THE DETERMINANTS OF HOUSEHOLDSWATER CONSUMPTION IN PLATEAU STATE: A CASE STUDY OF JOS METROPOLIS

BY

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DECLARATION

I, Bitrus Deborah Juryilla (M.Sc./Soc-Sci/05114/2010-2011) hereby declare that this research work titled "THE DETERMINANTS of HOUSEHOLDS WATER CONSUMPTION IN PLATEAU STATE, A case study of Jos Metropolis", was undertaken by me under the supervision of Dr. Salamatu Isah and Dr. Peter P. Njiforti. To the best of my knowledge, the work has not been presented anywhere for the award of Bachelor of Science or Masters of Science Degree in any institution of learning. All sources of information, materials and quotations used for this study were duly acknowledged by means of references.

…… **……..….**

BITRUS DEBORAH JURYILLA **Date**

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CERTIFICATION

This is to certify that this research work **"**The Determinants of households water consumption in Plateau State; a case study of Jos metropolis", conducted by Bitrus Deborah Juryilla, meets the requirements for the award of Masters of Science Degree in Economics in the Postgraduate School, Ahmadu Bello University, Zaria. The thesis work is this day approved for its contribution to knowledge and literally presentation.

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DEDICATION

This thesis is dedicated to the Almighty God, my parents; late W.O.2. Bitrus Juryilla and Mrs. Bitrus Juryilla. To my husband Mr. Bitrus M. Kopji, Reverend Igbul and all the Bitrus' who stood by me all the way.

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DEFINITION OF NECCESSARY ABBREVIATIONS

HH ……. Household

HHs……... Household size

Dis …….…….Distance

PSWB …….....Plateau State Water Board

Abstract

Growing populations and lack of available cost effective supply augmentation options make reliable estimates of residential water demand important for policy making. The interest of this thesis was to assess determinants of household's water consumption in Jos Metropolis of Plateau State. Understanding the variables that determine residential water demand helps the water supply utilities, governments and policy makers in their efforts of demand management and expanding service delivery to the un-served sections of the city. The factors that were hypothesized to affect household water demand were: income of household heads, price of water, educational level of household heads, and distance of water from home, family size, and house ownership. Data from 208 households were collected and analyzed using SPSS. Descriptive as well as Crosstab statistics were used for the descriptive results and explaining the linear relationships between the variables. Standard multiple regression analyses was used to determine factors explaining household's determinants of water demand (more specifically water used) of the surveyed Households. The analyses indicated that income, house ownership, distance and educational status of the household head, and price were statistically significant predictors of households' demand for water in the study area. Hence, monthly income and better education showed that people are better aware of the health benefits of reliable water and are able to obtain it. As distance and price of water increases, people sort other means regardless of the reliability of the water. People who are living in their own houses are more likely to be connected to pipe connection than those living in a rented apartment.

CHAPTER ONE

INTRODUCTION

1.1Background of the study

Water is essential for all forms of growth and development, and this include; human, animals and plants. Water is a fundamental basic need for sustaining human and economic activities (Asthana, 2001). Economic growth and development generally depend on the use of water as it affects almost all aspects of the economy, for instance, food production, security, health, sanitation, domestic activities, industries, environmental sustainability and others (WHO/UNICEF 2004). Availability of water has been identified as the key to the survival of all civilization that is why the International Drinking Water supply and other International declarations have recognized that access to water is a fundamental Human right, and has the most obvious and direct benefits in reducing mortality and morbidity (WHO, 1980).

An increasing demand for water resources resulting from increasing populations, urbanization, droughts and unpredictable weather patterns due to climate change is commonplace in many parts of the world (Bate, 2008). As a result, the sustainable management of urban water has become imperative, in response, a range of sustainable water management practices and principles have been introduced to ensure the secure supply of urban water, notably; Water Demand Management (WDM). WDM initiatives are utilized to assist in shifting consumers attitudes towards sustainable water consumption behavior. WDM is defined as the practical development and implementation of strategies aimed at influencing demand, which is characterized by reducing average water consumption to ensure efficient and sustainable use of the resource (Brooks, 2006).

In Nigeria and particularly plateau State, water is a highly sought after scarce resource. With both climate change and population growth affecting the availability and demand for more water, Plateau state is scrambling to find reliable sources of water to meet their growing, changing needs (Ezeji, 2009). As a result, reliable estimates of residential water demand, and the factors affecting it have become more important for policy making in the water supply sector. Supply augmentation requires several years of planning and large amount of capital investments before the water is available

The city of Jos in Plateau State is fast emerging as a densely populated urban center. The rate of growth is alarming and such basic amenities like portable water and sanitation facilities are lacking, therefore, meeting the World Health Organization (WHO) prescribed water minimum standard of 100 liters per capita per day is far from reality. Plateau state Water Board (PSWB) is the utility provider of water in the state, and its supply capacity does not meet basic test of reliability, accessibility adequacy and cost. Hence, the resort to water vendors, abstractions from streams and wells are on the increase (Ezeji, 2009).

As stated above, like other cities in Nigeria, Jos is facing acute shortage of drinking water because the demand for water is by far larger than its supply. The demand side needs a proper management to match the supply. Thus, this imbalance calls for a demand analysis to identify factors affecting household water demand in the city. This is helpful for supply augmentation and expansion of the service in the city.

1.2 Statement of the Problem

It is generally seen that demand for water in Jos is far greater than supply. According to PSWB report of 2014, even though 250 cubic meters of water is demanded, only 90 cubic meters is being supplied. This is possibly due to explosion in population growth and

economic activities that are paramount in the city. The pressure on the available water resource is high, for example, Yakubu Gowon dam was constructed to serve about 450,000 people as at 1972, and the same dam is serving the present population of about 3.3 million people in the state (PSWB, 2014).

Access to water has become more complicated, due to lack of household data on consumption level in assisting government plan in water provision in both rural and urban areas. Hence, the attitude of consumers and water demand policies in the state has not helped to solve the problem (PSWB, 2014). The attitude of consumers towards paying their bills and conservation is poor. Water supply operations and maintenance is being commercialized and sustained through pricing by fixing tariff (flat rate) sufficient to sustained operational expenses, but people have expectations that water should be provided by the government free of charge, and this has led to nonpayment of water bills by many users especially in plateau state (PSWB, 2014).

It has been observed that the use of flat rate has encouraged misuse of water resources over time, and one of the obstacles of the supply and provision of water services in plateau state is wastage of water due to poor consumers' attitude towards conservation, giving rise to high unaccounted for Water (UFW). Distribution losses arise from old and damaged pipes as well as illegal connections, and these have negative effects on water institutions especially on revenue (PSWB, 2014).

One of the ways to tackle the supply constraint problem is to increase and improve on the supply infrastructure such as expanding dams, treatment plants etc. But the state budget constraint is a problem (PSWB, 2014). There have been arguments that appropriate demand management strategies could guarantee sustainable and portable water needs with the existing infrastructure. These demand management strategies are closely related to the socioeconomic

characteristics of the household toward water usage and the attitude of households toward water demand management (Peter, 2010). This therefore calls for the need to analyze the factors affecting households demand for water, taking the Jos metropolis as a case study. This research work intends to answer the following research questions:

1.3 Research Questions

a) What are the socioeconomic characteristics of the sampled respondents and their implication on water demand in the study area?
b) What are the factors affecting the pattern and household demand for water in the study area?
c) What are the challenges facing households water demand in the study area?

1.4Objectives of the study

The main objective of this study is to analyze determinants of household demand for water in Jos Metropolis of Plateau State. To achieve this broad objective, the following specific objectives were addressed:

a) To analyze the socioeconomic characteristics of the sampled respondents and their implication on water consumption in the study area.
b) To analyze factors affecting the pattern and households water consumption in the study area.
c) To examine the challenges facing households water demand in the study area.

1.5 Hypothesis of the Study

The research hypotheses are as follows:

$H_0$1: Socioeconomic characteristics of the sampled respondents do not have implication on water consumption in the study area.

$H_0$2: the pattern of water consumption does not significantly influence household water demand in the study area.

$H_0$3: The challenge facing households' water demand in the study area is not significant.

1.6 Significance of the Study

Despite the initiatives of Government in Nigeria and the intervention of international donor groups aiding in the provision of water in the country, water shortage and the misuse of water in the country is wide spread, thus, implementing proper demand management strategy is required to expand water supply. Pertinent information on the residential water demand of households is necessary to properly assess the factors that affect residential water demand, considering the attitudinal problem of households towards paying their bills, illicit connection of pipelines and possible harassment of PSWB staffs by most households.

This information gap calls for a demand analysis in order to identify factors affecting household water demand in the city of Jos in Plateau State. The provision of the information will be helpful as a policy guide in the planning for supply augmentation and expansion of the water supply service in the city, and also, In addition, the provision of information from the study will be useful for water institutions and water allocation systems in incorporating user focused approach to address surface water demand and water quality issues because, specific focus on factors that influence households water demand and consumption pattern provide important information about water and its value in use to water institutions and

policy makers in the state. The study is expected to have a direct implication for policy makers, and for proper examination of demand management in the study area and how to improve water supply in the state.

Many studies on factors influencing water demand have been carried out in Nigeria and across the world and findings from the studies showed that demand for water increases with population growth. Urbanization comes with high accessibility to a taped water supply, income of the households, price of water, household size, age and sex composition of the family members. Others are; weather variables like temperature and climate, educational level of household heads etc. Some of these studies are: Mequanent (1998), Fekadu (2007) Hickma (2012), Peter (2010), Whittington (2009), Arbues(2003), Basania(2008), Dessalegn (2012).

It is hoped that this study will provide insight into the factors that affects water demand in Jos based on its peculiarity of the topographical nature and challenges in demand management and expansion of water supply service level in the state.

1.7 Scope and Limitations of the Study

The study is limited to Kabong, part of Jos metropolis of Plateau state. Water consumption and demand in industrial, institutions and commercial sector is beyond the scope of the study in view, due to the existence of an independent institutional or organizational water supply system in these sectors. However, the information used for the analysis is significant enough to provide all the necessary data for maximum research outcome. The analysis is based on responses from the sample respondents. However, it is important to note that the perceptions of the respondents and their responses may be subjective.

1.8 Organizations of the Study

This study is organized into five chapters. Chapter one consists of the introduction, statement of research problem, objective, justification, hypothesis, scope and limitation and the organization of the study. Chapter two consist of the review of literatures, made up of conceptual, theoretical and empirical as well as issues related to water demand in Nigeria and Plateau State in particular. The study framework and methodology are presented inchapter three, while analysis of the data presentation and discussion of results is carried out in chapter four. The work ends with summary of major findings, conclusion and recommendation in chapter five.

CHAPTER TWO

LITERATURE REVIEW

2.1 CONCEPTUAL LITERATURE

2.1.1 Water

Water is an essential environmental resource; its most important role lies in human sustenance. Human utilize water directly for many purpose; municipal water supply, sanitation, irrigation, transportation, industrial water supply, energy generation (hydroelectric) and recreation (Whittington 2009). Water plays an absolutely necessary and irreplaceable role in many ecosystem services, such as habitat creation, nutrient cycling, the hydrological cycle and climate regulation (Arbuse, 2006).

Water has many unique characteristic that makes it difficult to trade on regular markets; Exclusive property right cannot be assigned because of its physical attribute in particular its highly fluid nature and role in the hydrological cycle. Secondly, water can be utilized as a non-rival good, where ones use does not preclude another's use of that resource. Thirdly, due to the large amount of interdependency with uses of water such as hydroelectricity generation impacting recreation, externalities can be associated (Whittington, 2009).

When externalities exist, the full cost of an activity may not be visible or taken into account by the producer or consumer. Lastly, economies of scale in the supply of water lead to imperfect competition, where limited competition and monopoly supplier can significantly influence the pricing of good (Arbuse, 2003). As a result many disclaimers suggest that water is a "social good "and should be affordable to the poor (Whittington, 2009). Water economics is understood to deal with how best to meet all human wants making the right choice about the most sustained uses of water in broad social context, therefore, considering water as an

economic good is about making integrated choices not about determining the right price of water (Hikma, 2012).

2.1.2 Water Demand Management

Water demand management involves the adoption of polices or investment by a water utility to achieve efficient use by all members of the community. Demand management measure can be short or long term depending on the needs of the community served by the water utility. Strategic planning is a key aspect of a successful demand management strategy. It involves understanding the constraints, analyzing how much water is used, when, by whom, for what purpose and at what level of efficiency; determining the potential reduction in water use that can occur through improvement in water using equipment and behavior(Whittington, 2009).

According to Whittington (2006), any management practice, which aims to alter demand and leading to the alleviation of pressure on current supplies of water can be referred to as Water Demand Management (WDM). Also, Tsur (2006), defined water demand management as any measures that reduce or reschedule the average or peak withdrawals from the sources and maintaining the quality of return flow. Water demand management presents a philosophy of management that focuses on the demands made on water resource systems. Demand management can have significant impacts on system costs by fostering lower levels of demand, and thereby lower system capital. WDM are centered on lowering or mitigating proposed demands in a more socially beneficial manner, in view of the capital intensive structures. Water demand management signals a shift to management of the water resources for sustainability, therefore both the quantity and quality aspects of water must be preserved to support public health and socio economic development. It is therefore imperative that water quality management complements water demand management. This concept of water demand management refers to the adaptation and implementation of a strategy by a water

institution or consumer to influence the water demand and usage of water in order to meet any of the following objectives: Economic efficiency, Social development, Social equity, Environmental protection, Sustainability of water supply and services (Peter, 2010).

Also, according to Dinar (2006), Water demand management refers to any socially beneficial action that reduces or modifies average or peak water withdrawals or consumption from either surface or groundwater, consistent with the protection or enhancement of water quality. This implies that, Water demand management relies upon a range of tools and techniques, which can be divided into economic, structural, operational, and sociopolitical categories. Its techniques encompass both the concerns of water supply and waste disposal.

The structural components of demand management include metering, leak detection and repair, water storage and water auditing plus the construction of major works if necessary (Whittington, 2006). The financial tools consist of price, tariffs, taxes and subsidy.

2.1.3 Price

Price of water in the context of this study is the amount of money that is paid for water use, and this amount is set by the political and social system to ensure cost recovery, equity and sustainability. The price may or may not include subsidies. The problem faced by water sectors is that prices and tariffs are almost universally below the full cost of supply; this implies that, there are large inefficiencies in the water sector.

Price is an important tool for water demand management. The contention among economists is whether the price of water should reflect the full value (Whittington, 2009). Because water is a public good, most water authorities often charge price that does not reflect the full value of water. Some tend to charge discriminatory price where urban price is different from rural price and industrial price is charge differently from domestic price (Dinar, 2006). But because of the peculiar nature of water (no definite property right) and no tradable market

value price of water may be less than the full value or more than the full value as well as political and legislative intervention in water pricing have limited price as an effective demand management instrument (Whittington, 2009). Some institutions consider Block pricing which can be Incremental Block Pricing (IBP) or Decreasing Block Pricing (DBP).

2.1.4 Tariffs

Tariff is a rate charge on water use that is supplied by a public utility through a piped network to its customers. The term is also often applied to wastewater tariffs (Tsur, 2006). Water and wastewater tariffs are not charged for water itself, but to recover the costs of water treatment, water storage, transporting it to customers, collecting and treating wastewater, as well as billing and collection (Tsur, 2006).Free market advocates that tariff should reflect the full cost of water. For this to be achieved, proper metering is required. At times, tariff charge in urban centers may be different from tariff charged in rural areas (this is most times due to the discriminating price system by the government). Tariff charge may equally differ over time and space as well as over different economic activities (Whittington, 2009).

2.1.5 Subsidy

Subsidy is part of the cost of the commodity that is born by the government or supplier. Because water is considered as public good, the price charged is often less than the use value. The part of the cost not born by the consumer is known as subsidy. Subsidy assists water distribution equity, considering the fact that some water project like dam and pipe construction can be very costly (Whittington, 2009). In this case if price is charged to reflect full cost, then the less privileged would not be able to have access to water.

2.1.6 Water Supply System

Water supply system is a process or an activity by which water is provided for some use, such as in homes, factories or businesses (Dessalegn, 2012). The stringency of requirement that a supply of water must meet depends on the use to be made of it. The more usual requirement, however, are that water be free enough of harmful bacteria, chemicals and other contamination to be drinkable; free of substance that make its taste or appearance unpleasant; and if the water is to be used for washing, it should be free of salts, calcium and magnesium that will interfere with the action of soap (Hikma, 2012).A complete water supply system is often known as a waterworks. Sometimes the term is specifically applied to pumping station, treatment stations or storage facilities.

2.1.7 Surface Water

Surface water is a primary source of water for humans, and these include; river, lake, stream and fresh water (Hikma, 2012). Surface water is naturally replenished by perception and naturally lost through discharge to the Oceans, evaporation and sub-surface seepage. Although the only natural input to any surface water system is perception within its water shed, the total quality of water in that system at any given time is dependent on many other factors. These factors include storage capacity in lakes, wetlands and artificial reservoirs. Human activities have devastating impact on these factors (Hikma, 2012). They increase storage capacity by constructing reservoirs and decrease it by draining wet lands (Dessalegn, 2012).

2.1.8 Ground water

Ground water is the second largest sources of fresh water (Hikma, 2012). This is water that lay under the surface. It exists almost everywhere in the world. In some places, however,

people have to dig much deeper to access it than other places. In some places, it might be accessible but it might not be healthy for human consumption, if it is not treated. The level of ground water is supplied, in part, by precipitation when rain falls it sinks down in to the ground (Hikma, 2012).

2.1.9. Institutions and Water Pricing

Douglass North (1993) defined Institutions more broadly than simply government agencies and private organizations. According to him, institutions are "...sets of ordered relationships among people which define their rights, exposure to rights of others, privileges and responsibilities". In this context, institutions set the "rules of the game" within which the economic system operates. For example, the property rights system is considered a water institution because it includes provisions which determine access to water and land (Whittington, 2006). The property rights structure helps define the incentives, disincentives, rules, rights and duties (including informal customs and formal legal systems) that guide human activities and encourage conformist behavior. Thus, property rights are part of an institutional arrangement governing economic activities including water use (Whittington 2006).

2.2 THEORETICAL ISSUES:

2.2.1. DEMAND AND SUPPLY OF GOODS AND SERVICES

Demand and supply is perhaps one of the fundamental concepts of economics and it is the back bone of a market economy. Demand refers to how much (quantity) of a product or service that people are willing and able to buy (Mankiw, 1999). The quantity demanded is the amount people are willing to buy at a certain price; the relationship between price and the quantity demanded is known as the demand relationship. Supply represents how much the

market is willing and able to offer. The quantity supplied refers to the amount of a certain good that producers are willing to supply at a certain price (Mankivw, 1999). The correlation between prices and how much of goods or service supplied to the market is known as supply relationship. The relationship between demand and supply underlies the forces behind the allocation of resources. However, in the market economy theories, demand and supply will allocate resources in the most efficient way possible (Whittington, 2008).

The law of demand expresses a relationship between the quantity demanded and its price. The law of demand states that; 'all things being equal, the higher the price of a product, the lower the quantity demand and vice versa' (Lipsey, 1997). The amount of goods that people purchase at a higher price is less because, as price rises, the opportunity cost of buying such good also rise. Hence, people will naturally avoid buying a product that will force them to forgo the consumption of something else they value more. But there are exceptions to the law of demand, this is evidenced during war, depression, ignorance and giffen paradox (necessity to life like water) etc. The major determinants of demand are; income, taste and preferences, prices of related goods and services, consumers' expectations about future prices and income that can be checked, number of potential consumers and price of the product etc.

Like the law of demand, the law of supply demonstrates the quantities that will be sold at a certain price. But unlike the law of demand, the supply relationship shows an upward slope. This means that the higher the price, the higher the quantity supplied. This implies that, producers supply more at a higher price because selling higher quantities at high price increases revenue. Major determinants of supply are; price, cost of production, technology, number of sellers and expectation of future prices.

But there are exceptions to the law of demand; this is evidenced in the nature of the commodity (i.e. necessity to life like water). Although the law of demand and supply helps to clearly explain the demand and supply of water in a market economy, this only shows the normal case of the demand and supply of goods and services.

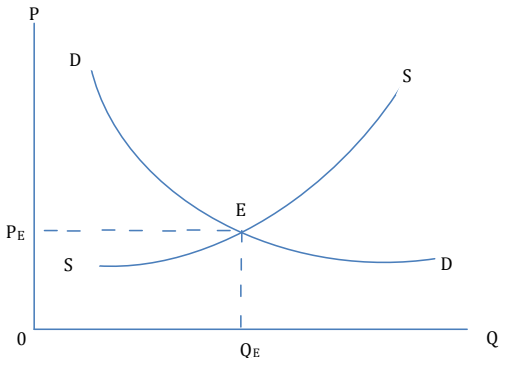
However, the demand and supply of water does not follow the normal case of the theory of demand and supply. As a necessity to life, the demand and supply of water tends to be mostly influenced by other factors other than the price of water. This implies that the demand for and supply of water is not so much determined by the price to be paid for the commodity. Thus, even at a higher price, consumers cannot naturally avoid the use of water, thereby making the opportunity costs of purchasing water at higher price falls unlike the normal case. This is because people are not ready to forgo the use of water for other goods. On the supply side, the need to improve revenue may influence authorities to supply more at certain high price. This however applies only in the normal scene. The supply of water scene tend to deviate from the normal case as the water board authorities may tend to supply water at a certain low price given the availability of certain factors like power supply, topographical problems, good distributional channels. Thus, the supply of water tends to be influenced more by other factors not in the control of water board authorities than the price paid for water.

2.3Water Demand Analysis and Water Pricing in Different Market Situations

Anything scarce and in demand commands a price; this is one of the basic principles of economics. Water is scarce so water pricing is increasingly seen as an acceptable instrument of the water institutions (Stoforos, 2006). The analysis of water demand aims at offering all the necessary information and knowledge for designing an effective water demand policy and

specifically, a policy that pursues the efficient use of water resources. Accordingly, efficient use is defined as a pattern of use that maximizes the benefits arising from the exploitations of water resources (Stoforos, 2006). A pure competitive water market would ensure efficient use by defining the optimum use of water and its optimum allocation among competing users. Under perfect competitive condition, the price of water would be determined by the interaction of the market demand and supply to reflect the actual costs of water usage. This price would induce users to purchase the optimum quantity of water. In this situation, no exogenous administrative intervention would be necessary; this is because the "invisible hand" would ensure the efficient level of use induced by an equilibrium price that reflects water costs. However, perfectly competitive market conditions for water do not and probably cannot exist in the majority of cases (Briscoe, 1997; Pearce, 1999). The economic characteristics of water sector in combination to the fundamental social perception that water is a socially sensitive good related to human existence and health led to strict administrative framework for the operation of the water supply sector and hence of the water market (Kaika, 2003). In effect, the fundamental decision like the determination of investment and prices, have been strongly influenced by administrative rationale. In such a framework of direct or indirect government intervention, the estimation of demand parameter and characteristics acquires a special significance, since the decision makers require sufficient knowledge and information. As water, or any other good or service, becomes more scarce, people are willing to pay more for incremental units. This inverse relationship between marginal willingness to pay, on the one hand, and quantity, on the other hand, is captured by a downward sloping demand curve. The condition for determining the efficient use of water and the relevance of demand analysis offers necessary information as seen in figure 1. Below;

FIGURE 2.1: Demand and Supply of water in a perfectly competitive market



In figure 2.1 above, the supply (SS) curve represent the long run Marginal Cost (LRMC) of water. The information and data needed for the estimation of the LRMC curve are to a significant level available to the administrative agencies responsible for formulating water policies. However, the authorities are hardly aware of the functionalities and operations of the LRMC of water supply. Curve D represent the Marginal Benefits (MB) of Water use. The information for defining curve D' could be revealed in a free water market as well as through market survey by the administration. In this competitive market, the efficient use of water is determined by the intersection of the Demand curve (MB) and the supply curve (LRMC). $0Q_E$ represent the efficient quantity of water used while $0P_E$ represent the efficient price of water paid. In this situation, consumers and producers surplus are maximize.

In the administrative regulated markets, the achievement of $0Q_E$ in the figure above can be ensured if the decision makers define the appropriate price which is $0P_E$, which is equal to the marginal cost of water use. To determine the appropriate price, decision makers should have sufficient information on water demand which is not directly

available in an administrative supervised market. Furthermore, the analysis of demand can be an important tool in formulating relevant investment in the sector. The key factor for making an appropriate investment decision is the expected demand. Forecasting demand leads to the determination of the optimal future level of water use and hence, the design of future capacity of water supplies system. Water supply infrastructure is considered to be expensive, especially as far as urban uses are concerned. Therefore, forecasting water demand and the appropriate magnitude of investments are very important for decision makers, Water resources are mobile, they flow, seep, and evaporate- making it difficult to establish and enforce exclusive property rights, the basis of an exchange economy. In addition, water is a bulky commodity; its per unit value is low, making the costs of transportation and storage high relative to its overall value in use. Extensive transportation infrastructure, such as that established for oil and natural gas, is found only where water scarcity is a recurring, long-term problem and the economic value of water is very high. Also, because of the particular cost structure of piped, treated water supply, the cheapest way to serve a given population is to have one firm serve the entire market, a condition known as 'natural monopoly'. It would be wasteful for competing firms to establish separate treatment facilities and distribution networks to supply the same population with drinking water. For all of these as well as other reasons, water is a special commodity, and if it were traded on simple markets, some aspects of the economic value of water would not be captured, and it would be under-supplied in some public uses.

Because of the peculiar nature of water the demand and supply of water is influenced by institutional interference and this in effect influence the behavior of the consumer.

2.4. FACTORS THAT DETERMINE HOUSEHOLD DEMAND FOR WATER

The determinants of water demand are very complicated. Unlike many other economic goods, living things need some minimum amount of water for their survival regardless of its scarcity (Whittington, 2006). According to Douglas (2008), there are so many factors that influence household demand for water; some factors are within the control of the water utilities like prices, water restrictions, rebate programs etc. while weather and demographic characteristics are not.

There are several factors that affect the demand for residential water of the households. Some of these factors are income of the households, price of water, household size, level of education, age and sex composition of the family members and weather variables like temperature and precipitation (Arbues, 2003).

i. Distance; one of the factors, which affect the use of water within each household, is the physical distance of housing unit from the water point. It is widely known that distance involved in fetching water is inversely related to per capital consumption of water (Hikma, 2012). Long distance involves considerable energy and time expenditure, which limits the frequency of fetching and the size of containers and hence reduces the per capital daily water consumption. (Teshome, 2007)

ii. Demographic factors; in dealing with the demographic factors like age and sex, Dessalegn (2012) suggest that a one unit increase in age (one year) reduces the daily per capita consumption. It terms of sex, Whittington (2009) suggests that female headed households will have lower per capita daily water consumption than the male headed households; this is because females are sensitive to hygiene and can minimize water use than male.

iii. Household size; when there is an increase in household size, there is high probability of collecting more water for large household size than individual household; as a

result, there is a positive relationship between household size and total consumption. However the per capita water consumption decreases with an increase in household size. When considering the supply necessary to meet the needs of large family, there is a problem of access and adequacy. This implies that there is a negative relationship between household size and per capita daily water consumption (Mesert, 2012).

iv. Educational level; households with less educated heads consume less water than a house hold whose head is more educated. This is because the higher the educational level of ahead of family, the higher the awareness about the benefits that could be gained from water and it uses (Whittington, 2006).

v. Income; households income is one of the major factors that influence demand for water. The higher the income size of households, the more water shall be demanded (Whittington, 2009).

vi. Price of water; the higher the price of water, the lower the quantity demanded of the priced water, people will shift their attention to other sources of water even though it may not be reliable (Ezeji, 2009).

vii. Factors like the size of the house and access to appliances such as showers, bathrooms, washing machines, flush toilets, availability of garden or lawn in the residence etc. also influence water demand (Renzetti, 2002). For this study, housing ownership and type of housing, and access to shower was collected. It is expected that housing ownership is likely to increase HHs' decision to have private piped connections as the primary source of water and is likely to increase the daily per capita water consumption. Thus, for both of the water source choice model and water demand estimation model, housing ownership is expected to have positive sign.

However, at the theoretical level, the determinants of water demands vary with specific uses and from region to region. Moreover, all of these determinants are significantly affected by institutional factors. In it simple linear form, demand for water can be represented as follows;

Dw = f (P, Y, Ho, Ag, Sx, HHs, Wh, Dis, Ed)

Where;
Dw = demand for water
P =the price of water per unit.
Y=Average income level of households.
Ag = Age of the people
Sx = Sex composition in the family
HHs= Household size
Wh = weather (temperature)
Dis = Distance
Ed = Education level
Ho= House ownership

2.5 EMPIRICAL LITERATURE ON DEMAND FOR WATER AND CONSUMPTION PATEERN

Household and daily per capita consumption of water is affected by various factors, the effects of which vary widely from place and from community. Many writers have tried to identify the factors influencing the amount of household and daily per capital water consumption, although, the most frequent variables in all studies are house hold size, income, education, expenditure of a household, age and sex of the respondents and distance of water source (Arbues, 2003)**.** Analysis and evaluation of these factors will help to identify factors, which either positively or negatively associates with the rate of per capita household water consumption.

A study carried out by Teshome (2007), revealed that there is a positive relationship between monthly income and per capital daily water consumption. This result confirms with economic theory which states that an individual's demand for a particular commodity depends on his/her income and quantity demanded are positively related, except in the case of inferior goods. The result of the survey shows that higher income groups have higher per capital daily water consumption than lower income group.

According to Dessalegn (2012), monthly expenditure of a household was found to have a positive relation with the per capita daily water consumption of household because family members of better household are more likely to have frequent bath, showering, frequent washing of cloth and more water for cooking as compared with worse off households, taking into consideration the households life style and sanitation preference of better- off household.

Douglas et al (2008) in their study of residential water demand management found that residential water demand is a function of several factors, some are within the control of the water utilities like prices, water restrictions, rebate programs etc. while others like weather and demographic characteristics are not. Their findings indicate that pricing and other outdoor water restrictions policies interact with each other to ensure that total water savings is a collection of both policies. This study also shows that pricing and restriction policies varies among different classes of customers (low, middle and high volume users), and between pre drought and drought periods.

A study done by Mesert (2010) in Simde district in Ethiopia suggest that the per capita water use is negative and significantly determined by the distance of water source from the households (i.e. keeping other factors constant), as the distance of water source from a household increases, the per capita water use significantly decreases. This implies that water facilities should be accessible to all segments of the population to better satisfy daily water requirement of residents. It also shows that convenience of location of water source is a

significant determinant of water use at household level. This means that households located nearer to water source are likely to use water more than those located farther away.

As indicated by Teshome (2007), the educational level of a house head is positively related with the per capita daily water consumption. Households with less educated head consume less water than a household whose head is more educated. This is because the higher the educational level of the head of the family, the higher the awareness about the benefits that could be gained from water.

Arbués (2000) found that water use is less than proportionate to the increase in HH size or population because of economies of scale in discretionary and nondiscretionary water usage, including cooking, cleaning, car washing and gardening as there is an optimum household size beyond which these economies of scale diminishes. Families with children could be expected to use more water as children require frequent sanitations. Outdoor uses by children and teenagers might be higher, youngsters might use water less carefully, have more showers and demand more frequent laundering, while retired people might have saving and disciplined water use behaviors.

But, Lyman (1992) found that retired people tend to spend more time at home and do more gardening, which is associated with more water use. However, water demand in most cases is perceived as inelastic in its nature as water has no perfect substitutes for its basic uses. In addition, consumers do exhibit a low level of perception of the rate structure since water bills typically represent a small proportion of income.

A study conducted by Scott and Dodley (1998), simulate the potential of water markets using dynamic optimization to derive short run demand functions for reservoir water, and marginal opportunity cost for a variety of decisions to derive optimal short run allocations. Their result shows that demand for water is responsive to price changes.

Renwick and Archibald (1998) estimate water demand elasticity by income quartile in southern California communities, using data collected over a six year period. Their result shows that low income households are more responsive to price change than high income households, indicating that low income households contribute a greater fraction of the cities aggregate savings than the high income households.

An aggregate demand study by Renwick and Green (2000) found out that public information campaign, retrofit subsidies, water rationing and water use restrictions have negative and statistically significant impact on average monthly residential water use, and more stringent policies have stronger effects than voluntary policies and education programs.

It has been found from all reviewed literatures with strong empirical evidences that demand management is more efficient than water supply management strategies. Non-price demand management policies (such as watering restrictions, low fixture etc.) are not effective in terms of conservation and management, however, price based approach have been found to be more advantageous in terms of compliance, monitoring and enforcement.

2.6EFFECTIVE WATER DEMAND AND PRICING SYSTEM

One aspect of water that has become increasingly subject to pricing principles is that of public water supply and wastewater services (Dinar, 2006). Efficient and effective water pricing systems provide incentives for efficient water use and for water quality protection. They also generate funds for necessary infrastructure development and expansion, and provide a good basis for ensuring that water services can be provided to all citizens at an affordable price (Whittington, 2009). The metering of water consumption is a prerequisite for the application of efficient water pricing policies. Since water is not traded in markets, it is not possible to expect prices to adjust automatically to reflect periods of scarcity, as they do for other goods and services (Whittington, 2009). Instead, most water pricing is regulated by

public institutions – city councils, public utility commissions, water boards, and other entities. Given the public benefits provided by many aspects of water supply and management, this could be a good thing from an economic perspective, if these price-setting public institutions had some way to measure the true economic value of water supply and to use this information to establish economically rational water tariffs (Hikma, 2012). There are various pricing rules of water, some of them are;

a) FULL COST PRICING

The World Water Commission (2000) strongly endorsed the need for full cost pricing of water services, but there is no clear term on the exact definition of full cost pricing. According to Roger (1998), full supply cost includes; capital charges while full economic cost include; opportunity cost and externalities. When water prices are lower than the cost of supply, consumers tend to use water inefficiently and this discourages maintenance, improvements and expansion in the distributional system, this therefore leads to irregular water supply and general poor services. Most times, water tariffs do not meet the full supply costs, and the value of water is mostly lower than the cost of supply (Okoli, 2003).

There are several elements of tariff or pricing structure, these include: a connection or fixed charge, a volumetric charge, block charge and a minimum charge. Many countries use a combination of these charges, depending on the situation and characteristics of the city, utility and behavior of customers (Rogers, 2002). The public (Administrative) pricing, two part tariff system and Block tariff structures are the popular combinations used in most developed countries.

b) PUBLIC (ADMINISTRATIVE) WATER PRICING

Because of the public nature of water, most government in developing countries decides to allocate, distribute and price water for users. This system does not always reflect demand and supply considerations (like in the case of perfect competition), but tends to promote equity. It attempts to protect the poor and to provide basic level of water to meet basic needs. Allocation rules are based on individual requirements, equal share in available water volumes and on political pressure (Tsur, 1997).

The pricing system usually adopted under public water pricing is the minimum charges, flat rate or fixed charge system. But the disadvantage of such pricing system is that prices do not represent the cost of water and the value to the users. This implies that prices are not reflective of marginal costs or average costs; as a result, it can be misused or wasted. This is because; this system does not provide incentive for people to conserve water and to improve efficient use.

c) TWO PART TARIFF SYSTEM

Two part tariff system is a pricing system by which customers pay more per unit for their purchases up to some given quantity, with a lower price per unit for further purchases (Roger, 2002). Such a system is only practicable when the customer can be identified, and resale is difficult. It can also be seen as aprice discrimination technique in which the price of a product or service is composed of two parts - a lump-sum fee as well as a per-unit charge (Roger, 2002). In general, price discrimination techniques only occur in partially or fully monopolistic markets. It is designed to enable the firm to capture more consumer surplus than it otherwise would in a non-discriminating pricing environment. Two-part tariffs may also exist in competitive markets when consumers are uncertain about their ultimate demand. The argument for two-part tariffs is that the higher price for the first units bought reflects the

overhead costs of supplying a particular customer (Dinar, 1997).One advantage of the Two-part tariff system is the stabilized revenue base it affords suppliers. The fixed element protects the suppliers from demand fluctuation and reduces financial risks, it gives the service provider revenue enough to cover overhead expenses, while charges to the consumer is made according to the consumption level, in this case, efficient use and conservation are encouraged (Roger, 2002).

d) BLOCK TARIFF SYSTEM

Block tariffs are volumetric charges. The prerequisite for setting a volumetric charge is that consumers have a metered connection to water services (Whittington, 2009). Under a block tariff scheme, users pay different amounts for different consumption levels. Block tariffs have a step-wise structure. The charges set per unit (e.g. cubic meters) of water consumed and remains constant for a certain quantity of consumption (first block) (Whittington, 2009). As the water use increases, the tariff shifts to the next block of consumption and so on for each block of consumption until the highest one. Block tariff system of pricing are primarily based on equity considerations, this implies that elements of economic efficiency is paramount because this system is based on the marginal average cost pricing. Allocations which equate marginal value of water with the marginal cost are considered as a "social optimum allocation" of water resources (Dinar, 1999).Block tariffs can be differentiated among consumer categories (e.g. domestic and non-domestic) and are of two main types: increasing and decreasing block tariff systems, while increasing Block Tariff refers to the rate per unit of water increase as the volume of consumption increases. Consumers face a low rate up to the first block of consumption and pay a higher price up to the limit of the second block, and so on until the highest block of consumption. At the highest block consumers can use as much water they desire, but for each additional water unit consumed they pay the highest price in

the rate structures. Increasing block tariffs are by far the most common charges for water services. They are used in countries were water has been historically scarce such as in Spain and the Middle East (Dinar, 1999).

e) RETROFIT OF EXISTING PLUMBING FITTINGS

Retrofit programs involve modifying existing household appliances and fixtures with devices that improve water use efficiency. This includes faucet aerators, toilet displacement dams, low-flow showerheads, and the like. It is estimated that by replacing existing plumbing fittings with more efficient fittings, the total consumption of water can be reduced by 14% or 50% of the domestic household and commercial water use (Peter, 2010). Opportunities in retrofitting of plumbing fittings include fitting dual-flush or interruptible toilets, user-activated urinals, low-flow shower heads and tap controllers and aerators. Toilets are the largest consumers of water in the home with 15 percent of total use (Whittington, 2009). Although there is some natural replacement through remodeling, retrofitting can help in conserving water efficiently; this is because, instead of using 3.5- 7 gallons of water per flush, toilets can flush well by using not more than 1.6 gallons of water per flush. A highly efficient showerhead uses 2.0 gallons minimum per minute. The showerhead uses air pressure instead of extra water to provide water at a comfortable rate. Low flow showerheads provide an even spray pattern (Whittington, 2009).

2.7 THE IMPORTANCE OF WATER DEMAND MANAGEMENT APPROACH

Until recently, the general approach to water management in most developing countries was to develop new water projects and transfer schemes in order to keep ahead of the ever increasing requirements due to the growing population and improved living standards (Whittington, 2009). This type of supply management was justified to some extent by the

relatively low financial costs of the initial schemes. In recent years, however, the situation has changed dramatically through both a greater awareness of environmental issues and very high real interest rates (Hikma, 2012). Consequently, the emphasis has shifted from the purely supply orientated approach to one of both supply and demand management with the latter receiving priority (Whittington, 2009). Bold and meaningful measures have recently been taken by many governments of developing countries like South African and Ghana, as well as developed countries like the United States of America. Through their new Water Services Act (Government Printers,1997)and the National Water Act (Government Printers,1998), (WHO, 2011), they introduce a new approach to water management, one in which demand management, water use efficiency and integrated catchment management are integral to the entire planning of water resource management and development (Hikma, 2012). The advantages of Demand management approach are as follows:

a) It requires low investment (except for repair of distribution network, which can be very expensive)

b) Public income can be generated by water fees

c) Incentive to industries and agriculture to improve their efficiency (and thereby their competitiveness in an open market)

d) Raw water is preserved for alternative uses downstream, including fisheries

e) Less sewage treatment capacity required (etc.)

2.8 WATER RESOURCE DEVELOPMENT AND MANAGEMENT IN NIGERIA

Government programs in the water sector have been centered on water resources development while proper management and conservation of the resource is not given adequate attention (Goldface, 2008). The turning point for water resources development and management in Nigeria could be traced as far back as 1960 after the severe drought of the

1960s. The Government's response to the catastrophe was the initiation of strategies for co-ordinated and effective water resources development, culminating in the creation of the Federal Ministry of Water Resources and the River Basin Development Authorities in the mid-1970s. The activities of these institutions were further strengthened in 1981 by the establishment of the National Committee on Water Resources, and by establishing Water Boards at the state level. These bodies were charged with taking an inventory, and ensuring rational and systematic planned management and conservation, of the country's water resources. The previous approach to water resource development and management involves treating water as a public social good which is centralized and entails command and control mechanism. There have been numerous activities and efforts in the area of dam construction, urban water supply for irrigation, domestic and industrial purposes and for power generation. The institutional arrangement for water resources and management in Nigeria is such that all tiers of government are involved.

The three levels of government (Federal, State and Local), share responsibility for water resources management. This led to fragmentation, duplication and lack of inter-sectorial coordination with each segment pursing its independent water agenda. The institutional arrangements in Nigeria's water resources are as follows:

a) Federal Government Level – (including 12 River Basin Development Authorities (RBDAs) and National Water Resources Institute (NWRI)– responsible for formulating and coordinating national water policies, development and management of large water resources infrastructure, dams' reservoirs, irrigation and water supply schemes.

b) State Government Level – Responsible for potable water supply (through state Water Agencies (SWAs).

c) Local Government level – responsible for provision of rural water supplies and sanitation facilities. Community Level participation in rural water supplies and sanitation.

In Nigeria, potable water supply is a public service, controlled by the government through its 37 corporatized utilities, variously called a water board, corporation or authority and generally known as State Water Agency (SWA). As the services rendered by these SWAs is historically considered as a social welfare service, their charges are usually fixed at uneconomically low rates,

The flat rate tariff is the formal tariff used by all the SWAs in Nigeria. The SWA prefer the flat rate because it covers up their inefficiency and frequent intermittent supply. However, the rate varies considerably from state to state and in most cases has little relation to the cost of production. They are initially set close to the cost of production but over time, due to their non-revision or marginal revision, the gap between the cost of production and the tariff widens and eventually makes the tariff out of line with the total cost. In all the SWAs the industrial and commercial rates are usually higher than the domestic rate.

Efficient provision of reliable public utility devices has remained elusive in the Nigerian economy especially since the oil boom period (1970s). In recent years, the problem in these sectors have reached crisis proportions as water taps remain dry for most of the time, while the performance of other public service sectors remain very unsatisfactory (Ezeji 2009). In response to these challenges, many businesses and households have resorted to self-provision which is usually at a higher cost. For example, a study by Lee and Anas (1996) and Okoli (2006) found that ninety two percent of firms of one hundred and seventy nine Nigerian manufacturers owned electrical generators; this implies that, self-provision of such public utility is a norm for low income consumers, and forty four percent had boreholes to ensure their own private water supply.

2.9 WATER RESOURCE DEVELOPMENT AND MANAGEMENT IN PLATEAU STATE

Plateau State Water Board (PSWB) and the state Ministry of Water Resources are the main Agencies responsible for water supply. The PSWB was established under edict No. 4 of 1991 to cater for urban and semi-urban water supply needs of the State, while the State Ministry of Water Resources takes care of the rural area (PSWB, 2014). The state government has constructed and commissions schemes at various local government councils for operations in the state. Maintenance of the scheme is between the state government, local government and the benefiting communities. Available records show that, less than 20% of the inhabitants of these areas have access to safe water (PSWB, 2014).

Water supply operation and maintenance is being commercialized and sustained by fixing tariff to defray operation expenses. This is an important step toward relieving government of its financial burden. Water supply was hitherto concentrated in the urban and rural areas with little attention on the semi urban areas. In addressing the problem, the state government fashioned out as a matter of priority a semi urban water supply programs for the provision of potable water.

Currently, the Plateau State Water Board has a total of 18 water schemes in 13 of the 17 Local Government Areas of the State, 5 earth dams with treatment works and the rest motorized boreholes, with total installed capacity of 131 MLD, about 80% is supplying Jos the state capital (PSWB, 2012). The State government through the Ministry of Water Resources and Water Board regulate and fix the price to be charged (Public/administrative pricing policy), and this price does not reflect the cost of water and its value to the users of water, this can create enormous waste of water. The actual average consumption of most of the consumers from different sources is 30L/c/d. The average cost of water from public sector

supply is ₦100/m^3 and the private supplier is N1, 000/m^3. Plateau state government set the following targets to achieve: 50% coverage service by 2012, 70% service coverage by 2013 and 100% service coverage by 2015 provide a minimum service level of 120litres per capita per day (1cpd) for urban areas and 80lcpd for semi urban and 40lcpd for rural areas. To achieve these targets, the state government uses the following strategies to manage water services:

a) Creating public awareness on water conservation and payments of water tariffs to change consumer's attitudes.

b) Charging some nominal fees to enhance operation and maintenance of semi urban and rural water supply scheme

c) Allowing non-governmental organizations like Water Aids etc.to contribute efficiently in service delivery

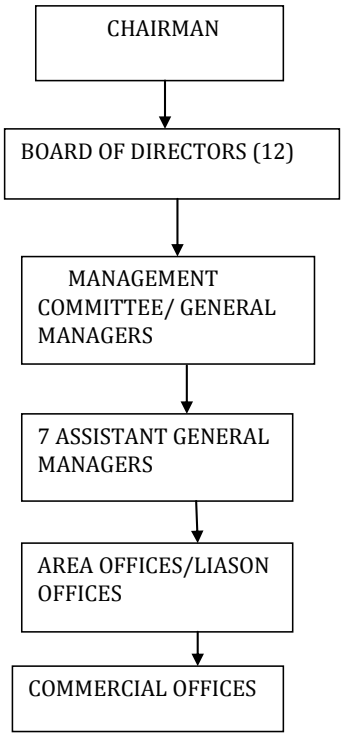
d) Monitoring and evaluating water supply schemes

e) Establishment control and management of water schemes consisting of dams, water works, distribution system for urban water supply for the purpose of providing water to meet the requirement of the general public.

f) The government is considering public-private partnership of the water Board for proper efficiency.

2.10 STRUCTURE OF PLATEAU STATE WATER BOARD

STRUCTURE OF THE PLATEAU STATE WATER BOARD



Source: PSWB 2012

PSWB is headed by a chairman and 12 other members who constitute the board of directors, who make policies, ratify appointments and endorse operational budgets. The management committee comprises the general manager assisted by 7 assistant general managers. The decentralization of area offices and recruitment of commercial officers to provide rapid response to customer complaints and to ensure payment of bills, made income to increase from 3 Million Naira to over 10million naira monthly (PSWB, 2014). A liaison office was set up to manage the utilities credit relationship with the Power Holding Company of Nigeria. This brought down the bills and avoided leakages by strengthening internal audit. On the part of the community the traditional rulers have come to realize that they can actually set up institutional structures to manage their water supply and sanitation infrastructures.

PSWB over the years had not met demands from the various urban poor communities around Jos and Bukuru Metropolis for proper access to water supply and basic sanitation. Most of the inhabitants of these communities suffered from diseases such as diarrhea, cholera, typhoid, Hepatitis and other water borne diseases which are direct result of the poor water supply and sanitation situation in the areas. The government undertook a project in October 2003 with a strategic alliance between PSWB and Water Aid Nigeria to provide an improved access to water supply, improved sanitation and hygiene promotion in an urban Slum community (Kabong). A situational analysis on water supply, sanitation and hygiene promotion in urban slum communities of Jos metropolis was conducted using the following criteria:

a) Long distance to water points

b) No access to safe water source

c) Valuable man hours wasted in search of water

d) Lack of awareness to approach government for the provision of water supply

2.11 PRIVATE WATER VENDORS

In response to the poor PSWB performance, some private sector activity operated side-by-side, through either self-provision mentioned above or an alternate informal sector. The about 50% of urban dwellers that are not directly served and about 25% of those that are inadequately served by the PSWB heavily patronize the services of these private water vendors (PWVs) although at a higher informal price (Ezeji,2009). These PWVs provide alternate water through borehole, dug-wells and uses trucks, water tankers or smaller receptacle such as carts, buckets and jerry cans to hawk water for distribution to their customers. In some cases, these PWVs only improved the supply from the PSWB by use of booster pumps and erection of storage tanks to create private water kiosks (Ezeji, 2009). Some also collect water directly from the PSWB's kiosks and later resells them at a higher

price. The major attraction to these PWVs is the fact that their services are more reliable though more expensive than that of the PSWB. The major characteristics of the alternate pricing method devised by these PWVs, is that the charges are demand driven and is based strictly on commercial business principles, this means that the higher the demand for their services, the higher their price. Similarly, as soon as their operation costs increases, their price is immediately increased upward.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 The study area

The city of Jos in Plateau State Nigeria is located at latitude 8.4^{o} East and longitudes 9.9^{o} North with a total land area of about 130 km^{2} is situated over 1,500m above sea level and has a cool temperate climate and it is once known as the World's famous tin mining State. Water supply technologies in Plateau State are influenced by geological and hydrological factors prevalent in the State. Plateau State presently has a population of about 3.3 million with about 1.3 million (about 33%) living in the urban town of Jos metropolis (NBS, 2013). The rapid urbanization in Jos also brings along with it the challenges of meeting the water, sanitation and hygiene promotion needs of the city. The annual average rainfall in the State is in the order of 1,600mmand the state has two main seasons, which are the dry and rainy seasons. The rainy seasons starts around April and ends around October (which is six month period), and the dry season is usually from November to March which is also six month period. There are five functional dams built and owned by the state government mainly for water supply and limited irrigation, these are;

i. Yakubu Gowon dam: This supplies Jos city at 90 cubic meters per day.
ii. Lamingo (liberty) dam: This supplies Jos East Local government at 45 cubic meters per day.
iii. Yelwa-Bukuru dam: This supplies Jos South Local Government area at 45 cubic meters per day.
iv. Pankshin dam: This is supplying Plateau central at 40 cubic meters per day.
v. Langtantang dam: This is supplying upper plateau at 30 cubic meters per day. The distribution is illustrated in table 3.1 below:

Table 3.1: Functional Dams in Plateau State

Name of Dam	Location	Distribution Area	Actual Capacity	Utilization	Reserve Volume
Yakubu Gowon	Jos Metropolis	Jos Metropolis	90 cubic meters per day	50 cubic meters per day	40 cubic meters
Lamingo (Liberty)	Jos east	Jos East	45 cubic meters per day	30 cubic meters per day	15 cubic meters
Yelwa-Bukuru	Jos south	Jos South	45 cubic meters per day	40 cubic meters per day	5 cubic meter
Pankshin	Pankshin	Plateau central	40 cubic meters per day	20 cubic meters per day	20 cubic meters
Langtang	Langtang	Upper Plateau	30 cubic meters per day	25 cubic meters per day	5 cubic meters

Source: Plateau State Water Board, 2014

Traditional means of water supply is through direct abstraction from streams, rivers, springs and shallow wells. The most popular water supply technology is the shallow wells with or without concrete lining. Many of the wells are known to dry up in the dry season forcing the users to seek alternative means of supply and in some cases to travel long distances to obtain water of doubtful quality from any available surface source including streams and ponds or abandoned mining pits. These shallow wells are used as secondary source where PSWB supplies water and primary source if the Board has no pipe lines in the area.

Historically, water supply has been seen as a Government responsibility to the people and many consumers have become used to the concept of getting government water supply for free. It is encouraging to note that nowadays according to survey, many consumers in Plateau State are prepared to pay for better water supply services from PSWB than any other source. In most areas where shortfalls do exist, the water supplies are supplemented by private wells and vendors. These Small Scale private sectors of Water resellers play an important role in distributing water to certain areas with few pipes; they source the water from PSWB and independent suppliers.

The move towards more integrated demand and supply approach takes a great deal of time, efforts and commitments and it is currently backed by players at many levels in the

institutional and political spectra (Whittington, 2009). Demand management approach place more emphasis on social and economic uses to which water is put. Demand management offers the prospect of improved water management in comparison to the supply approach. Beside efficiency, demand management promotes equity and environmental sustainability. Demand management is another approach to water resource management that contrast with the traditional supply approach which is aimed at increasing supply. This implies that the demand management approach targets water users than the supply of water to achieve more desirable allocation and sustainable use of water.

3.2 Empirical Framework

In analyzing factors that influences household demand for water in Jos metropolis of Plateau State, this study adapts the methodological approach of DessalegnChanie 2012 with little modification. The DessalegnChanie model used variables like expenditure, sex composition, and age of household heads, house type and price of water. In addition, this study employed the use of descriptive statistics, such as tables and percentages, to state and explains relationships of the variables used.

3.3 Analytical techniques

Crosstab statistics was used to explain the relationship that exists between socioeconomic characteristics of the sampled households and water demand in the study area. Among these include examining the relationship between occupation, income, formal educational level of the sampled household head and sources of water, type to pipe connection, distance etc.

The multiple regression analysis was also used in analyzing factors affecting households demand for water. The choice for this technique is justified on the ground that most of the models that were employed in residential water demand study both in developed and

developing countries employed this technique.. They typically use the form Q=f (P, Z) where P is the price variable and Z are factors or a range of shifters of demand such as socioeconomic characteristics, household demographics and other characteristics such as weather variables, etc. (Arbues, 2000). This study incorporate some variables like distance and source of water use as seen in 3.4.

3.4. Model Specification

The regression model has been employed to analyzed factors influencing household demand for water in the study area. As adapted from Arbues (2000) and Hikma (2012), water demand can be expressed as;

q=f(p,z),……(3.1)

where p is the price variable and z are other factors or range of shifters of demand such as income, household demographic and other characteristics like the weather variables etc. In countries where complete data set of residential water uses are unavailable from water supply offices, a cross sectional data that are collected for sample over individual households at a point in time can be used for estimating water demand of the household (Arbruse, 2003). For this particular study, the standard multiple regressions Model was used to analyze factors affecting households demand for water in plateau state. The multiple linear Regression Model is specified as:

Dw = f (P, I, Ag,SX, HHs, Dis, Ed, Oh,SW, Sv) ……. (3.2)

Equation (3.2) explains that demand for water (Dw) is a function of price of water, (P),monthly household income (I), age of a household head (Ag), sex composition in the family (Sx), Household size (HHs), distance from water source (Dis) ,educational status of a house hold head(Ed), house ownership status(Oh), The type of source of water (Sw) and seasonal variation.

For estimation purpose equation (3.2) can be expressed in stochastic form as;

$Dw=b_o+b_1P+b_2I+b_3Sx+b_4HHs+b_5Dis+b_6Ed+b_7Oh+U$…… (3.3)

Where b_o is the constant term

Bi = regression parameters (i=1……10)

U-error term

3.4. Apriori Expectations

Given the nature of the model specified and the variables chosen, it is expected that;

I. HHs (household size); demand for water is expected to increase with an increase in the household size; therefore, a positive sign is expected.

II. I (monthly income); monthly income of household; Households with higher income have greater ability to pay and have more water consumption. As a result, a positive sign is expected.

III. ED (level of education); generally, the higher the educational level of the head of a family, the higher the awareness about the benefits that could be gained from water. And hence educated household heads have preference for higher water consumption. So a positive sign is expected.

IV. OH (House Ownership); ownership of a house, the estimation of household wealth is difficult. However, ownership of a house is used as a proxy to the wealth of a household. The rational for wealth is similar to that of income. A positive sign is expected.

V. AG**;** age of household members; it is assumed that as people gets older, their per capital daily water consumption declines, so a negative sign is expected.

VI. Dis; distance from water source; It is known that as the distance from the water source increases, the water consumption of a household declines. So a negative sign is expected.

3.5. Sources of Data Collection

This study uses the two main sources of data; this implies the primary and secondary sources of data. Secondary data sources include data on water costs; water demand, water prices, and revenue are collected from the PSWB.

The primary data were collected through the use of a structured questionnaire which incorporates questions pertaining socio-economic and demographic aspects, source of water use; purposes/pattern of water usage; amount of water consumption of household etc., the questionnaire was administered between the months of June to September, 2014.

3.6. SAMPLING DESIGN AND DETERMINATION OF SAMPLE SIZE

The targeted respondents of the study comprises of domestic users of water. A total number of 250 questionnaires were administered. Determination of an adequate sample size can be controversial for statisticians and researchers, Pallant (2010), suggests that a sample size of greater than 150 will address analyses problems arising from a too small sample. With small samples, it is possible to obtain a result that does not generalize to other samples, in which case they have limited scientific value.

This study is a field survey study and the use of structured questioners was employed. The city was divided into three zones which informed the study to structure this survey into three groups using stratified sampling techniques to ascertain the earnings of the households. The groups are; high income earners, medium income earners and low income earners. The benchmark for the use of the low income is the present minimum wage of ₦18,000 in Nigeria.

CHAPTER FOUR

PRESENTATION AND DISCUSSION OF RESULTS

4.1 Introduction

This chapter presents the analysis and interpretation of the data collected during the fieldwork. The analysis of the report is divided into sections. The first section deals with the socio economic characteristics of the respondents in the study area. The second section handles the socioeconomic characteristics of households in relation to the consumption pattern and demand for water. The third section deals with factors that affect residential water demand in Jos and the last part deals with the major problems related to household water use in the city.

Two hundred and fifty (250) households were selected using stratified method of sampling, out of which, two hundred and eight (208) households responded to the questionnaires and about forty two (42) questionnaires were not retrieved, given a response rate of 83.2%. Thus, the analysis of the result is based on the retrieved number of questionnaires, and the variables of interest are based on the objectives of the study.

4.2 Socioeconomic Characteristics of the Respondents

Table 4.1 presents the socioeconomic characteristics of the sampled households. These include sex, age, marital status, educational level, household size, occupation, and income.

Table 4.1: Socioeconomic Characteristics

Sex of Respondents	frequency	percentage
Male	125	60.1
Female	77	37
No response	6	2.9
Total	**208**	**100**
Ages of respondents		
15 - 20 years	19	9.1
21 - 30 years	113	54.3
31 - 40 years	40	19.2
41 - 50 years	18	8.6
51 years and above	3	1.4
No response	15	7.2
Total	**208**	**100**
Variable	**Frequency**	**Percentage**
Marital status		
Married	76	36.5
Single	109	52.4
Divorce	16	7.7
No response	7	3.4
Total	**208**	**100**
Educational status		
Primary Education	3	1.4
Secondary Education	36	17.3
tertiary Education	157	75.5
No response	12	5.8
Total	**208**	**100**
Variable	**Frequency**	**Percentage**
Household size		
Two	49	23.6
Three	39	18.8
Four	25	12
Five	19	9.1
Six	12	5.8
Seven	7	3.4
Eight	3	1.4
Ten and above	2	1
no response	51	24.5
Total	208	100
Occupation		
Civil servant	66	31.7
Farmer	8	3.8
Business	23	11.1
House wife	10	4.8
Student	94	45.2
No response	7	3.4
Total	**208**	**100**
Monthly Income		
5000-35000	51	24.5
36000-66000	43	20.7

67000-and above	33	15.9
no response	81	38.9
Total	208	100

Source: Field survey, 2014

In table 4.1, out of the 208 water users that responded to the questionnaire, 60.1 % are male headed while 37.0% are female headed, and the rest 2.9% did not respond to the question. In relation to the ages of the respondents, 9.1% were between 15 and 20 years, 34.1% were between 21 and 25 years and 20.2% were between 26 and 30 years. Also, 11.5% were between 31 and 35 years while 7.7% were between 36 and 40 years and 4.3% were between 36 and 40 years. The study also indicated that 4.3% of the respondents were between 41 and 46 years and 46 and 50 years respectively and 1.4% were 51 years and above.

The marital status indicated that 36.5% of the respondents were married while 52.4% were single. Also, 7.7% were divorcees. With regards to educational qualification, majority of the sampled population were educated as 75.5% of the respondents had attended tertiary education and 17.3% had obtained secondary education while 1.4% had attained primary education.

In relation to Household size, 8.7% of the respondents had three members while 5.3% indicated that the house hold consisted of four members. The sample also indicated that 6.3% of the families had five members while 2.9% were harbouring six, 3.4% had seven members while 1.4% had ten and above members . 20.2% did not respond to the question.

Even though 38.9% of the respondents gave no response in relation to their income as shown in Table 4.1, 24.5% were earning between ₦ 5,000 and ₦35,000 while 20.7% were earning between ₦36,000 and ₦66,000 and 15.9% were on a monthly income valued above ₦67,000. This therefore implies that, most of the sampled respondents are married and are within the active age of child bearing, meaning that, they demand more water for domestic activities. Also, most of the sampled respondents are within the low income and middle income group. These are the group of people who sort water from other means and do more of illicit

connection anytime the need arise just to have water for their personal use. High price implies low demand of water due to their income level to the lower and middle income group, while increase in the price of water do not really affect the high income group.

4.2.2. Cross tabulation analysis of socioeconomic characteristics and water demand

Knowing the relationship that exists between variables used in this study is paramount in identifying which of the variables significantly influence demand for water in the study area. To achieve this therefore, the use of Crosstab statistics was employed. The Crosstab statistics show the linear association between two or more variables. The variables that were crosstab are: Occupation and type of pipe water, monthly income and distance of water source from home, level of education and water source, demand for water and distance of water source from home.

(a) Occupation and sources of water

Table 4.1.1 looks at the correlation that exists between occupation and various sources of water. The occupations that this study considered are: civil servants, farmers, business owners, housewives and students, while the sources of water include; private taps, public pipes/boreholes, public taps/boreholes and wells.

Table 4.1.1: Occupation * Source of water Crosstabulation

		Source of water						Total
		Private tap	Public tap/bore hole	Well	public tap/bore hole and well	All	No response	
Civil servant	Count	18	21	5	11	8	3	66
	% within Occupation	37.3%	31.8%	7.6%	16.7%	12.1%	4.5%	100.0%
	% within Source of water	34.6%	28.4%	16.1%	52.4%	47.1%	23.1%	31.7%
	% of Total	8.7%	10.1%	2.4%	5.3%	3.8%	1.4%	31.7%
Farmer	Count	3	2	2	1	0	0	8
	% within Occupation	37.5%	25.0%	25.0%	12.5%	0.0%	0.0%	100.0%
	% within Source of water	5.8%	2.7%	6.5%	4.8%	0.0%	0.0%	3.8%
	% of Total	1.4%	1.0%	1.0%	0.5%	0.0%	0.0%	3.8%
Business	Count	4	9	3	2	4	1	23
	% within Occupation	17.4%	39.1%	13.0%	8.7%	17.4%	4.3%	100.0%
	% within Source of water	7.7%	12.2%	9.7%	9.5%	23.5%	7.7%	11.1%
	% of Total	1.9%	4.3%	1.4%	1.0%	1.9%	0.5%	11.1%
House wife	Count	2	5	0	0	3	0	10
	% within Occupation	20.0%	50.0%	0.0%	0.0%	30.0%	0.0%	100.0%
	% within Source of water	3.8%	6.8%	0.0%	0.0%	17.6%	0.0%	4.8%
	% of Total	1.0%	2.4%	0.0%	0.0%	1.4%	0.0%	4.8%
Student	Count	24	37	20	7	2	4	94
	% within Occupation	25.5%	39.4%	21.3%	7.4%	2.1%	4.3%	100.0%
	% within Source of water	46.2%	50.0%	64.5%	33.3%	11.8%	30.8%	45.2%
	% of Total	11.5%	17.8%	9.6%	3.4%	1.0%	1.9%	45.2%
No response	Count	1	0	1	0	0	5	7
	% within Occupation	14.3%	0.0%	14.3%	0.0%	0.0%	71.4%	100.0%
	% within Source of water	1.9%	0.0%	3.2%	0.0%	0.0%	38.5%	3.4%
	% of Total	0.5%	0.0%	0.5%	0.0%	0.0%	2.4%	3.4%
Total	Count	52	74	31	21	17	13	208
	% within Occupation	25.0%	35.6%	14.9%	10.1%	8.2%	6.2%	100.0%
	% within Source of water	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	25.0%	35.6%	14.9%	10.1%	8.2%	6.2%	100.0%

Source: computer printout, 2015.

The result in table 4.1.1 showed that, 37% of civil servants get their water from private connection, 31% from public tap, 7.6% from wells and 16% from public tap/wells and

boreholes. It is also seen that 27% of farmers gets their water from private connection and, 25% from public taps, 25% from wells and 12% from public taps/wells and boreholes. 17% of business owners get their water from private connection, 39% from public taps, and 13% from wells while 8.7% gets their water from public tap/well and boreholes. For housewives, 20% and 50% gets their water from private connection and public taps respectively. For students, 25%, 39%, 21% and 7.4% gets their water from private connection, public taps, wells, public taps/wells/boreholes respectively.

The highest percentage of respondents with private connections are the civil servants (37%), this is because; their level of income permits them to have the comfort of a private connection in their compound. However, the largest percentage of those who use wells are farmers (25%) and this has great health implication. Those whose wells are close to a toilet sock away are prone to diseases like hepatitis, cholera, typhoid etc. which is dangerous and is the case in the study area especially during dry season when there is severe scarcity of water.

Surprisingly, students who earn no income are connected to a private tap. This is partly due to the fact that, their parents are well to do, so therefore, the parents provide for them the comfort of renting apartment with basic amenities like water and electricity needed to allow them concentrate on their studies.

b) occupation and kind of water services

Table 4.1.2 showed the relation that exists between occupation and the kind of water services. The occupations that this study considered are: civil servants, farmers, business owners, housewives and students, while the kind of pipe services include: tap inside the house, tap inside the compound, tap water from vendors, public/boreholes.

Table 4.1.2:Occupation * Kind of pipe water service Crosstabulation

Occupation		Kind of pipe water service						Total
		Tap inside the house	Tap inside the compound	Tap water from vendors	Public stand pipe/bore hole	one and four	No response	
Civil servant	Count	23	17	1	17	2	6	66
	% within Occupation	34.8%	25.8%	1.5%	25.8%	3.0%	9.1%	100.0%
	% within Kind of pipe water service	34.8%	32.7%	9.1%	33.3%	50.0%	25.0%	31.7%
	% of Total	11.1%	8.2%	0.5%	8.2%	1.0%	2.9%	31.7%
Farmer	Count	1	2	1	4	0	0	8
	% within Occupation	12.5%	25.0%	12.5%	50.0%	0.0%	0.0%	100.0%
	% within Kind of pipe water service	1.5%	3.8%	9.1%	7.8%	0.0%	0.0%	3.8%
	% of Total	0.5%	1.0%	0.5%	1.9%	0.0%	0.0%	3.8%
Business	Count	11	4	2	4	0	2	23
	% within Occupation	47.8%	17.4%	8.7%	17.4%	0.0%	8.7%	100.0%
	% within Kind of pipe water service	16.7%	7.7%	18.2%	7.8%	0.0%	8.3%	11.1%
	% of Total	5.3%	1.9%	1.0%	1.9%	0.0%	1.0%	11.1%
House wife	Count	2	3	0	5	0	0	10
	% within Occupation	20.0%	30.0%	0.0%	50.0%	0.0%	0.0%	100.0%
	% within Kind of pipe water service	3.0%	5.8%	0.0%	9.8%	0.0%	0.0%	4.8%
	% of Total	1.0%	1.4%	0.0%	2.4%	0.0%	0.0%	4.8%
Student	Count	29	25	7	21	2	10	94
	% within Occupation	30.9%	26.6%	7.4%	22.3%	2.1%	10.6%	100.0%

	% within Kind of pipe water service	43.9%	48.1%	63.6%	41.2%	50.0%	41.7%	45.2%
	% of Total	13.9%	12.0%	3.4%	10.1%	1.0%	4.8%	45.2%
	Count	0	1	0	0	0	6	7
	% within Occupation	0.0%	14.3%	0.0%	0.0%	0.0%	85.7%	100.0%
No response	% within Kind of pipe water service	0.0%	1.9%	0.0%	0.0%	0.0%	25.0%	3.4%
	% of Total	0.0%	0.5%	0.0%	0.0%	0.0%	2.9%	3.4%
	Count	66	52	11	51	4	24	208
	% within Occupation	31.7%	25.0%	5.3%	24.5%	1.9%	11.5%	100.0%
Total	% within Kind of pipe water service	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	31.7%	25.0%	5.3%	24.5%	1.9%	11.5%	100.0%

Source: computer printout 2015.

Occupation determines the kind of pipe connection of the respondents as shown in table 4.1.2. Given the option in the kind of pipe water service in the study area, civil servants were more likely to be connected with private taps in their homes (47.8%), while 25.8% made use of taps in the compound of the house. However, 25.8% of civil servant compliments this water services source with public stand/boreholes. Also, 12.5% of farmers are connected to private taps inside their houses while 50% are more connected to public pipes/boreholes and 25% compliment their water source with taps inside the compound. The highest percentages of people with taps inside the house are the civil servants (47.8%). This is due to the fact that most of the civil servants own the house they are currently living in, and for this reason, they desire all the comfort needed to have a private connection inside their houses. Business owners, students, housewives and farmers have 34.8%, 30.9%, 20.0% and 12.5% respectively. the farmers are the lowest in this category, this is because, the farmers are not large scale farmers, they produce in a subsistence level, majorly for consumption and little percentage for sale, therefore, the level of income they derive from their occupation is low. Most students prefer to rent apartment where there is adequate water supply and electricity

regardless of the cost of the rent, hence, the reasons why students also have high percentage of pipe connection inside the house.

a) Occupation and Distance of water source from Home.

Table 4.1.3 showed the relationship that exists between occupation and distance of water source from home. The occupations that this study considered are: civil servants, farmers, business owners, housewives and students, while the distance of water source was from 1-5 miles, 6-10 miles, 11-15 miles 16-20 miles and 21 mile and above

Table 4.1.3: Occupation * Distance of water source from home Crosstabulation

Occupation		Distance of water source from home							Total
		1-5 miles	6-10 miles	11-15 miles	16 -20 miles	21 and above	no response	200.00	
Civil servant	Count	51	11	2	2	0	0	0	66
	% within Occupation	78.4%	16.7%	3%	3.0%	0.0%	0.0%	0.0%	100.0%
	% within Distance of water source from home	24.8%	20.8%	71.1%	28.6%	0.0%	0.0%	0.0%	31.7%
	% of Total	12.5%	5.3%	13.0%	1.0%	0.0%	0.0%	0.0%	31.7%
Farmer	Count	4	2	0	1	0	0	1	8
	% within Occupation	50.0%	25.0%	0.0%	12.5%	0.0%	0.0%	12.5%	100.0%
	% within Distance of water source from home	3.8%	3.8%	0.0%	14.3%	0.0%	0.0%	100.0%	3.8%
	% of Total	1.9%	1.0%	0.0%	0.5%	0.0%	0.0%	0.5%	3.8%
Business	Count	16	6	1	0	0	0	0	23
	% within Occupation	69.6%	26.1%	4.3%	0.0%	0.0%	0.0%	0.0%	100.0%
	% within Distance of water source from home	15.2%	11.3%	2.6%	0.0%	0.0%	0.0%	0.0%	11.1%
	% of Total	7.7%	2.9%	0.5%	0.0%	0.0%	0.0%	0.0%	11.1%
House wife	Count	6	2	1	0	1	0	0	10
	% within Occupation	60.0%	20.0%	10.0%	0.0%	10.0%	0.0%	0.0%	100.0%
	% within Distance of water source from home	5.7%	3.8%	2.6%	0.0%	50.0%	0.0%	0.0%	4.8%
	% of Total	2.9%	1.0%	0.5%	0.0%	0.5%	0.0%	0.0%	4.8%
Student	Count	47	32	9	4	1	1	0	94
	% within Occupation	50.0%	34.0%	9.6%	4.3%	1.1%	1.1%	0.0%	100.0%
	% within Distance of water source from home	44.8%	60.4%	23.7%	57.1%	50.0%	50.0%	0.0%	45.2%
	% of Total	22.6%	15.4%	4.3%	1.9%	0.5%	0.5%	0.0%	45.2%
No response	Count	6	0	0	0	0	1	0	7
	% within Occupation	85.7%	0.0%	0.0%	0.0%	0.0%	14.3%	0.0%	100.0%
	% within Distance of water source from home	5.7%	0.0%	0.0%	0.0%	0.0%	50.0%	0.0%	3.4%
	% of Total	2.9%	0.0%	0.0%	0.0%	0.0%	0.5%	0.0%	3.4%
Total	Count	105	53	38	7	2	2	1	208
	% within Occupation	50.5%	25.5%	18.3%	3.4%	1.0%	1.0%	0.5%	100.0%
	% within Distance of water source from home	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	50.5%	25.5%	18.3%	3.4%	1.0%	1.0%	0.5%	100.0%

Source: computer printout 2015

Table 4.1.3 looks at the correlation that exists between occupation and distance of water source from home. It is clear from the table that, 78% of civil servants have less distance of about 1-5 miles followed by 60% of housewives, 69% business owners, and then 39% of farmers and the rest no response. Those with the longest miles of 11-15 are the farmers with 12%, housewives with 10%, students with 9%, and business owners with 4% and civil servants with 3%. This by implication shows that, civil servants trek less distance to get water compare to farmers, housewives, business owners and students, and this can be traced to their level of income. The higher the level of income, the less the distance of water source from home. This implies that a better occupation provides the comfort of water source close to the home or residents.

b) monthly income and source of water

Table 4.1.4 showed the relationship that exists between monthly income and source of water. The sources of water are private tap, public/borehole, wells, and public/borehole/wells, while monthly income is divided into three. From ₦ 5,000 - ₦ 35,000, ₦ 36,000 - ₦ 66,000, and ₦ 67,000 and above.

Table 4.1.4: Monthly income * Source of water Crosstabulation

Monthly income		Source of water						Total
		Private tap	Public tap/borehole	Well	public tap/borehole and well	All	No response	
5000-35000	Count	12	20	10	6	1	2	51
	% within Monthly income	23.5%	39.2%	19.6%	11.8%	2.0%	3.9%	100.0%
	% within Source of water	23.1%	27.0%	32.3%	28.6%	5.9%	15.4%	24.5%
	% of Total	5.8%	9.6%	4.8%	2.9%	0.5%	1.0%	24.5%
36000-66000	Count	9	15	2	5	7	5	43
	% within Monthly income	20.9%	34.9%	4.7%	11.6%	16.3%	11.6%	100.0%
	% within Source of water	17.3%	20.3%	6.5%	23.8%	41.2%	38.5%	20.7%
	% of Total	4.3%	7.2%	1.0%	2.4%	3.4%	2.4%	20.7%
67000-and above	Count	11	10	3	2	4	3	33
	% within Monthly income	33.3%	30.3%	9.1%	6.1%	12.1%	9.1%	100.0%
	% within Source of water	21.2%	13.5%	9.7%	9.5%	23.5%	23.1%	15.9%
	% of Total	5.3%	4.8%	1.4%	1.0%	1.9%	1.4%	15.9%
no response	Count	20	29	16	8	5	3	81
	% within Monthly income	24.7%	35.8%	19.8%	9.9%	6.2%	3.7%	100.0%
	% within Source of water	38.5%	39.2%	51.6%	38.1%	29.4%	23.1%	38.9%
	% of Total	9.6%	13.9%	7.7%	3.8%	2.4%	1.4%	38.9%
Total	Count	52	74	31	21	17	13	208
	% within Monthly income	25.0%	35.6%	14.9%	10.1%	8.2%	6.2%	100.0%
	% within Source of water	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	25.0%	35.6%	14.9%	10.1%	8.2%	6.2%	100.0%

Source: computer printout 2015

Also, as seen in the table 4.1.4, it is clear that income status is a major determinant of source of water by the respondents. People with high income choose their source from a private tap connection compare to people with lower income. From the table, 33.3% of the respondents

that earned income of 67,000 and above have private connection, while 23.9% and 20.5% (of people that have private connections) earned 36000-66000 and 5000-35000 respectively. This analysis is needed in demand and supply framework so that we will know if the price of water determines its demand and supply and even the source of water.

4.3. Analysis of determinants of household water demand

This section basically considers factors that influences household demand for water in Jos, therefore, the factors that this study considered are; monthly income of the respondents, price of water, distance of water source from home, household size, educational level of household heads and house ownership. To achieve one of the objectives of this study, regression analysis was employed.

Table 4.2: Regression result of factors influencing households demand for water

Variables	coefficient	Std. Error	t	Sig
(Constant)	1.899	1.091	1.741	0.033
Price per unit OK	-0.70858	0.264	-2.684	0.0358
Monthly income	0.342774	0.139	2.466	0.0541
Educational Status	0.83	0.332	2.5	0.0442
House hold size Dependent(s)	0.14121	0.054	2.615	0.0539
Distance of water source from home	-0.01512	0.012	-1.26	0.409
House ownership	0.84035	0.343	2.45	0.0242

Source: computer printout, 2015.

The regression results on table 4.2 shows the measurement of the magnitudes and directions of the selected factors influencing water demand in the study area. All the coefficients are significant in explaining water demand in the study area.

4.3.1 Price

In table 4.2, a 1% increase in price reduced water demand by 70%, and this is significant at 5%. As the price of water increases, people seek alternatives like wells, streams, etc. the findings on the relationship between demand for water and price of water confirmed the theoretical framework of law of demand and substitution effect of alternative goods that are close substitute

One of the major factors that influences quantity of goods demanded in economics is the price. According to the law of demand, which state that: all things being equal, the higher the price, the lower the quantity demanded and vice versa. Water in this case is not an exception to this fact, since there are various alternatives to water source in the study area.

4.3.2Monthly Income

From the regression result in table 4.2, income of households is positively and statistically significant in explaining demand for water in the study area. A 1% increase in income increases water demand by 34%, and this is significant at 5%

Monthly income is another independent variable, which affects demand for water. Generally, the living standard and income level of the people are directly related everywhere. People with higher income are in a better position to satisfy their basic needs than low-income groups. The high income group can afford to allocate a relatively larger amount of their income for water than the lower income group. Households with higher monthly expenditure are more likely to obtain water primarily from private pipes. This is probably due to the fact that better-off households are likely to be able to pay the service and connection charges required in advance by PSWB.

4.3.3 Education

In table 4.2, the coefficient for Educational level is positive and statistically significant in determining water demand at 5%. A one per cent increase in education leads to 0.83%

increase in demand for water.

It is assumed that, the educational status of the households will affect their decision of having private piped connections. This could be related with better job opportunities, resulting to a high income of educated people, and better awareness and understanding of educated household heads on the positive returns in improved health and sanitation associated with piped water and the need for various retrofits in the households. Examples of such retrofits include; flush toilet, shower heads and connections of pipe through sinks in the kitchen.By conclusion, we say that education and demand for water are positively related.

4.3.4 Household size

From table 4.2, household size is positively and statistically significant in determining household demand for water in the study area. A 1% increase in household size will trigger water demand by 14%.It is assumed that households with more people are expected to use more water, especially families who have more children. This is because, children require frequent sanitation, and outdoor uses by children and teenagers might be higher. The more the household size, the more the demand for water.

4.3.5: Distance

From the result in table 4.2, distance is negative and significant in determining water demand. This implies that, a 1% increase in distance reduces water demand by 1.5%, and this is significant at 5%.

One of the factors, which affect the use of water within each household, is the physical distance of housing units from the water point. It is widely known that distance involves in fetching water is inversely related to per capital consumption of water. Long distance involves considerable energy and time expenditure, which limits the frequency of fetching water, thereby, reducing the per capital daily water consumption.

4.3.6: House Ownership

From the result in table 4.2, it is clear that house ownership positively and significantly influence demand for water in the study area seeing that a 1% increase in house ownership increases water demand by 84%, and this is significant at 5%.

Households who own the house they are currently living in are more likely to obtain water from taps in their residence because of the comfort and benefits associated with water source close to a residence. Whereas households who do not own the house they are living in are uncertain about their future which doesn't encourage them to have private pipes by themselves unless the owners have connections before they rented it out.

4.4: Challenges of demand for water in the study area

Household demand for water comes with a lot of challenges as observed from the field survey. Almost all of the household surveyed (75.5 %) used piped water as their main source of water for domestic purposes, and the rest 25% are obtained from other sources like wells, streams, rivers etc. Sources of piped water in the survey area include private tap in house and in compound, tap water from vendor and public tap.

Table 4.3: Why using other sources of water?

Variable	Frequency	Percentage
High cost of water	57	27.4
Distance of pipe water from home	54	26.0
Lack of access to tap water	33	15.9
Interruption of tap water supply	47	22.6
No response	17	8.2
Total	**208**	**100.0**

Source: Field survey 2014

Problems related to household water supply system are numerous and they vary from one urban center to the other. But in general, according to this study, the main challenge of water

demand in the study area are high cost of water, distance of pipe water from home, lack of access to tap water, interruption of tap water supply.

The reasons advanced by the consumers for using sources other than piped water were that the cost of pipe water was high (27.4%). Some (26%) said the distance of pipe water from homes is relatively far off. Also, 15.9% complained that they lack access to tap water while 22.6% observed that constant interruption of tap water supply by the water board is a major cause as seen in table 4.3.

Table 4.5: Purpose of using water at home

Variable	Frequency	Percentage
Cooking and bathing	16	7.7
Cleaning and flushing toilet	5	2.4
Washing cloths and drinking	9	4.3
All of the above	165	79.3
No response	13	6.3
Total	**208**	**100.0**

Source: Field survey 2014

In Table 4.4, Majority of the respondents (79.3%) use water for cooking, bathing, cleaning, flushing toilet, washing cloths and drinking. However, only 7.7% used water for only cooking and bathing, this is probably due to the fact that they consume sachet/bottle water for drinking and they used more of pit-toilets than modern toilet system. 2.4% used water for cleaning and flushing toilets while about 4.3% used water for washing cloths and drinking.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

An improved and sufficient water supply service is important for economic development, and its existence enables healthy and productive population that has a great role in increasing the productivity of the economy. This study therefore investigated the determinants of water demand in Jos. In order to carry out this, a field survey was carried out in the city. The city was divided into three senatorial zones which are; north, east and south, after which 250 questionnaires was administered to Kabong ward, using stratify sampling technique. The sample respondents were divided into three groups of income earners; high income earners, medium income earners and low income earners.

The factors that were hypothesized to affect household water demand were: income of household heads, price of water, educational level of household heads, and distance of water from home, family size, and house ownership. Data were collected and analyzed using SPSS.

Out of the 208 water users that responded to the questionnaire, majority are male headed. In relation to the ages of the respondents, most of the respondents were between ages21 and 30years.

The marital status indicated that majority of the respondents are married. With regards to educational qualification, majority of the sampled population were educated as 75.5% of the respondents had attended tertiary education.

In relation to Household size, most of the respondents have dependents of more than five people in their houses.

Majority of the respondents are low income earners followed by medium income earners and high income earners.

The cross tab result showed that, civil servants get their water from private. Majority of farmers trek more distance to get water than any other occupation and more of civil servants trek less miles to get water

People with high income choose their source of water from a private tap connection compare to people with lower income.

The regression analysis indicated that the variables used, (education, family size, income, price, distance and house ownership) are statistically significant to affect the per capita daily water consumption of households in the study area.

5.2 CONCLUSION

Water is vital for life and a major asset for development anywhere. Understanding factors that affect household water demand is important for a variety of planning purposes in water supply sectors, as result of a shift in the orientation of household water management from the supply driven to demand driven approach. The study examined the different factors that affect water demand of households in Jos metropolis of plateau State.

From among the variables that were hypothesized to significantly affect HHs likelihood of piped water included; income, price, household size, educational level, seasonal variation, distance from source of water. Households with higher monthly income were more likely to obtain water primarily from private pipes. This is probably due to the fact that better-off HHs are likely to be able to pay the service and connection charges required in advance by PSWB. Similarly, educational status of the HH was also found to affect the decision of HHs to have private piped connections. This could be related with the better awareness and understanding of educated HHs on the positive returns in improved health and sanitation associated with piped water. The price of water also has a negative relationship with the demand for water. As the price of water increases, people resort to other means other than piped water regardless of the reliability of water. Also, as HHs size increases, there is need to demand

more water for domestic activities in the house. Similarly, during raining season, demand for water reduces compare to dry season and also, distance has a negative relationship with demand for water as seen in the results.

Monthly income was found to have a positive relation with demand for water in the study area, because family members of better-of HHs are more likely to have frequent bath and showering, frequent washing of clothes and more water for washing dishes and cooking water as compared to worse of HHs, taking in to consideration the HH lifestyles and sanitation preferences of better-off households. Housing ownership, educational status of the head, family size average age of family members and number of female members in the family did not have statistically significant effects on household water demand.

Comment [U1]: This still sounds like summary Conclusion should be based on your findings.

5.3 Recommendation

From the preceding chapters, it is clear that the yield of the water source and pipeline network is not enough to satisfy the needs of the community. This and related factors invite researchers on such topics and help to recommend ways and means of improving water demand management. Thus, the following measures should be taken in order to improve water consumption rate of Kabong community.

vi. The pricing policy that is practiced in the state (Flat rate), does not encourage water conservation but encourages wastage, hence, it is recommended that Water consumption should be metered so that consumers will only pay for what they consume. This would discourage wastage and some abnormalities from water users, and check the manner in which people use water.

vii. Also, findings from the study showed a low literacy level of households, thereby, there is high level water wastage, illicit pipeline connection, nonpayment of water bills and harassment of PSWB staffs, therefore, there should be strong public

awareness and orientation in the community on economic use of the available water resources.

viii. Public private partnership should be encouraged. This can bring about competition to boost supply, but should be monitored to avoid exploitation and unhealthy competition.

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APPENDICES

Appendix A: Income determine source of water

Variable	Frequency	Percentage
Yes	79	38.0
No	112	53.8
No response	17	8.2
Total	**208**	**100.0**

Extent to which income affect the demand for water

Variable	Frequency	Percentage
very high	9	4.3
high	33	15.9
moderate	10	4.8
not at all	34	16.3
No response	122	58.7
Total	**208**	**100.0**

Source: Field survey, 2014

Appendix B: House ownership

Variable	Frequency	Percentage
Rented	92	44.2
Personal house	93	44.7
family house	5	2.4
Free	6	2.9
No response	12	5.8
Total	**208**	**100.0**

House type

Variable	Frequency	Percentage
Single room	41	19.7
Room and pallor	43	20.7
Two bedroom flat	65	31.3
three bedroom flat	46	22.1
four bedroom flat	2	1.0
No response	11	5.3
Total	**208**	**100.0**

Source of water

Variable	Frequency	Percentage
Private tap	52	25.0
Public tap/borehole	74	35.6
Well	31	14.9
public tap/borehole and well	21	10.1
All	17	8.2
No response	13	6.3
Total	**208**	**100.0**

Kind of pipe water service

Variable	Frequency	Percentage
Tap inside the house	66	31.7
Tap inside the compound	52	25.0
Tap water from vendors	11	5.3
Public stand pipe/borehole	51	24.5
one and four	4	1.9
No response	24	11.5
Total	**208**	**100.0**

Possession of a private water tank

Variable	Frequency	Percentage
Yes	72	34.6
No	123	59.1
No response	13	6.3
Total	**208**	**100.0**

Capacity of Tank (in litters)

Variable	Frequency	Percentage
No response	147	70.7
100 - 500	9	4.4
600 - 1000	9	4.4
1500 - 2500	16	.7.8
3000 - 5000	17	8.2
6000 - 10000	4	1.9
11000 - 15000	4	1.9
18000	2	1.0
Total	**208**	**100.0**

Water using fixture

Variable	Frequency	Percentage
Yes	88	42.3
No	103	49.5
No response	17	8.2
Total	**208**	**100.0**
Type of water using fixture Variable	**Frequency**	**Percentage**
Bath showers	18	8.7
Flush toilet	20	9.6
Kitchen	40	19.2
All	24	11.5
No response	106	51.0
Total	**208**	**100.0**

Source: Field survey, 2014

Appendix C: Purpose of using water at home

Variable	Frequency	Percentage
Cooking and bathing	16	7.7
Cleaning and flushing toilet	5	2.4
Washing cloths and drinking	9	4.3
All of the above	165	79.3
No response	13	6.3
Total	**208**	**100.0**

Distance of water source from home (in meters)

Variable	Frequency	Percentage
No response	79	38.0
20- 500	38	18.3
700 - 1000	20	10.0
1500 - 2500	29	14
3000 - 5000	22	10.8
6000 - 10000	11	5.3
12000 and above	9	4.3
Total	**208**	**100.0**

Source of water out of State water board

Variable	Frequency	Percentage
Yes	108	51.9
No	68	32.7
No response	32	15.4
Total	**208**	**100.0**

Daily consumption rate for cooking (in litres)

Value	Frequency	Percentage
No response	52	26.0
2 - 10	50	25.0
11 - 30	56	28
35 - 70	34	17
75 - 100	9	4.5
101 and above	7	3.5
Total	**208**	**100.0**

Source: Field survey, 2014

Appendix D: Current water bill (in Naira)

Value	Frequency	Percentage
No response	111	53.4
100 - 500	12	5.7
600 - 1000	14	6.7
1100 - 1500	13	.6.2
1600 - 3000	30	14.4
3500 - 5000	15	7.2
5500 – 10,000	9	4.3
11000 and above	4	1.9
Total	**208**	**100.0**

Price per unit OK

Value	Frequency	Percentage
Yes	99	47.6
No	90	43.3
No response	19	9.1
Total	**208**	**100.0**

Charged even when tap does not flow?

Value	Frequency	Percentage
Yes	121	58.2
No	66	31.7
No response	21	10.1
Total	**208**	**100.0**

Comfortable with the flat rate water policy

Value	Frequency	Percentage
Yes	73	35.1
No	116	55.8
No response	19	9.1
Total	**208**	**100.0**

Prefer pay as you go

Value	Frequency	Percentage
Yes	121	58.2
No	69	33.2
No response	18	8.7
Total	**208**	**100.0**

Less demand for water during raining season

Value	Frequency	Percentage
Yes	147	70.7
No	42	20.2
No response	18	8.7
Total	**208**	**100.0**

Source: Field survey, 2014

APENDICE E: QUESTIONAIRE

AHMADU BELLO UNIVERSITY ZARIA

FACULTY OF SOCIAL SCIENCES

DEPARTMENT OF ECONOMICS

This questionnaire is prepared to gather information about factors determining household water demand in Jos, the city of plateau State, in partial fulfillment of Masters of Science in Economics, by Bitrus Deborah in A.B.U Zaria. I kindly request you to give the required information for this study. The information generated by using this questionnaire will be used only for academic purpose and all household level information will be confidential. Thank you for your cooperation.

SECTION A: HOUSEHOLD CHARACTERISTICS

1. Sex

(a) Male (b) Female

2. Age _____-

3. Marital status

(a) Married (b) unmarried (c) divorced (d) others, specify_____

4. Educational status

(a) Primary education. b) Secondary education (c) tertiary education (d) others specify

5. House hold size

a) Number of spouse (ses)._____
b) number of child (ren)_____
c) number of dependent(s) _____

SECTION B: INCOME AND HOUSEHOLD WATER USE

6. What is your Occupation? _____

7. What is your monthly income (in Naira) _____

Does your income determine the source of your water?

(a) Yes (b) No

10. To what extend does income influence your demand for water?

_____

8. House ownership status of a family

a) Rented from private owners

b) Personal own house

c) Others specify_____

9. House type

(a) single room,(b) a room and a Palou, (c) two bedrooms flat, (d) others specify _____

SECTION C: WATER DEMAND AND USE PATTERNS OF HOUSEHOLD

11. What is/are the sources of water for your household use? (More than one choice is possible)

(a) private tap connection (b) public tap/ borehole (c) well, (d) others specify _____

12. If you have access to private pipe, what kind of pipe water service do you use currently?

(a)Tap inside a house, private

(b) Tap inside a compound, private

(c) Tap water from private vendors

(d) Public stand pipe/borehole

(e) Others_____

13. Do you have a private water tank in your compound?

(a) Yes (b) no

14. If yes, what is the capacity? _____(in liter) ?

15. Do you have water using fixture?

a) Yes (b) no

16. If yes, which one? _____

b) (a) Bath showers,(b) flush toilet (c)kitchen with complete water supply service

d) Others specify,_____

17. For what purpose do you use water at home?

(a)cooking and bathing (b)cleaning and flushing toilet (c)washing cloths and drinking

(d) all of the above (e) others specify

_____

18. If you use source of water other than pipe, what is the main reason to do so?

(a) High price of water (b) physical distance of tap water point from your home

(c) Lack of access to tap water, (d) high interruption of tap water supply

(e) Others,_____

19. Mention the average distance at which your source of water is far from your home._____-_____.

SECTION D: PRICE OF WATER

Is your source of water from the state water board?

(a) Yes (b) No

22. What is your current water bill?_____

21. How much water did your household consume per day in liter? For cooking _____drinking _____Flushing toilets_____washing cloths_____ and cleaning_____ Total demand for water _____

23a. is the price charged per unit of water ok by you?

(a) Yes (b) No

23b. If no why?

_____

24a. Are you charged water rate based on the type of residence?

(a) Yes (b) No

24b. If Yes, how much are you charged per residence?

_____

25a. Are you charged water rate even when tap does not flow?

(a) Yes (b) No

25b. Are you charged below quantity of water consumed?

(a) Yes (b) No

26. Are you comfortable with the current flat rate water policy?

(b) Yes (b)No

27. Has the flat rate policy favors you in any way?

(a)Yes (b) No

28. Do you prefer Pay as you go (Water meter)?

(a)Yes (b) No

29. Does current water rates payment guarantees constant flow of water?

(a)Yes (b) no (c)not sure

30. Does price influence the quantity of water demanded?

(a)Yes, (b) No

SECTION E: SESONAL VARIATION AND HOUSEHOLD DEMAND FOR WATER

31. How does seasonal variation influence your demand for water?

_____

___

32. Do you collect rain water for domestic use?

33. Do you demand less water during raining season?

a) Yes, b) no

34. Kindly suggest how to ensure safe and sufficient water supply for households in the city of Jos?

_____