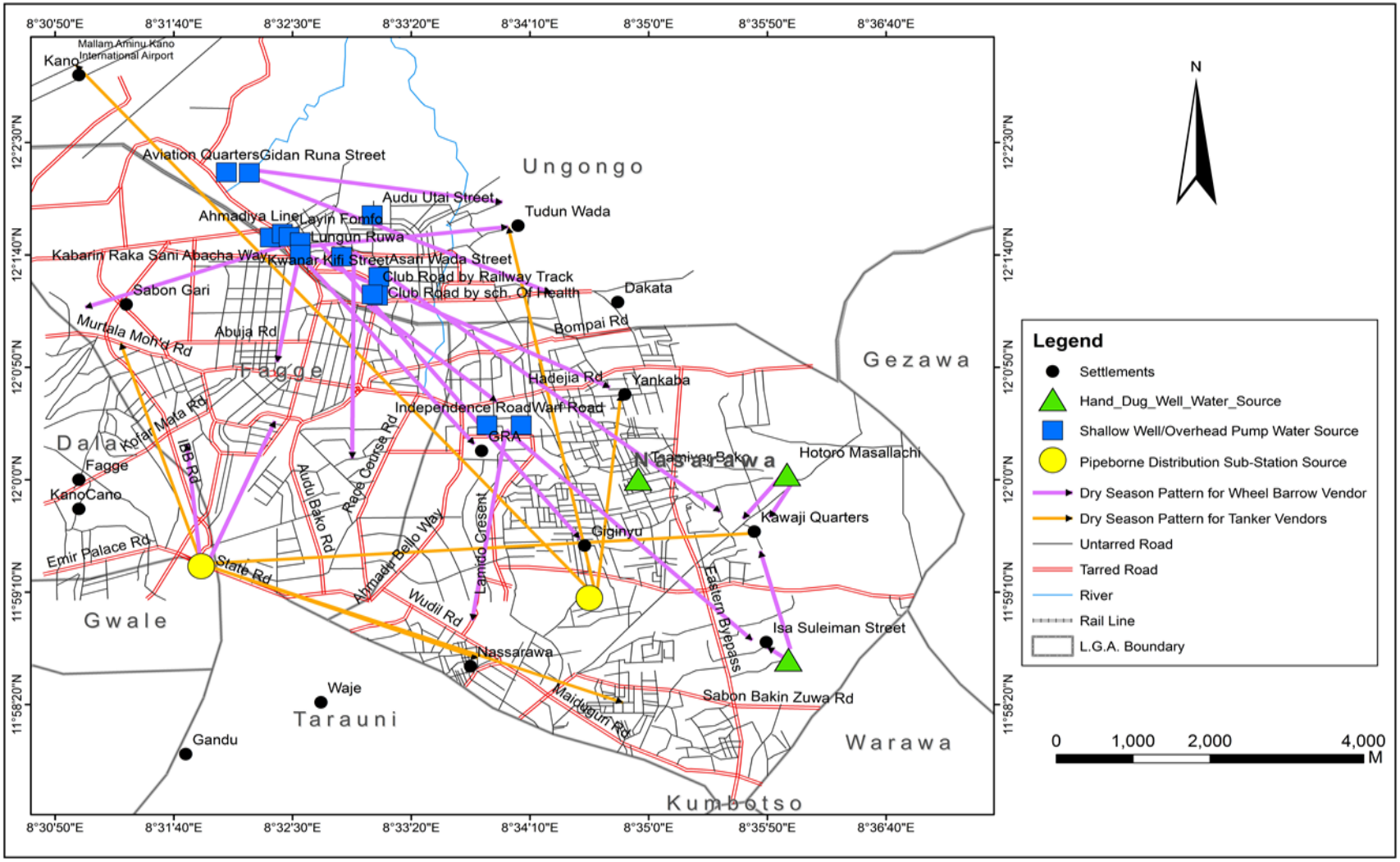


**Figure 4.4: Distribution of Dry Season Vended Water Supply Pattern**

**Source: Field Survey, 2015.**

In addition, wheel barrow vendors who source their water from hand dug wells located atHotoroMasallachi and SabonBakinzuwa road, move towards Hadeja road, Yankaba, Giginyu and GRA to supply water to the households.

Generally, it is noticeable from the above Figure 4.4 that there is high concentration of water vendor movements in virtually all nooks and crannies of the study area in the dry season

compared to rainy season as presented in Figure 4.5. This is attributable to the demand for water which is usually high during the dry season. This is in agreement with thereport by Whittington, Lauria and Mu (1989) where itwas shown 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.

### 4.6.3 Rainy Season Distribution Pattern

From Figure 4.5, it can be observed that there is a general low level of coverage on water distribution by vendors during the rainy season, compared to dry season level of coverage. This is indicated where Tanker vendors sourcing their supply from pipe borne distribution sub-stations in Tarauni LGA cover settlements around GRA, Kawaji quarters and Maiduguri roads and MurtalaMoh'd road. There is also low level of traffics with vended water distribution movements from locations outside the study area into settlements within Nassarawa LGA area, especially when compared to the level of traffic during the dry season as shown in Figure 4.4 above. The low concentration of traffic of water vendor movements noticed during the rainy season in the study area is due to the fact that water is mostly and easily available during this period of time, as it is expected that during the rainy season, underground water

level is increased which makes is possible for household to source their domestic water needs viahand dug wells as well as complementing it with water harvested during the rains through water harvesting system.

### 4.6.4 Morning Hours Vended Water Distribution Pattern

Figure 4.6 reveals that the morning pattern of vended water distribution across various settlements in the study area covers wider and longer distances especially for movements of tanker vendors sourcing water from the pipe borne distribution sub-station in Nassarawa LGA towards MallamAminu Kano International airport as well as movement from Tarauni LGA pipe borne distribution sub-station towards settlements around Kawaji quarters, Wudil and Maiduguri roads in the study area.

Wheel barrow vendors also cover wider and longer distances during the morning hours of supply, with most of them sourcing their water from locations outside the study area into settlements located around the central parts of study area. It is notable that there is heavier supply patterns of water by the vendors in the morning hours compared to the afternoon hours. The reason for this may likely be that the demand is mostly higher in the morning hours especially as many households within this time of the day will need water for various household purposes that range from laundry, bathing, cooking etc.

### 4.6.5 Afternoon Hours Vended Water Distribution Pattern

From the afternoon distribution pattern of vended water in the study area presented in Figure 4.6, it shows that wheel barrow vendor movements is limited to short distances and lower coverage. Whereas, tanker vendors afternoon distribution pattern in the study area have wider coverage. For instance, tanker vendors sourcing their water from pipe borne water distribution sub-station

located in Tarauni LGA travels through Nassarawa LGA as far as into Tudun Wada area in as well as towards settlements around GRA in the study area. The possible reason for the lower concentration of water distribution pattern for wheel barrow vendors in the study area during the afternoon hours is because within the hours, the weather would have been too hot and most buyers would have been away from home to carry out their daily activities.

### 4.6.6 Evening Hours Vended Water Distribution Pattern

With reference to Figure 4.6, the evening pattern of water vending shows that there is a moderate concentration of both wheel barrow and tanker vendors movement in the study area, compared to morning pattern in Figure 4.4 above. This is indicated where tanker vendors travels as far as SabonGari and Kofar Mata road in Fagge LGA from Nassarawa LGA. There is also tanker vendor water supply movement from location at Tarauni LGA towards GRA and the surrounding settlements in Nassarawa. There is also concentration of tanker vendor evening supply from the pipe borne distribution sub-station located in the study area towards settlements around Isa Suleiman Street, Maiduguri road and Kawaji quarters in Nassarawa LGA.

On the other hand, there is wheel barrow evening water vending supply movement from source location at aviation quarters at GidanRuwa Street in the LGA into settlements around the GRA in the study area and towards Abuja road and AuduUtai Street in Fagge L G A. There are also movements of wheel barrow water vendors sourcing their water from hand dug wells in the study area towards settlements around independence road, Warf road and Yankaba parts of the study area.

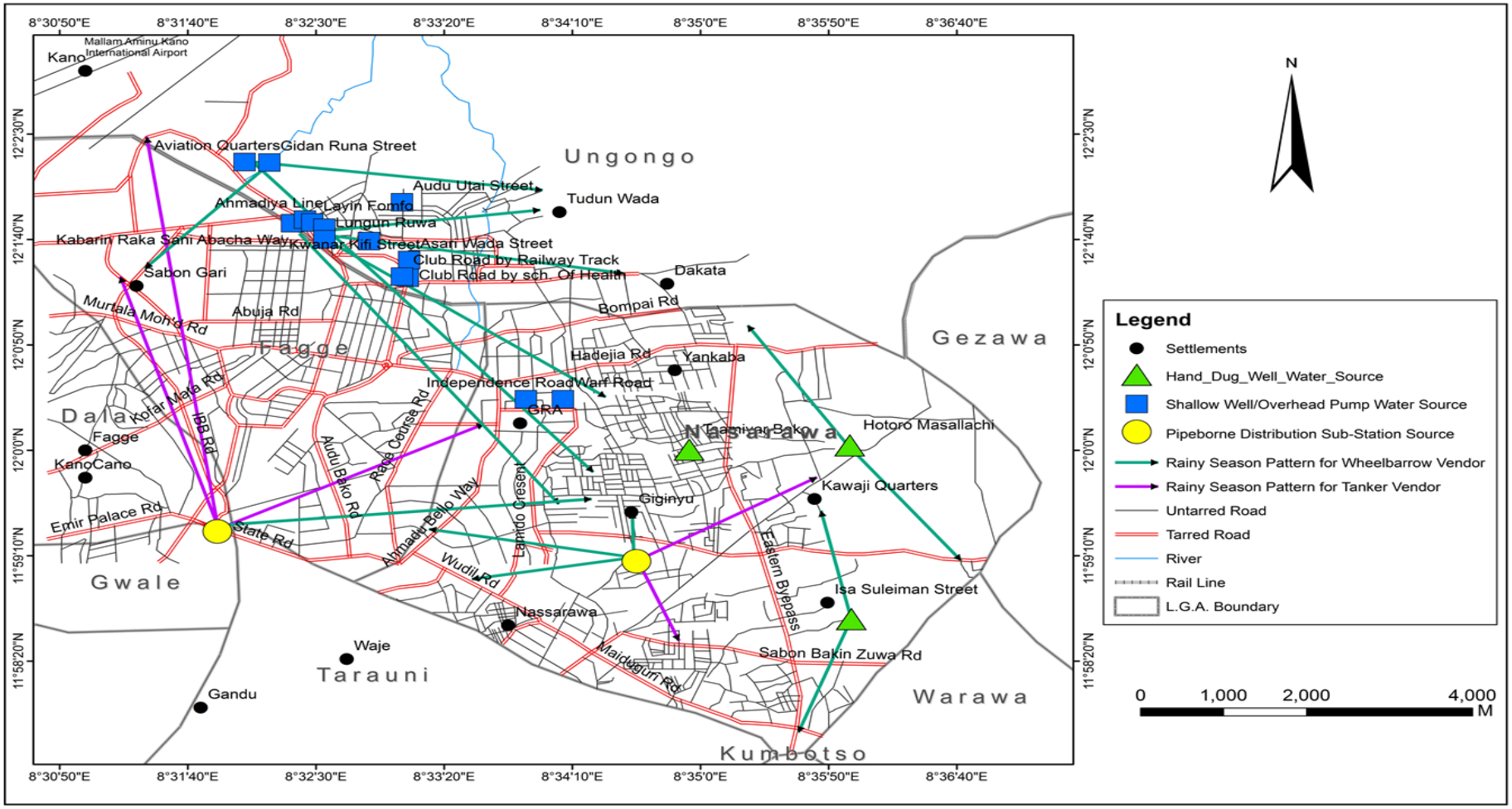


**Figure 4.5: Distribution of Rainy Season Vended Water Supply Pattern**

**Source: Field Survey, 2015.**

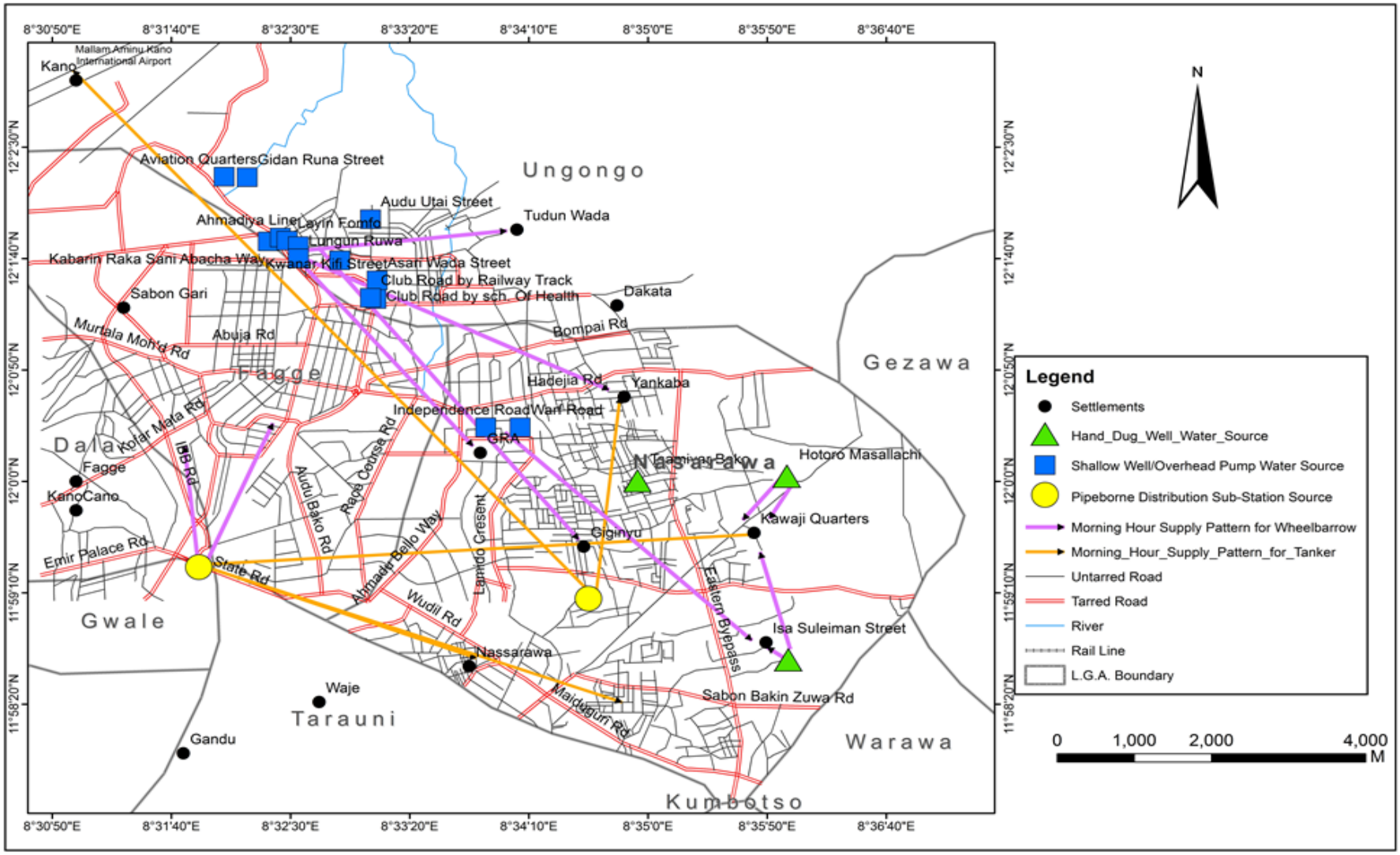


**Figure 4.6: Morning Pattern of Vended Water Distribution**

**Source: Field Survey, 2015.**

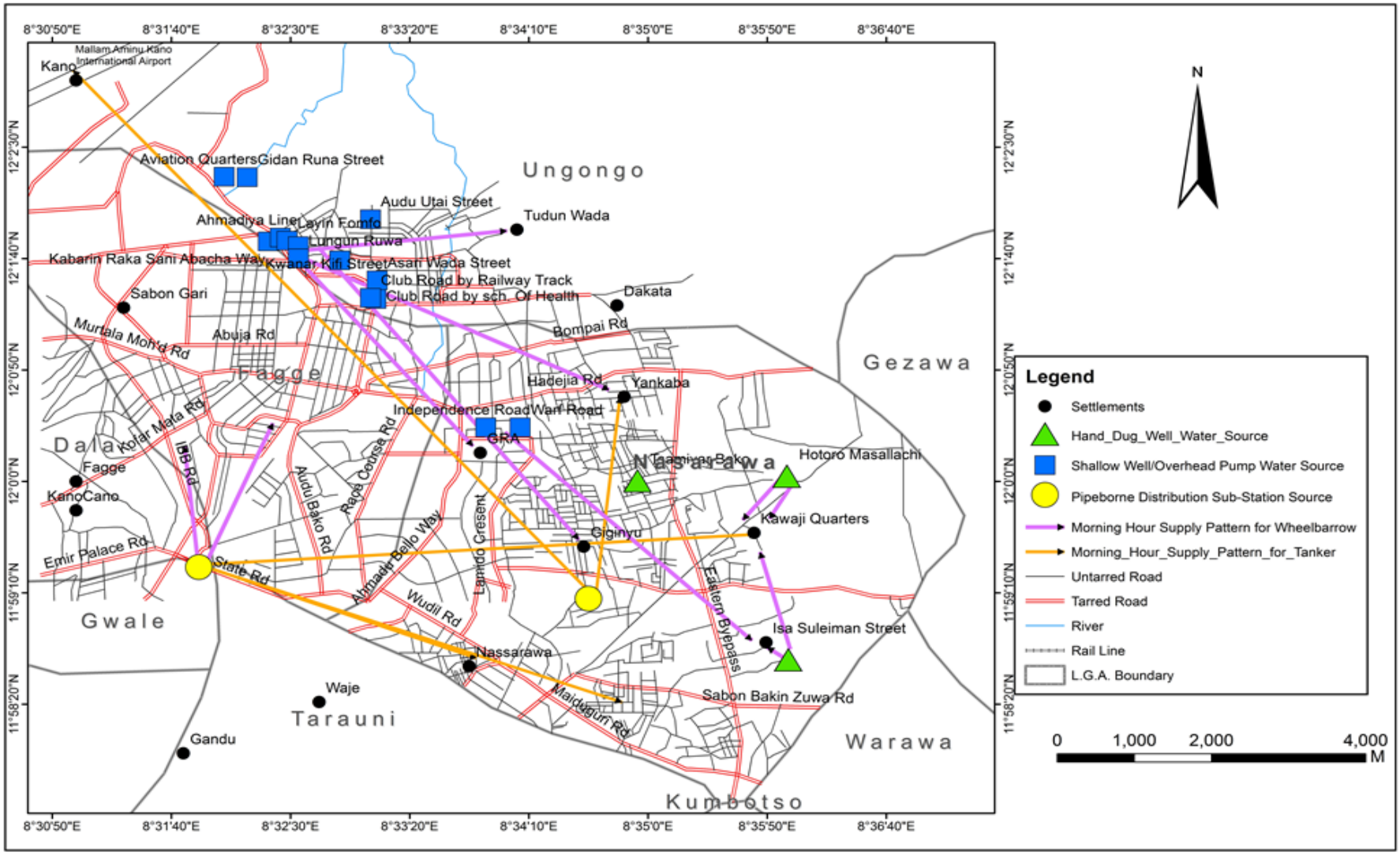


**Figure 4.5: Morning Pattern of Vended Water Distribution**

**Source: Field Survey, 2015.**

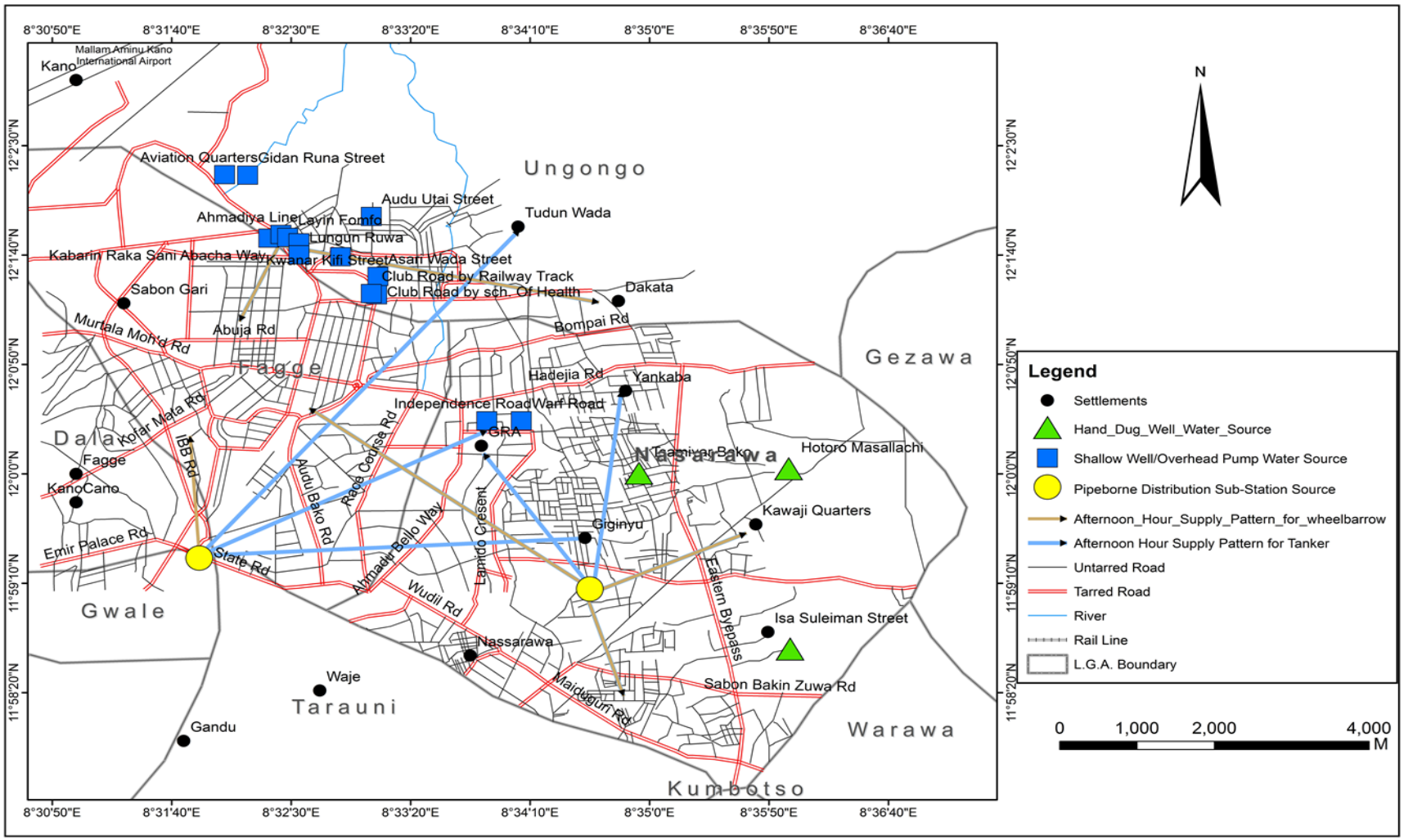


**Figure 4.7: Afternoon Pattern of Vended Water Distribution**

**Source: Field Survey, 2015.**

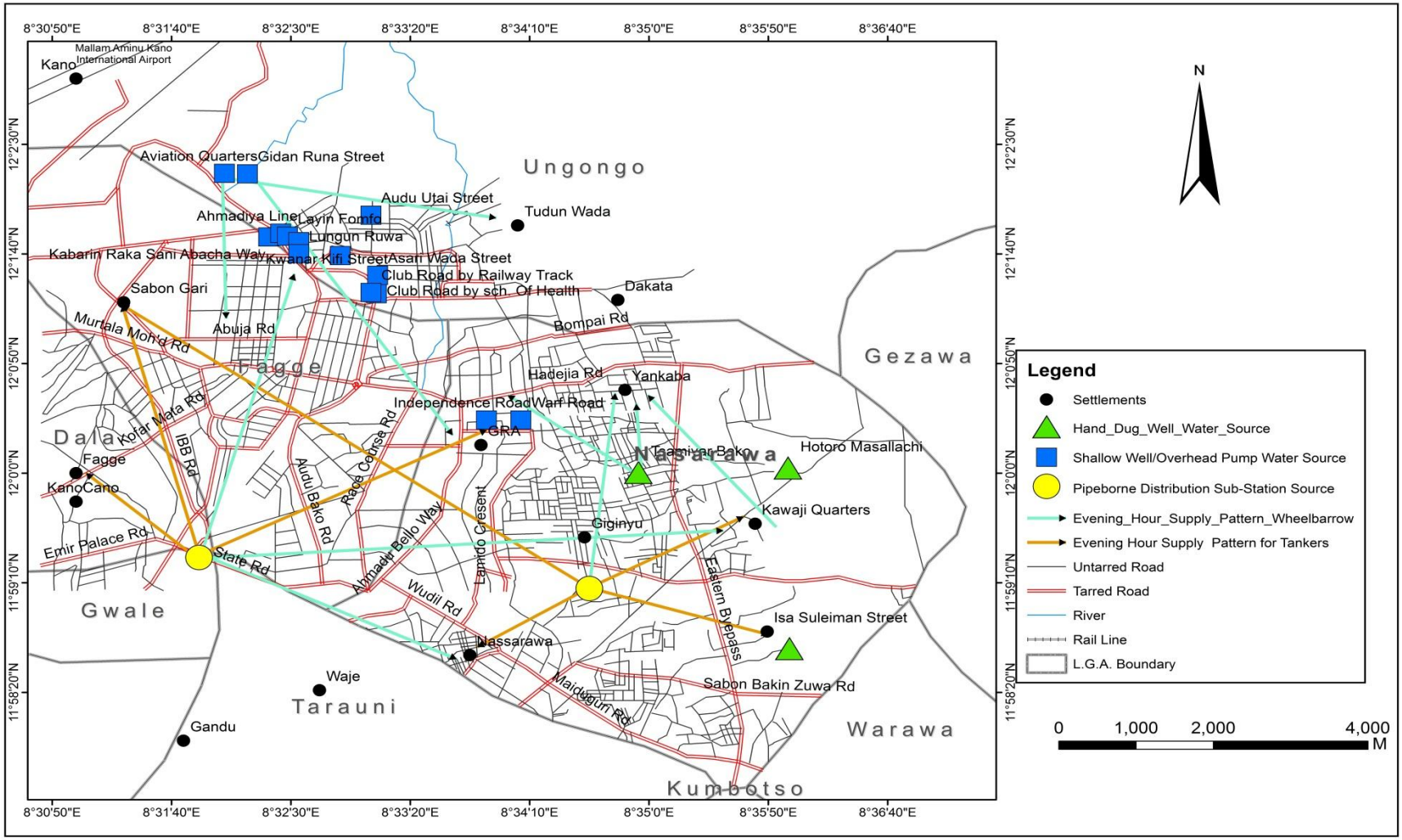


**Figure 4.8: Evening Pattern of Vended Water Distribution**

**Source: Field Survey, 2015.**

### 4.7 Challenges in Patronising Water Vendors

Water quality and prices have often been considered as the most common challenges faced by those that patronise vended water. For instance, 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.Under this section, the issues examined are the specific challenges faced by residents who patronises water vendors services, specific price of water from various types of vendors across the seasons, perceptions on cost of buying water from vendors, challenges of selling water by the vendors and the solutions to the challenges faced by vendors meeting the household water needs.

#### 4.7.1 Specific Challenges of Buying Vended water

Table 4.8 shows the major challenges faced by respondents from buying vended water. From where it shows that lack of water quality guarantee dominated among the challenges with 29.7%, followed by high charges from vendors with 25.3%. This finding is further justified by Snell (1998) who noted that 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.

**Table 4.8 Distribution of Challenges in Patronising Water Vendors**

| Challenges of Patronising Water Vendors | Frequency | Percentage |
|---|---|---|
| Water price are higher than those from household public utilities | 20 | 11.0 |
| Poorest cannot or hardly afford the price | 46 | 25.3 |
| Service is not guaranteed | 38 | 20.9 |
| Water quality is always not guaranteed | 54 | 29.7 |
| Irregularities in the price of water per litre | 20 | 11.0 |
| Others | 4 | 2.1 |
| **Total** | **182** | **100.0** |

Source: Field Survey, 2015.

In addition, lack of guaranteed services by vendor accounted for 20.9% on the challenges of patronising vended water services. While higher charges compared to public water utilities, irregularity of service delivery accounted for 11.0% each. "Other" among the challenges such as bad manners/characters of vendors, poor hygienic appearances of vendors accounted for 2.1% of the challenges faced by respondents in patronising water vendors. This is similar to the finding by Ibiam (2008) who reported that drinking water supply in Nigeria is grossly inadequate especially in the rural areas. Many households, often the poorest, end up purchasing water from private vendors at a price much more expensively than from the public supply.

### 4.7.2 Price Differentials for Vended Water by Season

Table 4.9 shows that during the raining season, the price for 25 litres 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 (25 litres) is sold between ₦10 -₦25. With price differentials that ranges between ₦5 - ₦10 across the seasons.

**Table 4.9 Distribution of Water Vendor's Price Differentials by Type of Vendors across Seasons**

| Type of Vendors | Raining Season Price for Vended Water | Dry Season Price for Vended Water | Price Differentials |
|---|---|---|---|
| Wheel Barrow Vendors Per 25 litres | ₦5 (25 litres)<br>₦15 (25 litres) | ₦10 (25 litres)<br>₦25 (25 litres) | ₦5<br>₦10 |
| Tanker Trucks Vendors Per 1000 litres | ₦3000 (1000 litres)<br>₦3500 (1000 litres) | ₦4000 (1000 litres)<br>₦5500(1000 litres) | ₦1000<br>₦2000 |

Source: Field Survey, 2015.

On the other hand, respondents who obtain their vended water from tanker truck vendors, pay between ₦3000 -₦ 3,500 per 1000 litres during the raining season, but pay between ₦4000 - ₦5,500 for the same quantity (1000 litres) of water during the dry season, indicating price differential that ranges between ₦1000 - ₦2000 across the seasons. However the differences in

the price of water across the seasons may be attributable to scarcity of water which often may result to rise in water demand.

### 4.7.3 Perception of Cost of Buying Water from Vendors

Table 4.9 shows that majority of the respondents (54.9%) perceives the price of vended water as affordable, followed by those that perceives it as expensive that constitutes 29.7%.

**Table 4.9: Distribution on Perception of cost of buying water from vendors**

| Perception of cost of buying water from vendors | Frequency | Percentage |
|---|---|---|
| Cheap | 16 | 8.8 |
| Affordable | 100 | 54.9 |
| Expensive | 54 | 29.7 |
| Don't know | 12 | 6.6 |
| **Total** | **182** | **100.0** |

Source: Field Survey, 2015.

More so, about 8.8% of the respondents perceive the price ass cheap, while 6.6% do not know if the price is cheap, affordable of expensive. The dominant of those who perceived the price of vended water as affordable may be likened to the fact that most respondents are high income earners as presented in Table 4.1. Hence they can afford to spend extra money if need be to ensure that the household water need is adequately met, as well as the fact that the cost of water provides incentives to change the way we value water, and it also affects a household decision to opt for a new source of supply.

### 4.7.4 Challenges Faced by Vendors in selling Water

Table 4.10 shows that water vendors are faced with numerous challenges in the process of carrying out their business activities. Among these challenges, distance between the water source to selling points dominated with 39.0%.

**Table 4.10: Distribution on the Challenges Faced by Vendors in selling Water**

| Challenges of selling Vended Water | Frequency | Percentage |
|---|---|---|
| Distance from the source to the Customers | 39 | 39.0 |
| High cost of diesel/gas | 6 | 6.0 |
| Seasonal fluctuation in price of water at source | 12 | 12.0 |
| Selection based on quality | 25 | 25.0 |
| Shortage of Water from the sources | 1 | 1.0 |
| Physically demanding | 17 | 17.0 |
| **Total** | **100** | **100.0** |

Source: Field Survey, 2015.

Selection of water by customers based on quality accounted as the second major challenges with 25.0%. Vendors who attributed the challenges of water vending to be physically demanding constitute 17.0%. Meanwhile vendors that attributed the challenges of water vending activities to seasonal fluctuation in price of water at source, high cost of diesel/gas and shortage of water from the source accounted for 12.0%, 6.0% and 1.0% in that order. This finding is similar to that made by Njiru (2004) where selection in water quality, seasonal variation of water availability and cost of water at the purchasing points are noted as challenges of selling water to consumers.

### 4.7.5 Solution to the Challenges

Table 4.11 reveals that the need for loans to be provided to water vendors so as to enhance their business activities dominated water vendor's suggestions to the challenges face in doing their business with 19.0%.

**Table 4.12: Distribution on the Suggested Solutions to the Challenges**

| Solution to the Challenges | Frequency | Percentage |
|---|---|---|
| Provision of more quality water | 10 | 10.0 |
| Deep wells and boreholes should be increased by the authority | 9 | 9.0 |
| Government to improve and expand water and road infrastructure | 7 | 7.0 |
| Loan provision to vendors | 19 | 19.0 |
| Provision of more water sources within the community | 7 | 7.0 |
| Recognized by the government water authorities | 17 | 17.0 |
| **Total** | **100** | **100.0** |

Source: Field Survey, 2015.

Suggestions like recognized by the government water authorities, provision of more quality water, sinking of more deep wells and boreholes by the authority accounted for 17.0%, 10.0% and 9.0% in that order. Based on the findings from the study, it is clear that provision of loans by the authority to water vendors will greatly help to improve the services of handcart water vendors to construct kiosk or mini depot/ container to store water within the settlements or wards for onward distribution or reselling as well as reduce costs or charges of water sold to the final consumers.Also to purchase trucks for onward distribution of water in volumes to reduce mileage coverered in the cause of vending as it poses health challenges such as chest pain to the handcart/wheelbarrow vendors. This is further confirmed by Kariuki and Schwartz (2005) 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.

# CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATION

## 5.1 SUMMARY OF FINDINGS

Water vending is often taken as a symptom of a failure in piped water systems, whichstill plays significant roles in providing water to many urban dwellers in many parts of the world. Kano state metropolis, has a total water demand estimated to about 550 million liters per day but the whole water work that supply treated water to the metropolitan area has a design capacity of 200 million litres per day. It is very clear that the demand is far away from the supply. This is often attributed to high concentration 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.

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 a 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 customers are not exploited.

Hence, this study was carried out to examine the role of water vendors in domestic water supply inNassarawa LGA of Kano. The specific objectives were to; identify and map out the main water pumps used by vendors for water supply in the study area, examine the role of water vendors in domestic water supply, ascertain the factors responsible for the involvement of water vendors in meeting household water needs, assess the pattern of vended water distribution and to identify the challenges of patronising vended water in the study area

In order to achieve the objectives of this study, a survey research design was conducted and the data for the study was acquired by the administration of questionnaires to both residents and water vendors with a total of 384 questionnaires. About 284 residents were sampled, while 100 water vendors were also sampled at various locations in the study area. The residents were purposively selected based on the nature of their houses, while 100 water vendors were sampled at the points of carrying out their activities. The data generated were analysed using both descriptive and inferential statistics and the results were presented in form of charts, tables and maps.

Findings from the background characteristics of the respondents revealed that majority that constitutes 37.0% are within the age groups of 30-39 years, the least age group are those aged 70 years and above that comprises of 1.4%. Majorities are males and those living in nuclear family type of households also dominated with about 62.7%. The household sizes shows that 5-9 members per house dominated followed by 10 and above household members. Results on the ownership of accommodation, shows that majority of the respondents that comprise of 53.9% live in self-owned family house, followed by those that live in rented apartments with 27.8%, with those living in 3 bedroom apartments constituting the majority with 36.3%, followed by those living in 4 bedroom apartments with 26.8%. Educationally, tertiary education qualification dominated the education levels with 70.8%.

Civil servants dominated respondent's occupational status with 40.5% and farmers accounted for the least with 4.9%. The highest monthly income earned by respondents is between ₦75,000 and above which consists of 50.4%, followed by those with monthly income of ₦100 - ₦18,000. While the least monthly earned income by the respondents is ₦18,100 - ₦37,000.

On the other hand, the analysis on the background characteristics of water vendors showed that majority of the vendors (44.0%) are aged between 19-29 years, followed by those aged between 30-39 years that constitutes 24.0% and the least age groups of vendors are 60-69 years which accounted for 8.0%. Females where not found to be involved in water vending activities, hence, 100% of the vendors are males. On the nationality of the vendors, majority (62.0%) are Nigerians, while 38.0% are from Niger Republic. Among the vendors with Nigeria nationality, Majority (42.0%) are indigenes of Kano State, followed by those from Jigawa State with 38.0%. Vendor's number of years of experience in water vending activities reveals that majority that constitutes 59.0% have been in the business between 5 years and above. Those with less than 1 years of experience in the business accounted for the least on the years of experience. The monthly income distribution showed that majority with 60.0% earn ₦18,100 - ₦36,000, followed by those with monthly income of ₦36,100 - ₦54,000 that accounted for 21.0% and earning between ₦100 - ₦18,000 monthly among the vendors accounted for the least 2.0% respectively.

Analysis on the location of water pumps from where water vendors obtain their water for onwards supplies to the end users/households showed that majority of the vendor's source their water from outside Nasarawa LGA. Majority source their water from shallow wells/stand pumps located in Ungongo LGA which is about 3 – 4 km away from Nasarawa LGA. However, some shallow wells/stand pumps are located in the study area around the GRA, one (1) water works station and some hand dug wells are also located in the study area. Also, one water works (pipe borne water distribution station) is located around the south western part of the study area (i.e. Tarauni LGA) from where vendors supplying water to the settlements in study area source their water from.

It is clear that water vendors play significant roles in providing households with their daily household water needs. This is shown where out of the entire respondents sampled in the study area, majority (64.1%) attested to their patronage of water vendor services, while only about 35.9% attested to non-patronage of water vendor's services. Out of those patronising water vendors services, majority (81.3%) buys water from wheel barrow vendors, while 15.4% buy theirs from tanker truck vendors and the least types of water vendors patronised by respondents is head carriage vendors with 3.3%. Analysis of respondent's major source of domestic water uses showed that water vendors source dominated with 34.2%, followed by hand dug wells and deep boreholes with 24.6%.Daily patronage of vendor services accounted for the most (45.6%) as the frequency of respondent's patronage of vended water supply, followed by those twice weekly that accounted for 22.0%.

Usage of water supplies by vendors for all household purposes dominated other uses with 57.1%, followed by those that use it for cooking purposes with 22.0%.Out of the entire reasons given for vendor patronage, more reliability and availability of supply dominated with 34.1%, followed by those with reasons like timely and efficiency in supply compared to others sources that accounted for 20.3%.

Analysis on the number of households with connection to pipe borne water supply in the study area showed that majority of the households(51.0%) are not connected pipe borne water network connection. Out of the entire respondents connected to pipe borne water network, majority (45.3%) receives duration of water flow from the tap between 1:30m-6hours, followed by those that receives the supply between 7 hours- 12 hours. On the other hand, daily supply dominated the frequency of pipe borne water supply with 34.5%, followed by those with thrice weekly supply with 22.3%.

Comparatively, the number of hours to frequency of supply analysis showed that among those with daily supply, majority (10.1%) receives pipe borne water 1:30-6 hrs duration. Also, among those with timely durations between 13 hours – 24 hours, daily supply dominated the frequency of water supply with 10.8%.

On the general pattern of water supply is the study area; the study found vended water services covered virtually every nooks and crannies of the study area. There is however, great variation in the seasonal coverage of water supply pattern across the study area. Therefore, it was found that during the dry seasons, there is a heavy inflow of vended water from sources located outside the study area especially from Ungongo LGA into the study area. Also, water vendor have wider coverage during the dry season than in the rainy seasons. There is also variation in daily flow pattern as morning pattern of vended water distribution across various settlements in the study area covers wider and longer distances especially movements of tanker vendors sourcing water from the pipe borne distribution sub-station. On the other hand, wheel barrow vendors also covers wider and longer distances during the morning hours of supply, with most of them sourcing their water from locations outside the study area into settlements located around the central parts of study area. It is notable that there is heavier supply patterns of water by the vendors in the morning hours compared to the afternoon hours. Evening supply also is recorded as high level of traffic flow across the study area, but with lower flow in terms of distance compared to morning pattern and higher than afternoon flow.

Furthermore, findings on the major challenges faced by respondents from buying vended water showed that lack of water quality guarantee dominated with 29.7%, followed by high charges from vendors (price) with 25.3%. Lack of guaranteed services by vendor accounted for

20.9%, while higher charges compared to public water utilities and irregularity of service delivery accounted for 11.0% each.

On the price differentials across the seasons it showed that during the raining season, the price for 25 litres 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 (25 litres) 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 1000 litres during the raining season and between ₦4000 -₦5,500 for the same quantity (1000 litres) of water during the dry season, indicating price differential that ranges between ₦1000 - ₦2000 across the seasons.

Majority of the respondents (54.9%) perceives the price of vended water as affordable, followed by those that perceive it as expensive that constitutes 29.7%. Among the challenges faced by vendors in water service deliveries, distance between the water sources to selling points dominated with 39.0%. Customers selection of water by based on quality accounted as the second major challenges with 25.0%. The need for loans to be provided to water vendors to enhance their business activities dominated water vendor's suggestions to the challenges face in doing their business with 19.0%, followed by with suggestions on the need for government to recognize water vendors services as an extension of service in water provisioning borne by the inefficiencies in pipe borne water services to each households as well as the need for more shallow wells to be sunk by the authority across the study area so as to ease supply.

## 5.2 CONCLUSION

Based on the findings from the study, the following conclusions were drawn

- The location and sources where water vendors obtain their water for onwards supplies to the end users/households were mostly outside the study area, from deep bore holes, shallow/hand dug wells mostly patronized by handcart vendors, and pipe borne substation some located in Ungongo, Kumbotso, Fagge and Kano Municipal LGAs which is about 3 – 6 km away from Nasarawa LGA. However, some shallow wells/stand pumps are located within in the study area around the GRA, a pipe borne water substation and some hand dug wells are also located in the study area from where vendors obtain water which they supply to the settlements.
- Factors responsible for water vendors involvement in domestic water supply include household not being connected to pipe borne water supply, the erratic frequency of pipe borne water, the reliability and availability of vended water influence residentspatronage. While economic empowerment on the part of the vendors to meet their daily needs.
- The pattern of vended water shows a heavy flow/traffic on the hand cart water vendors followed by the truck/tanker vendors travelling between 2 to 6 km in and outside the study area to source for water and supplying to buyers in streets. The temporal pattern shows heavy traffic in the morning and evening.
- The challenges of patronizing water vendors include water quality not guaranteed, high charges and also poses health challenges such as back and chest pain are experienced by the handcart vendors.

## 5.3 SUGGESTION FOR FURTHER STUDIES

- There is the need for further research to assess the factors affecting water vendor supply
- Assess per capita and per household water consumption in the study area
- Evaluating the means of expanding water ownership, infrastructure and conservation of vended water sources

## 5.4 RECOMMENDATIONS

Based on the findings from the study, given the current conditions of service provision by public utilities in the study area, it is unlikely that public utilities will be able to serve such clients in the near future. If anything, rapid urbanization and overwhelming population growth is putting further pressure on already over-stressed public utilities.it is very obvious that the role of water vendors in domestic water supply in the study area cannot be over-emphasized. Irrespective of the numerous challenges faced by the vendors and customers alike in the process of water demand and supply respectively, vendors still makes daring efforts in meeting the needs of customers. It is against these backdrops that the following recommendations were made;

- To reduce the challenges accruable from hurling water over long distances to get to supply destinations, efforts should be made by appropriate authorities including governments at all levels, private organisations and individuals to construct more water sources such as boreholes/shallow wells and or extension of public water supply points into the remote areas from where residents and vendors alike can directly obtain water from.

- Seeing resellers and vendors as an integral part of the water system may help in the design (and implementation) of more comprehensive policies that better serve (poor) end-users. Policies and interventions with relation to drinking water need not stop at the tap, but rather with the ingestion of the water. With such a view, allowing vendors (and other indirect means of accessing water) to be a recognized extension of the piped system, the real outcome of policies and investment decisions may be better predicted and directed and this will on the long run, bring about greater reliabilities and affordability water vendors service.

- To reduce the challenges of high price of vended water in the study area, there is the need to develop alternative sources, such as boreholes and such sources can have the added advantage of providing an alternative when there is a breakdown in the piped-water network.

- Soft loans should be made available to the standpipe operators/owners, tanker and Hand carts/wheel barrow vendors so as to be able to offset the costs of purchasing and maintenance of equipment which will invariably help to reduce cost of water as well as improve services.

- Also, soft loan should made available to hand cart water vendors to construct water kiosks or mini depot/containers to store water and to purchase trucks for onwards distribution of water to ease or reduce the mileage cover in the cause of vending as it poses health challenges to the vendors.

- Efforts should be made by government to expand pipe borne network coverage to every households in the study area as well ensure steady supply of water. However, in the case of inabilities of the authorities to achieve 100% household connection to water network, efforts to should be made to strategically and randomly construct public water stations to serve remote areas.

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**RESIDENTS**

**DEPARTMENT OF GEOGRAPHY**

**AHMADU BELLO UNIVERSITY, ZARIA**

Dear Respondent,

I am a student of the above department undertaking a study. This questionnaire is designed to collect information on the role of water vendors in domestic water supply in Nasarawa Local Government Area of Kano State, Nigeria and you are one of the carefully selected respondents. The exercise is purely an academic work and all information will be treated as confidential.

Thank you for your assistance.

Please provide information or tick in the appropriate boxes to the following questions.

**SECTION A: RESIDENT BIO-DATA.**

1. Age of the respondent ……..
2. Sex: (a) Male [ ] (b) Female [ ]
3. Nature of Household (a) Nuclear [ ] (b) Extended [ ]
4. Size of the household (a) 0-4 [ ] (b) 5-9 [ ] (c) 10 + [ ]
5. Ownership of accommodation

a. Self-owned family house [ ] b. Rented [ ]

c. Official [ ] d. Squatting [ ]

c. Others (specify)……

6. Number of Rooms in the house

a. 1 bedroom apartment [ ] b. 2 Bedroom apartment [ ]

c. 3 bedroom apartment [ ] d. 4 bedroom apartment [ ]

e. Others specify…….

7. Educational level

a. No Formal Education [ ] b. Quaranic Education [ ]

d. Primary [ ] d. Secondary [ ]

e. Tertiary or above [ ] f. Others (specify) ……

8. What is your main occupation?

a. Civil servant [ ] b. Farmers [ ]

c. Full time house wife [ ] d. Artisanal/Labourer [ ]

e. Others (specify) …….

9. What is your average annual income from all sources?

a. ₦100 -₦18,000 [ ] b. ₦18,100 – N37,000 [ ]

c. ₦37,100 – N56,000[ ] d. ₦75,100 and above [ ]

**SECTION B: ISSUES OF DOMESTIC WATER SUPPLY**.

11. Do you patronise water vendor services? a. Yes [ ] b. No [ ]

12. if yes, specify type of water vendors patronised

a. Tanker trucks [ ] b. Wheel barrow distribution vendors [ ]

c. Head Carriage Vendors [ ] d. Donkey Carriage Vendors [ ]

e. Others specify…….

14. How many litres of water do you buy (weekly estimate)

a. 100-150litres [ ] b. 151-250litres [ ]

c. 251-350litres [ ] d. 351-450 [ ]

e. 451litres and above [ ]

15. How much do you spend in buying water from vendors? (weekly estimate)

a. less than ₦100 [ ] b. ₦101-₦200 [ ]

c. ₦201- ₦300 [ ] d. ₦301-₦400 [ ]

e. ₦401-₦500 [ ] f. ₦501 and above [ ]

**SECTION C GENERAL REASONS FOR WATER VENDORS PATRONAGE**

16. What is major source of household water supply for domestic use?

a. Deep bore hold [ ] b. Protected spring/river water [ ]

c. Hand dug wells [ ] d. Rain water [ ]

e. Water vendors [ ] f. Pipe borne water [ ]

g. Others specify ……

17. If water vendors, why? (If more than one option indicate)

a. More affordable than pipe borne source [ ]

b. More reliable and available in supply [ ]

c. More better in terms of quality compared to other sources [ ]

d. Timely efficiency in supply compared to other sources [ ]

e. Others specify……

18. How often do you buy water from the vendors?

a. Daily [ ] b. Twice Weekly [ ]

c. Thrice Weekly [ ] d. Monthly [ ]

e. Others specify……..

19. What domestic purpose(s) do you mostly use water bought from the vendors for

a. Cooking [ ] b. Drinking [ ]

c. Laundry [ ] d. All of the above [ ]

e. Others specify…….

20. Is your house connected to the public pipe borne water system?

a. Yes [ ] b. No [ ]

21. If yes, how frequent is the supply?

a. Daily [ ] b. Twice Weekly [ ]

c. Once a week [ ] d. Monthly [ ]

e. Others specify……..

22. What is the duration of pipe borne water supply based on frequency of supply indicated above?

a. less than 1 hour [ ] b. 1:30-6hours [ ]

c. 7hours- 12hours [ ] d. 13hours- 24hours [ ]

e. Others specify……..

**SECTION D WATER VENDORS DISTRIBUTION PATTERN AND CHALLENGES**

23. Do you patronise water vendors throughout the year?

a. Yes [ ] b. No [ ]

24. If yes, are there times/seasons in the year when you patronise water vendor's services more?

a. Yes [ ] b. No [ ]

25. If yes, specify the time/season

a. Rainy season [ ] b. Dry season [ ]

26. what time in the day are the vendors mostly available to sale their water?

a. Morning [ ] b. Afternoon [ ]

c. Evening [ ] d. Anytime [ ]

27. Is the price of water supplied by vendors the same throughout the year?

a. Yes [ ] b. No [ ]

28. If no, specify the price across the two major seasons in naira per gallon

Rainy season ……..

Dry season ……..

29. What is your perception of cost of buying water from vendors

a. Cheap [ ] b. Affordable [ ]

c. Expensive [ ] d. Don't know [ ]

30. What are the factors responsible for the variation in price fluctuation across the seasons

a. Higher demand for water by households [ ]

b. Shortages of supply at the vendor's purchasing points [ ]

c. Distance from vendors purchase points to supply points [ ]

d. Other specify……

31. What are the specific challenges encountered in patronising water vendors in your area

……

**WATER VENDORS**

**DEPARTMENT OF GEOGRAPHY**

**AHMADU BELLO UNIVERSITY, ZARIA.**

Dear Respondent,

I am a student of the above department undertaking a study. This questionnaire is designed to collect information on the role of water vendors in domestic water supply in Nassarawa Local Government Area of Kano State, Nigeria and you are one of the carefully selected respondents. The exercise is purely an academic work and all information will be treated as confidential.

Thank you for your assistance.

Please provide information or tick in the appropriate boxes to the following questions.

1. Age of the respondent ……..
2. Sex: (a) Male [ ] (b) Female [ ]
3. Nationality……
4. State of Origin (Nigerians only)……..
5. Duration of participation in water vending activities

a. < 1year b. 1-2years c. 3-4years

d. 5-6years e. 7years and above

6. Where do you mostly source your water from?

a. Deep bore hold [ ] b. Protected spring/river water [ ]

c. Hand dug wells [ ] d. Rain water [ ]

e. Water vendors [ ] f. Pipe borne water [ ]

g. Others specify ……

7. Do you pay to get the water?

   a. Yes [ ] b. No [ ]

8. If you do pay to get the water, how much do you pay per gallon (25litres)

a. ₦5 [ ] b. ₦10 [ ] c. ₦15 [ ] d. Others Specify

9. How much do sell per gallon (25litres) ……

10. Do you have variation in the price of water per gallon (25litres) within the year?

a. Yes [ ] b. No [ ]

11. If yes, how much difference ……..

12. Why the difference…….

13. How much do you make on average monthly from selling water?

a. ₦100 -₦18,000 [ ] b. N18,100 – N37,000 [ ]

c. N37,100 – N56,000 [ ] d. N75,100 and above [ ]

e. Others Specify……..

14. What specific challenges do you face in selling water? .....

15. What do you think is the solution to the challenges? …….

## APPENDIX II

**Information on Geographical Location/Coordinates of Shallow well/ Overhead pump water source that are generated using GPS**

| Shallow_well/ overhead_pump water_source | X | Y | LOCATION | WARD |
|---|---|---|---|---|
| sw1 | 8.5366 | 12.03792 | Gidan_Ruwa_Street | kauran_Goje_Ward |
| sw2 | 8.54332 | 12.03412 | Ahmadiyya_School_Street | kauran_Goje_Ward |
| sw3 | 8.53907 | 12.02993 | Kabarin_Raka_Saniabachaway | Gwagwarwa_Ward |
| sw4 | 8.54048 | 12.0304 | Ahmadiyya_Line | Gwagwarwa_Ward |
| sw5 | 8.54127 | 12.03002 | Layin_Fanfo | Gwagwarwa_Ward |
| sw6 | 8.54571 | 12.02781 | Kwanar_Kifi_Street | Gwagwarwa_Ward |
| sw7 | 8.54258 | 12.02933 | Lungun_Ruwa | Gwagwarwa_Ward |
| sw8 | 8.5474 | 12.02757 | Garba_Gawuna_Street | Guwana_Ward |
| sw9 | 8.55176 | 12.02507 | Sani_Wada_Street | Guwana_Ward |
| sw10 | 8.55099 | 12.03269 | Audu_Utai_Street | Gama_Ward |
| sw11 | 8.5516 | 12.02275 | Club_Raod_by_School_of_Healt h_Teacnology | Tudun_Wada_Ward |
| sw12 | 8.5516 | 12.02275 | Club_Raod_by_Rail_Way_Track | Tudun_Wada_Ward |
| sw13 | 8.56442 | 12.02048 | Independence_Road | Dakata_Ward |
| sw14 | 8.56842 | 12.00674 | Warf_Road | Giginya_Ward |

| PipebornDistrbution Sub-Station | X | Y | LOCATION |
|---|---|---|---|
| PS 1 | 8.013793 | 11.719208 | Challawa_Treatment_plant,kumbotso_L.G.A. |
| PS2 | 8.53086229 | 11.9891 | Behind Fire Service_kanomunicipal_L.G.A |

**Information on Geographical Location/Coordinates of Pipe Born Distribution Sub-Station that are generated using GPS**

| Hand Dug Well Water Source | X | Y | LOCATION |
|---|---|---|---|
| H1 | 8.607429 | 11.990805 | HotoroMasallaci |
| H2 | 8.599245 | 11.973555 | Isa Suleiman Street |
| H3 | 8.591564 | 11.989797 | TsamiyanToka |

**Information on Geographical Location/Coordinates of Hand Dug Well Water Source that are generated using GPS**