DETERMINANTS OF WATER ACCESSIBILITY IN KENYA

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DECLARATION

This research paper is my original work and has not been presented for award of a degree in any other university.

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This research paper has been submitted for examination with our approval as university supervisors

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DEDICATION

To my loving wife Frida Kanja and my three sons: Rawlings Ramogi, Leone Kiogora and Powel Lang'ni, my mother Rosemary Anyango and late father Joseph Ombok.

ABBREVIATIONS AND ACRONYMS

MDGs	Millenium Development Goals
WHO	World Health Organisation
NGOs	Non-Governmental Organizations
GWP	Global Water Partnership
ODI	Overseas Development Institute
WSP	Water Sanitation Programme
GOK	Government of Kenya
MTEF	Medium Term Expenditure Framework
CBOs	Community Based Organisations
WSRAF	Water and Sanitation Research in Africa
WSRS	Water Sanitation Reform Secretariat
WMS	Welfare Monitoring Survey
CBS	Central Bureau of Statistics
OLS	Ordinary Least Squares
ML	Maximum Likelihood
WBWDRT	World Bank Water Demand Research Team
Kshs	Kenya Shillings
US$	United States Dollar
USA	United States of America

ABSTRACT

The study examines the determinants of safe water accessibility in Kenya. Cross sectional data analysis technique is used with a sample of 41 districts for the year 2000. The safe water access model is estimated by the OLS method. Results show that safe water accessibility is explained by water infrastructure, distance to water source and water morbidity. The findings indicate that a 10% increase in water infrastructure results in a 10.1% increase in safe water access; a 1% decrease in time taken to fetch water results to a 0.017% increase in safe water access and; a 1% fall in water morbidity implies a 0.038% rise in safe water access. Strikingly, water tariff effect on safe water accessibility result was revealed to be insignificant. Therefore, to increase safe water accessibility, efforts must be made to deal with non-operational water infrastructure, non-maintained water infrastructure problems and water quality. Current efforts by the government and individual organizations to improve and construct new water infrastructure need to be encouraged.

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CHAPTER 1: INTRODUCTION

1.1 Background

The worlds' fresh water utility is threatening as consumption is almost twice that of its annual replenishment. The situation is exacerbated by industrial and population demands for water doubling every 20 years against rainfall and melt provision of 40-50,000 cubic kilometers of fresh water every year. (Hamnarskjold, 1999). According to the International Forum on Globalization, the situation is projected to worsen by 2025, with freshwater need outstripping the annual supply by 56 per cent. The condition is forecast to be chronic to almost a third of the worlds' population (1.8 billion people) mainly from Middle East, North Africa, South Asia and China. Currently, Odhiambo (2002) indicates that 20 poor countries of the world are already suffering chronic water scarcity. Of these poor countries, 9 are in Africa_ among them are three that belong to the Nile Basin Initiative: Burundi, Kenya and Rwanda.

The situation has compelled the world governments especially developing nations to take water stress[1] and absolute scarcity[2] seriously. Therefore actions ensuring water access to all has been defined by all the developing countries as one of the Millennium Development Goals target. Presently, global coverage for access to safe drinking water stands at 83 per cent. But for Sub-Saharan Africa the situation is grim. About 400 million more people need to gain access to improved water before 2015 for Sub-Saharan Africa to reach the MDGs target for water (WSP, 2003a). It is important to note that inadequate or lack of water access results in waterborne diseases, increase in morbidity and loss in productive time. In addition, poor environmental problems relating to lack of safe drinking water, hygienic sanitation and waste disposal systems resulting in waterborne diseases (typhoid, cholera etc) increasingly emerge (GoK, 2002; Arnell, 2000; Turton and Ohlsson, 1999). The World Health Organization (WHO) captures the effect by estimating that 80 per cent of all diseases and an annual total of approximately 25 million premature deaths in developing countries result from contaminated water (Vision 21, 2000).

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[1] Water scarcity is the annual water availability between 1000-1600m^3

[2] Absolute water scarcity is the annual water availability below 1000m^3

The other issue is the high rate of migration from rural to urban areas in developing countries which has greatly affected equitable distribution of water services. Water supply is inclined to urban areas than in rural areas. Though the argument for the imbalance is attributed to the high population density in the urban areas, the fact remains that majority of the population live in the rural areas (Mehta, 2000).

On water financing, the Camdessus Panel approximates that global investments required to meet the drinking water target stand at about US$13 billion per annum. But these figures underestimate the total requirements as they do not take into account wider sector management costs as well as operations and maintenance costs of existing capital stock. Furthermore, the Global Water Partnership (GWP) has suggested that US$180billion for all water uses, including agriculture is required annually to overcome the crisis of under-provision and poor water management in developing countries, of which US$30billion is for water and sanitation alone. This is over and above the existing expenditure of some US$75billion, and the current estimate of US$14billion spent annually on water and sanitation. In addition, US$9billion is required annually as additional costs borne by households and communities on basis of population projections (Vision 21, 2000; ODI, 2002).

On private investment in water and sanitation in developing countries, The World Bank note an estimate of US$25billion annually which is almost non-existent in South Asia and amounts to only US$0.25billion in Africa.(Hamnarskjold,1999). The two are the most critically resource poor areas. Only US$5billion is the amount spent by governments of developing countries in water and sanitation far below their current and increasing population requirement. Thus, a significant gap exists on under-expenditure in the provision of this commodity.

1.2 Water Sector Services Accessibility in Kenya

Though 64.2 per cent of Kenya population has access to basic minimum level water service, less than 30 per cent and 70 per cent of rural and urban population respectively has access. This level of coverage significantly discriminates upon rural areas to urban areas. Rural water access stands at an approximately 48.1% of rural population a level lower than urban water access of 94.1% of urban population. The central government, local government and NGO's provide water to 65.6%, 3.3% and 31.1% of rural population respectively. Thus, the highest water provider in the rural areas is the central government, followed by the NGO's and with the least provider being the local government. In urban areas, the central government, local government and NGO's provide 37.9%, 50.5% and 11.6% respectively. Hence, letting the local government be the highest provider, while the least being the NGO's.

Table 1.1: Level of Water access and provider shares (% of Serviced Population) in Kenya

		Share of served Population By type of WSP.........		
REGION	% of total population served	Central Government or central utility	Local Government or local utility	Non Governments (CBOs, PSSPs)
Urban	94.1	37.9	50.5	11.6
Rural	48.1	65.6	3.3	31.1
TOTAL	**64.2**	**51.4**	**27.6**	**21.1**

Source: WSP, (2003). Governance and Financing of Water Supply and Sanitation in Ethiopia, Kenya and South Africa: Across Country Synthesis.

Notwithstanding, in urban areas, large population living in informal settlements within the towns and cities have no access to safe drinking water. Besides, in rural areas, there are reports that levels of coverage has declined due to the collapsing of some large rural water schemes and operational problems experienced in others. For example, GoK(2002a) indicates that at present exist over 1,800 water supplies of which 1,000 are public operated schemes and rest run by NGO's, self help groups and communities. But out of 2,451 small dams and water pans (small dams 1,782 and water pans 669) in the country, only 48.3 per cent or 1,183 are effectively operational. In addition to, there exists about 9,000 boreholes which lack re-habilitation or need replacement. The other issue is that water access in Kenya has large rural geographic disparities. For example, less than 30 per cent of the poor in North Eastern and Eastern provinces have access to safe water compared to some 60 per cent in Western Kenya (GoK, 2000a; WSP, 2003b).

Embodied in the problem of water provision is declining public resources for investments in new water projects, operation and maintenance. It is reported that more of this problem is related to the issue of financial accountability. In addition, the sector also lacks a monitoring and evaluation department. Therefore, financing is not sustainable in the long-run especially with the government sector expenditure prioritized in the Medium Term Expenditure Framework (MTEF). For example, the total government development expenditure in water sub-sector in 2001/2002 was Kshs 1,343million and was expected to increase to Kshs 2,319million in 2002/2003(GoK, 2003); whereby Kshs822.5million for water supplies development and Kshs243.5million for rehabilitation of rural and urban water supplies. At this point, it is important to note that expenditure comprises three main components. First, increased access requires new infrastructure and rehabilitation of non functioning infrastructure. Secondly, adequate allowance must be made for operation and maintenance of new and existing infrastructure stocks. Finally, finances are required for sector development including activities such as capacity building in communities, policy formulation and standard setting, and sector monitoring and regulation. As already stated, it is clear that sustainable long term financing of the water sector is threatened and therefore is the access to water services. Currently more worrying is the pullout by the government from water service provision to policy formulation and regulation; leaving the private water providers. This leaves a huge financial gap in the sector which doubtedly can be filled by the private sector. The National government provides 45.3% of Sector expenditure compared to local government and NGO's which provide 23.7% and 31% of sector expenditure. The share of the expenditure on rural and urban area shows that the National government, local government and NGO's allocate 50.6%, 34.4% and 15% share of their sector expenditure to the urban supplies and; 38.5%, 9.9%, and 51.6% share of their sector expenditure to the rural supplies. It is clear then that rural supplies will greatly suffer from the government pull-out in water provision.

Table 1.2: Expenditure estimates for different levels and service providers in Kenya

Region	National Government + National Utility			Local Government + Local Utility			NGO			Total WSS
	National Government	Utility	Total	Local	Utility	Total	CBO's	PSSP's	Total	Expenditure
Urban	29.9%	20.7%	50.6%	29.0%	5.4%	34.4%	10.7%	4.3%	15.0%	56.2%
Rural	29.9%	9.4%	38.5%	8.8%	1.1%	9.9%	51.2%	0.4%	51.6%	43.8%
TOTAL	29.6%	15.8%	45.3%	20.1%	3.5%	23.7%	28.4%	26.0%	31.0%	100%

Source: WSRAF,(2003). Sector Finance and Resource Flows for Water Supply and Sanitation: A Pilot Application for Kenya.

Water access problem is further argued to be due to a steady rise in the population and the persistent cyclical droughts which have plagued the country in the past three decades. The impact of population increase is more evident in urban areas with a major problem of water scarcity. For example, Nairobi the capital city has a population 2.7million far beyond the 1.4million planned water provision. Engulfed is also the increasing epidemiological outbreaks related to waterborne diseases and child morbidity especially in the informal settlements (GoK, 2002; WSP, 2003a)

Withstanding, the situation in Kenya has been argued to be gravely contributed by the old legal and institutional framework that caused confusion in the water sector. The review of the government policy on water provision marked the governments' acceptance on water access being a serious problem; also re-affirmed her commitment to the goal for all Kenyans having access to water within a reasonable distance.

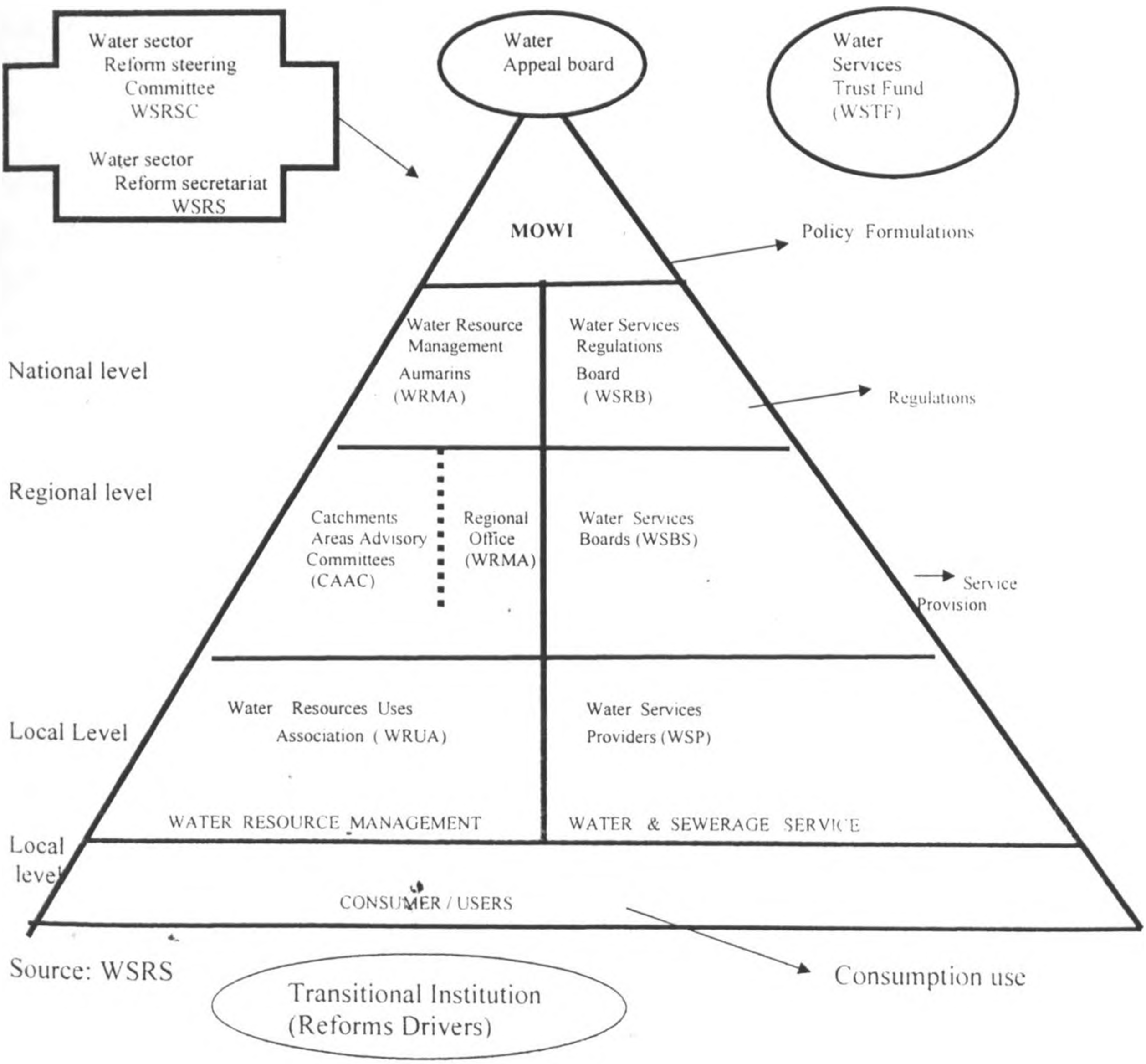
1.3 Legal and Policy Framework

The old legal and institutional framework CAP 372 of the laws of Kenya was ridden with lot of problems. The major difficulties leading to its dysfunctions include. First, the many legal provisions which are conflicting and therefore difficult to enforce; Secondly, the many different actors whose activities conflict and no mechanism for resolution; Thirdly, mixed roles of the ministry of water handling policy, regulation and service provision at the same time; Finally, the supply driven environment, with serious consequences on sustainability and efficiency of resource usage. With the drawbacks overwhelming the sector, a new water policy was formulated to reform the sector.

The Water Act 2002 replaced the old legal and institutional framework CAP 372. The main goal of the reform is restructuring the role of national sector institutions and regional or local service providers through the appropriate separation of policy, regulation and service delivery functions. The national government is restricting its role to policy formulation, sector coordination, supervision and guidance. The arrangements let the private sector as a major player in water provision. For the rural areas provision is left for the local authority under the policy of full cost recovery.

The major challenges facing the reform process are the transfer of funded programs and how the institutions are financed and run. Other teething problems are the emergence of cartels, increased water tariffs and the ability of the private sector to access low cost credit. Critical to the reform, is the capacity of the private sector to bridge the funding gap left by the government. (see table 1.2). Currently, the implementation is undergoing in five towns namely Nairobi, Kisumu, Nakuru, Eldoret and Meru a speed notably slow for whole country to be effectively covered. Withstanding, the impact of Nairobi Water Services Board (NWSB) licensed to provide water services in the capital city is already being felt compared to other towns. Otherwise the new policy is still being rolled out and other boards are in the process of being licensed for water provision in their jurisdiction on submission and approval of strategic and business plans.

1.4 Institutional Set-up under Water Act 2002



Source: WSRS

1.5 KEY FUNCTIONS OF TRANSITIONAL INSTITUTIONS

1.5.1 The Water Services Trust Fund (WSTF)

WSTF assists in financing and support of water services to areas of Kenya without adequate water service. Other functions include: Capacity building activities and initiatives among communities; Awareness creation and information dissemination regarding community management of water services and; Active community participation in the implementation and management of water services.

1.5.2 The Water Appeals Board (WAB)

WAB provides a mechanism for dispute resolution. The key responsibility is to hear and determine appeals on orders, decisions, disputes, permits and licenses. Where resolution is not arrived at, appeals on law matters are transferred to High Court.

1.5.3 The Ministry of Water and Irrigation (MoWI)

MoWI has devolved from regulation and direct service provision to focus on its core functions policy formulation, overall sector coordination, supervision and guidance.

1.5.4 The Water Service Regulatory Board (WSRB)

WSRB is responsible for the regulation of water and sewerage services in partnership with the people of Kenya. Other functions include: Giving advice to the Minister; Licensing of WSBs; Consent to agreement between WSBs and WSPs; Monitor WSBs and WSPs; Develop tariff guidelines; Develop model like use agreements; Develop model performance agreements; Establish procedures for customer complaints and; Inform the public of sector performance.

1.5.5 The Water Services Boards (WSBs)

WSBs is responsible for the efficient and economical provision of water and sewerage services within their areas of foundation. Other functions include to: Develop facilities, prepare business plans and performance targets; Apply for license to provide water and sewerage service and to; Apply regulations on water services and tariffs, contract water services provider, purchase, lease or acquire water and sewerage infrastructure and land.

1.5.6 The Water Service Providers (WSPs)

WSPs are contracted by WSBs to provide quality and sewerage (sanitation) services. The key functions of the providers are to bid for service provision, operate and maintain facilities, comply with quality standards and service levels and finally billing and revenue collection

1.6 Statement of the problem

Although the GoK, NGO's and donor agencies have expressed the desire to improve and expand the accessibility and financing of water sector, their effort has been significantly frustrated hence no much improvement and expansion has been achieved in the sector. This is most likely due to high population growth rate which overcrowds the available water facilities. In respect, water quality has become generally low threatening the health status of Kenya population. This situation has been exacerbated by low levels of increamental financial resources, the inefficient utilization of existing resources, the emergence of new waterborne diseases and the growing appreciation of improved water systems. The scene is further aggravated by technological problems. There is under-training of water engineers a state attributed to low emoluments in the profession failing to attract prospective water specialists.

There is also a discriminating component in the sector resource allocation between the rural and urban areas. It prejudices against rural and poor populations. With respect, 56.2 per cent and 43.8 per cent sector expenditure in 2003 were apportioned to urban and rural areas respectively. Hence, water expenditure clearly favors the urban areas (WSRAF, 2003).

The other issue is the devolution of water services provision by the government. This undermines government responsibility and capacity to uphold the provision of this commodity which is a basic human right. It also ensues with the future means of addressing water availability for the poor. Though corporate privatization enhances water services efficiency, for the rural poor the impact is enormously adverse. For example, Ruth and Caplan, 2004, explains privatization increases consumer water rates which the poor cannot afford, lack of investment in water infrastructure, weak regulations and public health crisis

The purpose of the study is therefore to establish the extent to which the poor population, water tariffs, water morbidity, water infrastructure, distance and household incomes determine water access; and propose relevant policies necessary to address the problem effectively.

1.7 Objective of the Study

The overall objective is to investigate the existing significant factors influencing water services accessibility. If such factors are found to exist, necessary policy proposals will be made to address the situation.

To achieve the overall objective, the study pursues the following specific objectives.

1. To establish the effect of water tariffs on safe water access
2. To establish the impact of improved water infrastructure on safe water access.
3. To explore other relevant policy variables that affects water accessibility.

1.8 Importance of the Study

It is a fact that water is a basic need and an input in the economic and social development process. Lack of water availability threatens the existence of humanity and affects every sector of the economy such as health, education, and agriculture amongst others. As stated by Mehta (2000) and ODI (2002), 1.2billion people have no access to safe drinking water and twice as many people do not have adequate waste water disposal systems. In addition, they estimate that 3.1billion people of which 0.7billion rural and 2.4billion urban will join the group by 2025. Worse still, lack of water availability hits hardest among the developing countries threatening food security, gender education imbalance and reversing gains already made in the health sector.

Access to clean water is declining with the decline in public resources in the developing countries. To curb this most countries(South Africa, Zambia, Kenya etc) are now embracing privatization to ensure resource flow into the sector and possibly to avert the impending catastrophe. However, there are emerging problems relating to closing the funding gap by the private sector, transfer of already funded projects, lack of water investment in rural poor and increased high tariffs. Thus, it is imperative that resource allocation in the sector be sufficiently and efficiently allocated. Otherwise, in the near future resources meant for other sectors may be diverted to water and health sectors; which is detrimental to balanced growth in a country.

The results of this study may be useful to:-

1 The Kenyan Government, NGO's and International Aids Agencies when giving both financial and technical assistance and more especially when formulating their water policies.

2 The private sector on deciding the areas on which to lay more emphasis while investing in the water sector.

3 The scholars and researchers who might have an interest in developing the findings further or taking other related field in water services accessibility, financing and poverty: and as a source of reference.

4 It sheds more light on the impact of water services privatization.

1.9 Scope of the Study

The study focuses on the entire country since it mostly uses the Second Poverty Report of November 2000; drawn by the Ministry of Finance and Planning. The report is based on WMS III data of 1997 collected by CBS which has a representative clusters in all the districts in Kenya. It covered 10,875 house-holds comprising a total number of 50,705 individual respondents on water access (safe and unsafe water).

CHAPTER 2: LITERATURE

2.1 Theoretical Literature

Most of the researches such as Hall (1996); Saleth and Dinar (1997); Renzetti (2002); The World Bank Water Research Team (2001) support that privatization of water services is key to improvement in social welfare. In rejoinder, privatization increases resource flow into the water sector thus subsidizing and bridging the gap left by the declining public resources. The increase in private resource flow is envisage to increase development of new water projects, enhance maintenance of existing water projects, rehabilitation of installed water infrastructure, improve sanitation conditions and capacity building in the sector. Overly, the success of privatization is evident in house-holds access to clean water, reliable water supply and access to improved water systems. Infact, Asthana (1997) from his findings recap that households derive a high marginal benefit from privatization.

On the other hand, Whittington and Briscoe (1990) put that corporate water privatization curtails the access of water services for the poor especially on improved water systems. For example, they observe that well educated and rich families spend more on improved water systems whereas the poor cannot afford the impost water tariffs. The impact of resource allocation to water access for the poor is even worse since they cannot afford the increased tariffs attributed to corporate loan burdens and improved water system costs(Eaton and Caplan, 2004; Public Citizens Water for All Program, 2003). The additional issue to financing the sector is the water corporate conditional demands from the government and international financial institutions such as currency exchange rate insurance and guarantees on loans. In some cases, if not granted the loans, they pull out thus curtailing the access to water services.

Finally, public finance and water sector literature consistently emphasize the quality of governance, or the policies and institutions that manage expenditure on service delivery and sector regulation as the most important determinant in the efficiency and effectiveness of public expenditure. Getting policies right and establishing accountable institutions, enhances the quality of public spending therefore leading to better development outcomes in the water sector (WSP, 2003; Pfefferman, 2001; Abrams, 1999)

2.2 Empirical Analysis

Theoretical models and empirical works indicate that consumer incomes and assets, education, gender occupation, family size, reliability and macro policy variables effects the relationship of water financing on access. In modeling the access to improved water systems, the World Bank Water Demand Research Team, (2001) used the logit and probit model to determine the key factors influencing the demand for improved water systems. The estimation process begins by modeling the demographic impacts on access to improved water systems. This is done by use of both indirect (revealed preference) and direct (contigent valuation) methods to study how households made their choices about water sources. The indirect approach used discrete choice econometric techniques to model households' decisions and to derive estimates of welfare change from the actual choices that households made. The direct approach involved asking people who did not have an improved water source whether they would use a new source if it were provided under specified conditions and how much they would be willing to pay for access to different kinds of improved water systems, such as a public tap or a private house connection. In respect, two types of villages (type A and type B) were identified. In type A villages, households already had the option of connecting to a piped water system; some had connected, others had not. In these villages, the researcher used an indirect approach to assess the determinants of house-holds decisions. Sometimes the respondents in type A villages were also asked contigent valuation questions about their willingness to pay for various improvements in service and their response to different tariffs. In type B villages, improved water systems were not yet available. Households in these villages were asked a series of hypothetical questions about whether they would choose to use an improved system if it were offered at a specified price.

Notably, the two methods outcomes significantly yielded the same results. Their findings were that three sets of characteristics jointly influence a household willingness to use or to pay for an improved water system. This include, the socioeconomic and demographic characteristics of the household; the characteristics of the existing or traditional source of water versus those of the improved water supply, including the cost (both financial and in time required to collect water) and lastly; households attitudes toward government policy in the water supply sector and their sense of entitlement to government services. The researchers findings in the multivariate analysis of water use in Ukunda, Kenya revealed that, a 10 per cent increase in household income would result in 0.06 per cent increase in the probability that a household would choose to use the improved water system; a 10 per cent increase in the cost of water would result in a 0.4 per cent decrease in the probability that a household would choose to use the improved water system. On perceived quality of water, access to it was statistically insignificant. Other general findings without Kenya states that a family in which the head of the household had no 1-4 years primary education and that which the head finished primary education is 7 per cent and 20 per cent more likely to connect to pipe water respectively. On gender, females were willing to pay more for improved water systems. Finally, those in formal occupation were willing to pay more than informal sector also more for reliability.

Kaliba, Norman, Chang (2003) model improves on the WBWDRT by adding agro-ecological conditions and expected utility approach. However, due to problems related to correlating agro-ecological conditions, the variable was dropped. The researcher used a multinomial probit model to determine the factors influencing positive demand for improved water services. Where the probability of accessing improved water system is expressed as:

$$P(S=1) = (Ø_0 + Ø_1D_1 + Ø_2X_2 + Ø_3X_3 + Ø_4X_4 + Ø_5 X_5 + Ø_6X_6 + Ø_7X_7 + Ø_{8i}D_{8i} + V_i)$$

$$P(S=0) = - V_i$$

Where S=1 represent individuals who indicated positive demand for improved water services. S=0 for individuals who wanted to maintain status quo (no improvement). D_1 the dummy variable for sex of the respondent, X_2 age of respondent in years, X_3 educational level, X_4 family size, X_5 respondents ranking on participation in the project activities on 0 to 1 scale and X_7 the individuals cash contributions during the project initiation and development. Finally *Ø the coefficients to be estimated*, V_i composite error term assumed to be normally distributed and D_{8i} the dummy for the type of clusters. For the urban areas occupational clusters were used while in rural region, clustering is based on agro-ecological conditions (i.e suitability for agricultural production).

The researchers outcomes on willingness to pay to improve community based rural water utilities in Dodoma and Singida regions of central Tanzania revealed, in Dodoma 14 per cent of respondents satisfied with the status quo, 64 per cent suggested increasing water discharge and watering point, and 22 per cent proposed other improvements relating to water quality. In Singida region, 31 per cent of respondents were satisfied with the status quo, 59 per cent wanted deeper boreholes and watering points and 10 per cent indicated other types of improvement relating to water quality.

In another study determining access to improved water services in Costa Rica and Laos villages of Limon, Guanacaste and Muang Xaithani respectively; Aguiler et al (1995) investigated the impact of different socio-economic variables on willingness to pay for improved water services by households. They used a log-linear function to estimate the willingness to pay for improved water services. The findings were consistent with the earlier stated researches. On average, women were willing to pay more than men and: young people willing to pay more than the older people. Finally, incomes, family size and: age, willingness to pay had a positive and negative relationship respectively.

The study of Whittington et al (1991) on access to safe water indicates that people are willing to pay more for piped water. In their study area Onitsha-Nigeria, they observed that people are already paying high water rates to water vendors. The findings reveal this to be due to the high income levels during the period of the research and further to the exploitative rates charged by the water boards.

Griffin et al (1995) used contingency valuation method approach to determine the accessibility of improved water services quality in India. The villagers were given questions in the areas of water supply characteristics such as on the water connection cost, monthly service and improved quality of service. The recommendations were encouraging private water connections by incorporating the cost of connections into monthly tariff and using the same to invest in the sector to maintain a higher quality water service. Above all, the critical policy changes in water sector service improvement by the local authority.

Jordan & Elnagheeb (1992) in line with other researchers used the same contingency valuation method to estimate the willingness to pay for improved drinking water in Georgia, USA. The results were similar to the earlier stated findings after regressing two equations and estimating them by using OLS and Maximum Likelihood (ML) respectively.

2.3 Overview

From theoretical considerations and empirical evidence, water access is a major issue comparatively to improved water systems. Therefore calling for more resource allocation in development of water infrastructure and increasing the water discharge points. One of the problems of carrying out a study of financing on water accessibility is insufficient quantitative analysis. Most of empirical literature is qualitative with no strong scientific and statistical methodological approach. Therefore, there usefulness in modeling is limited.

The WBWDRT (2001) concentrated their study in rural areas to find out why households opt for an improved water service rather than the current supply by use of socioeconomic, demographic, existing water sources against improved water supply characteristics and household attitudes towards the government policy in water supply. This study already assumes adequate water accessibility in the rural areas and the only thing required is to improve the water systems. In addition, rural households have enough income to afford the improved water services. Therefore according to WBWDRT (2001), they assume that the problem is in technological improvement of water system and not accessibility per se.

The study of Kaliba et al (2003); Aguiler and Sterner; Griffin et al(1995) and; Jordan and Elnagheeb (1992) mainly focuses on rural areas water access. They ignore that safe water access is also a critical issue in urban areas; both in the informal settlements in the urban areas and formal settlements due to increased population pressure. However, the studies do recognize from their findings that water accessibility is indeed a problem. Incognizant, the study of Whittington et al (1991) findings slightly differs from the findings of others as it depicts that incomes is not a major significant determinant of Willingness To Pay for improved water service unlike the other studies.

The study of Kaliba et al (2003) and that of WBWDRT (2001) is an enrichment to our study since they were conducted in Tanzania and Ukunda, Kenya respectively. The point of departure from the authors study is on coverage, variables used in the model and the estimation technique employed. Also the study is to establish the impact of the poor population, water tariffs, water morbidity, distance, infrastructure and house-hold incomes on access to improved water supplies regardless of rural or urban localities.

CHAPTER 3: METHODOLOGY

3.1 Theoretical foundation

To develop the framework for analysis, the study takes (Kaliba, Norman, Chang, 2003) water demand model based on the McFadden (1981) random utility hypothesis that is consistent with economic theory; and improves on it by integrating the household incomes, poor population, water tariffs, distance, water infrastructure and water morbidity.

Taking the indirect utility function of the form

$$V_j = \beta_{0j} + \beta_{1j} H_j + \beta_{2j} (Y_i - P_j) + \sum_{i=1}^{M} \beta_{3i} D_i + \epsilon \text{ .... (1)}$$

The indirect utility function is expressed as an additive linear function of water and any other goods consumption on conditional choice j. The equation 1 resulted in maximizing the conditional utility of each individual willing to pay for desired water services improvement designed as j.

From equation 1; V_j is the utility obtained from providing the desired water service j, and j= 1, 2,.......k; Hj is the expected improvement in water quality or quantity; Y_i is individual income; P_j is the amount an individual is willing to pay to get improved water services; D_i is a vector of variables describing the demographic characteristics; β_{ij} are parameter of the model; and ϵ is the normally distributed random error term.

The stable utility maximization condition requires imposing the following: -

$\beta_{ij} = \beta_{1k}$, $\beta_{2j} = \beta_{2k}$ .... $\beta_{nj} = \beta_{nk}$

The restriction allows utility to be rational and transitive. To test for statistical validity, additive separability condition can be relaxed by allowing interaction between H_j and $(Y_i$-$P_j)$.

The interpretation of the interaction is the marginal utility of payment depends on an expected improvement in water quality or quantity. When deciding to pay for quality, an individual compares the change in utility; ΔV_j, between seeking improved and maintaining the status quo.

The utility difference of available alternatives and interaction between H_j and $(Y_i - P_j)$ variable is given by: -

$$\Delta V_j = (\beta_{0j} + \beta_o) + \beta_{1j}(H_j - H_o) + \beta_{2j}(Y_i - Y_i - P_j)$$

$$+ \sum_{i=1}^{M} \beta_{3j}(D_i - D_i) + \beta_{4j}(H_j - H_o)(Y_i - Y_i - P_j) + (\epsilon_1 - \epsilon_o)$$

$$= \beta_j + \beta_{ij}Q_j + \beta_{2j}P_j + \beta_{4j}Q_j P_j + U_j \text{ .... } (2)$$

In equation 2, $Q_j = (H_j - H_o)$ is the marginal improvement in water quantity or quality after improving alternatives J; and H_o is the status quo (i.e. no improvement). Income and demographic characteristics are fixed and thus left out of the model.

If $\Delta V_j > 0$, an individual will seek improvement in water services and if $\Delta V_j = 0$, an individual will seek no improvement. This is because only a change in utility matters; and it is a change in utility that is observable.

Following Persson, Norinder, Svenson (1995), willingness to pay is obtained by estimating the payments that would cause the respondent to be indifferent after a single unit increase in an independent variable. This is achieved through setting equation (2) to zero then solving for P_j.

Accordingly, the willingness to pay for improvement in category j is given by:

$$P^*_j = (\hat{a}_j + \hat{a}_{1j}Q_j) / (\hat{a}_{2j} + \hat{a}_{4j}Q_j)$$

i.e. willingness to pay depends on the utility from the expected quality or quantity improvement. Actually, P^*_j is lower value consumers are willing to pay.

Incorporating; water tariffs, water infrastructure, distance, water morbidity and poor population variables into the equation.

$$V_j = \beta_{0j} + \beta_{1j} H_j + \beta_{2j} A_j + \beta_{3j} C_j + \beta_{4j} D_j + \beta_{5j} E_j + \beta_{6j} F_j + \beta_{7j} G_j +$$

$$\beta_{2j} (Y_i - P_j) + \beta_{3j} (K_i - K_j) + B_{4j} (W^{in}_i - W_j) + \beta_{5j} (D^s_i - D^s_j) +$$

$$\beta_{6j} (Q_i - Q_j) + \beta_{7j} (M_i - M_j) + \sum_{i=1}^{M} \beta_{8i} D_i + \epsilon \ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

To test for statistical validity, the additive separability condition is relaxed by interacting the following:

H_j and $(Y_i - P_j)$; A_j and $(K_i - K_j)$; C_j and $(W^{in}_i - W_j)$; D_j and $(D^s_i - D^s_j)$; E_j and $(Q_i - Q_j)$; F_j and $(M_i - M_j)$

The interpretation of the interactions are; marginal utility of incomes, marginal change in water tariffs, marginal change in water infrastructure, marginal change in water distance, marginal change in water morbidity, marginal change in poor population respectively on an expected improvement in water access.

The utility difference of available alternatives and the interactions between the above variables is given as

$$\Delta V_j = (\beta_{0j} + \beta_0) + \beta_{1j} (H_j - H_o) + \beta_{2j} (A_j - A_o) + \beta_{3j} (C_j - C_o) + \beta_{4j} (D_j - D_o) +$$

$$\beta_{5j} (E_j - E_o) + \beta_{6j} (F_j - F_o) + \beta_{7j} (Y_i - Y_i - P_j) + \beta_{8j} (K_i - K_i - K_j) +$$

$$\beta_{9j} (W^{in}_i - W^{in}_i - W_j) + \beta_{10j} (D^s_i - D^s_i - D_j) + \beta_{11j} (Q_i - Q_i - Q_j) +$$

$$\beta_{12j} (M_i - M_i - M_j) + \sum_{i=6}^{M} \beta_{13j} (D_i - D_i) + \beta_{14j} (H_j - H_o) (Y_i - Y_i - P_j)$$

$$+ \beta_{15j} (A_j - A_o)(K_i - K_i - K_j) + \beta_{16j} (C_j - C_o)(W^{in}_i - W^{in}_i - W_j) +$$

$$\beta_{17j} (D_j - D_o)(D^s_i - D^s_i - D_j) + \beta_{18j} ((E_j - E_o)(Q_i - Q_i - Q_j) +$$

$$\beta_{19j} (F_j - F_o)(M_i - M_i - M_j) + (\epsilon_6 - \epsilon_o)$$

$$= \beta_j + \beta_{1j} Q_j + \beta_{2j} R_j + \beta_{3j} S_j + \beta_{4j} T_j + \beta_{5j} X_j + \beta_{6j} Y_j + \beta_{7j} Q_j P_j +$$

$$\beta_{8j} R_j K_j + \beta_{9j} S_j W^{in}_j + \beta_{10j} T_j D^s_j + \beta_{11j} X_j Q_j + \beta_{12j} Y_j M_j + U_j \quad \text{.............}(4)$$

In equation (4) Q_i, R_i, S_i, T_i, X_i and Y_i are marginal improvements in water sector after improving alternatives, and H_o, A_o, C_o, D_o, E_o and F_o is the status quo (i.e. that is no improvements in welfare)

Letting income and demographic characteristics be fixed, we leave them out of the model. If $\ddot{A}V_i > 0$, an individual will seek improvements in waters services and if $\ddot{A}V_i$ 0 an individual will seek no improvement.

The impact of water access is obtained by estimating the variables that would cause the consumer to be indifferent after a single unit increase in an independent variable. This is achieved by setting equation (4) to zero then solving for P_i, K_i, W^{in}_i, D^s_i, Q_i and M_i

3.2 The Empirical Model

The model takes the lead from Aguiler et al, (1995) and Kaliba et al (2003). Assuming an implicit function for equation 4, the empirical model is defined as follows

$$A_w = \Phi Y^{\Phi 1} P_n^{\Phi 2} W_m^{\Phi 3} W_I^{\Phi 4} T_w^{\Phi 5} D_s^{\Phi 6} \quad \text{................................} 5$$

Where A_w is safe water access; Y is household incomes, P_n is poor population, Wm is water morbidity, W_I is water infrastructure, T_w is water tariffs, and D_s is distance from water points.

Log linear regression model is used to estimate the model. By introducing logs on both sides of the equation 5, the empirical model to estimate is specified by equation 6.

$$\ell nA_w = \Phi + \Phi_1 \ell nY + \Phi_2 \ell nP_n + \Phi_3 \ell nW_m + \Phi_4 \ell nW_t + \Phi_5 \ell nT_w + \Phi_6 \ell nD_s + \epsilon \qquad 6$$

Where Φ is the coefficients to be estimated and ϵ is the error term. Detailed descriptions of the variables being estimated are as follows.

Dependent variable: A_w represents house-holds safe water access in percentages covering 41 districts.

Explanatory variables

Y is the household incomes in thousands (Kshs). It expected that if income increase, access to safe water increase i.e positive relationship.

P_n is the proportion of poor population in percentages. It is expected that if the poor population increase, access to safe water declines i.e negative relationship

W_m is the water morbidity (proxied by the number of persons who are out-patients treated of bilharzia and diarrhoea). It is expected that if water morbidity increase, there will be an increase in demand for safe water i.e positive relationship.

W_I is the water infrastructure (proxied by piped water in compounds, public boreholes, outdoor taps and protected well in percentages of improved water infrastructure). It is expected that if improved water infrastructure increase, safe water access increase i.e positive relationship.

T_w is the average water tariffs charged per annum in (Kshs). It is expected that if the water tariff increase, safe water access decline i.e negative relationship.

D_s is the distance from water source (proxied by time taken to collect water) in minutes. It is expected that if time taken to fetch water is reduced, water access will increase i.e negative relationship.

Log-linear form is chosen because it's easy to apply and interpret since slopes in the model are direct estimates of elasticities. Also, it is commonly used in models of demand and production (Greene, 1997).

3.3 Data Type and Sources

The study utilizes cross sectional secondary data mostly obtained from the Second Poverty Report of November 2000 and the Welfare Monitoring Survey (WMS III) of 1997, Population and Housing Census of 1999 conducted by CBS and Statistical Abstracts of 2004. The survey covered 41 districts, 1,107 clusters and 10, 873 households comprising of 50,705 individuals.

3.4 Hypothesis Testing

The study attempts to address the following hypothetical research questions

1. Are the factors used in the model affecting water accessibility?
2. Are there any other variables that have significant effect on water access?

After fitting the data on the above described model, hypothesis tests are to be carried out to assess the significance of the variables in question so as to get answers for the research questions. In order to carry out the test of significance on the estimated coefficients (Φ_i), the null and alternative hypothesis (Ho and H1 respectively) are set as follows.

1. Ho: $\Phi_i = 0$ implying the variables used have no significant effect on water accessibility, against an alternative hypothesis.

   H1: $\Phi_i \neq 0$ implying the variables have significant effect on water accessibility.

2. Ho: $\Phi_i = 0$ implying that there are other variables with significant effect on water accessibility, against an alternative hypothesis.

H1: $\Phi_i \neq 0$ implying the there are no other variables with significant effect on water accessibility.

The t – values are used to reject or accept the null hypothesis. Rejecting null hypothesis implies that the coefficient in question is significantly different from zero, hence statistically significant. Accepting null hypothesis implies that the coefficient in question is significantly equal to zero, hence statistically insignificant.

3.5 Limitation of the Study

The data from the WMS III of 1997 and the Poverty Report II of 2000 are expected to have sampling error, questionnaire administration and editing problems among other.

CHAPTER 4: RESULTS AND DISCUSSIONS

4.0 Introduction

This section uses data from the Second Report on Poverty in Kenya volume II of November 2000 drawn by the Ministry of Finance and Planning. The report is founded on the Welfare Monitoring Survey III of 1997. The survey covered 41 districts, 1107 clusters and 10, 873 households comprising of 50,705 individuals. STATA econometric computer package is used in the data analysis.

4.1 Descriptive Statistical Analysis

Data from 41 districts on safe and unsafe water access was analyzed. Descriptive statistics of these data are presented in Table 4.1. in their level form.

Table 4.1: Summary of Descriptive Statistics.

VARIABLE	OBSERVATION	MEAN	STANDARD DEVIATION	MIN	MAX
Safe Water Access	41	33.63415 percentages	18.02001	0	64.7
Poor population	41	273696.2 persons	159160.9	15576	617479
Water Tariffs	41	4.936585 Kshs	14.59859	0.1	84.9
Distance	41	14.67561 minutes	16.26256	0.1	58.4
Infrastructure	41	32.45854 percentages	16.75715	0.1	62.8
Water Morbidity	41	14693.9 persons	9543.065	1949	39113
Household income	41	1181.615 Kshs	1781.933	48.6	9596.1

The total observation is 41 in number representing the number of districts sampled. The mean (average) safe water access per observation is estimated at 33.6 with a standard deviation of 18.0. The standard deviation, which measures variables dispersion from the mean is fairly small hence an indication of data reliability. The proportion of the poor population, water morbidity and household income variables whose individual mean records 273,692.2, 14,693.9 and 1,181.6 have high standard deviation of 159,160.9, 9,543.1 and 1,781.9 respectively. Descriptive statistics of the variables in log form are shown in Appendix 1.

More descriptive statistics is presented in Table 4.3. Data from the Second Report on Poverty in Kenya drawn by the Ministry of Planning in November 2000 reveals that the dry seasons and wet seasons have considerable impact on water access for both the poor and non-poor.

Table 4.2: Households Access to Safe Water (%)

	Dry Season				Wet Season			
	POOR		NON-POOR		POOR		NON-POOR	
REGION	Safe	Unsafe	Safe	Unsafe	Safe	Unsafe	Safe	Unsafe
Central rural	27.1	72.9	39.5	60.5	28.2	71.8	38.2	61.8
Coast rural	44.7	55.3	56.5	43.5	38.8	61.2	55.9	44.1
Eastern rural	30.6	69.4	40.6	59.4	24.2	75.8	31.8	68.2
Nyanza rural	29.3	70.7	33.6	66.4	23.9	76.1	29.3	70.7
Rift valley	27.6	72.4	41.4	58.6	25.6	74.4	38.7	61.3
Western rural	58.4	41.6	63.9	36.1	56.7	43.3	56.9	43.1
AVERAGE RURAL	**34.4**	**65.6**	**42.9**	**57.1**	**30.8**	**69.2**	**39.1**	**60.9**
AVERAGE URBAN	**80.6**	**19.4**	**90.2**	**9.8**	**80.7**	**19.3**	**91.9**	**8.1**
Nairobi	77.7	22.3	100	0	77.7	22.3	100	0
Mombasa	90.2	9.8	80.5	19.5	89.5	10.5	83.9	16.1
Kisumu	78.2	21.8	64.5	35.5	78.6	21.4	72.8	27.2
Nakuru	96.3	3.7	95.2	4.8	90.7	9.3	92.6	7.4
Other urban	79.3	20.7	83.1	16.9	81.1	18.9	86.5	13.5
NATIONAL TOTAL	**43.3**	**56.7**	**53.0**	**47.0**	**40.4**	**59.6**	**50.3**	**49.7**

Source: GoK, Poverty in Kenya: Incidence and Depth of Poverty. Second Report November, 2000.

On provincial analysis for safe water access, Western province tops with 58.4% followed by Coast province at 44.7% and the least being Central at 27.1% during the dry season for the poor category. For the non-poor group, again Western province tops at 63.9%, followed by Coast province at 56.5% with the least being Nyanza province at 33.6% in the dry season.

In the wet season, Western province has highest safe water access at 56.7%, followed by Coast province at 38.8% and the least being Nyanza province at 23.9% for the poor category. On the other hand, safe water access to non-poor group stands at 56.9%, 55.9% and 29.3%, in Western province, Coast province and Nyanza province respectively.

The table 4.2 indicates that 43.3% and 40.4% of the poor households access to safe water during the dry season and wet season at national level respectively. The non-poor households access to safe water is at 53.0% and 50.3% respectively during the dry and wet season respectively. Striking in the data is the level of unsafe water access during the wet season in relation to the dry season for both the poor and non-poor. At the national level 56.7% and 59.6% of the poor access unsafe water in dry and wet seasons respectively whereas the non-poor is at 47.0% and 49.7% for the dry and wet season respectively as shown in Table 4.2.

4.2 Water Access for the Poor and Non-poor in Urban and Rural areas

Figure 4.1a. : Water Access in the dry season for the rural and urban poor and non-poor

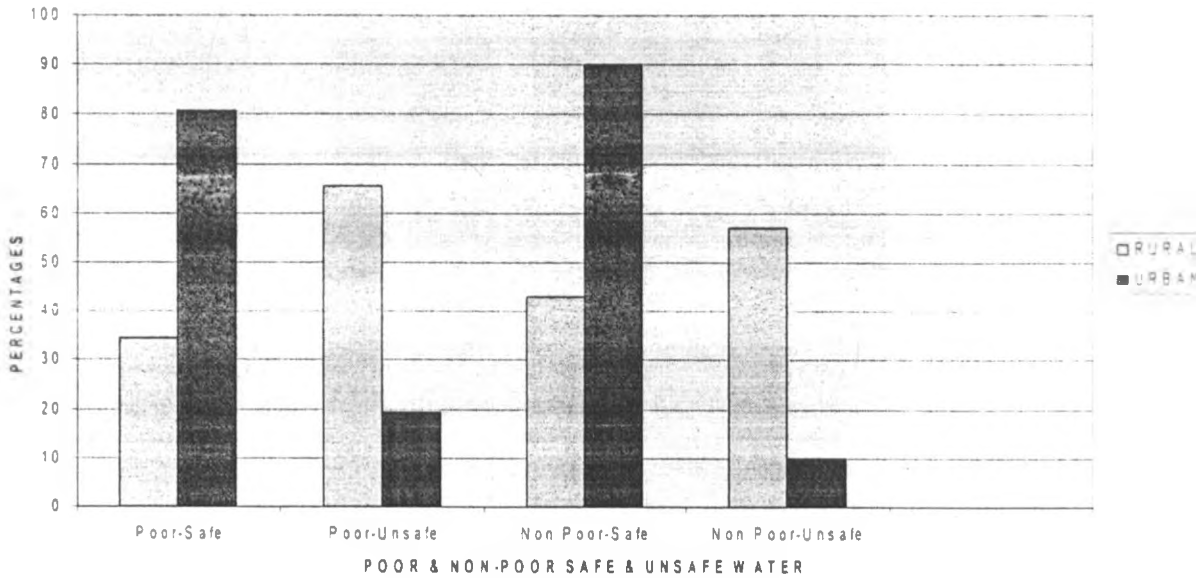


Figure 4.1a reveals high disparity on safe and unsafe water access to rural and urban regions both for the poor and non-poor. In the dry season 34.1% and 80.6% rural and urban poor access safe water respectively whereas 42.9% and 90.2% rural and urban non-poor has access to safe water. For the wet season 30.8% and 80.7% rural and urban poor have access to safe[1] water, and the non-poor rural and urban 39.1% and 91.9% have access to safe water as revealed in Figure 4.1b.

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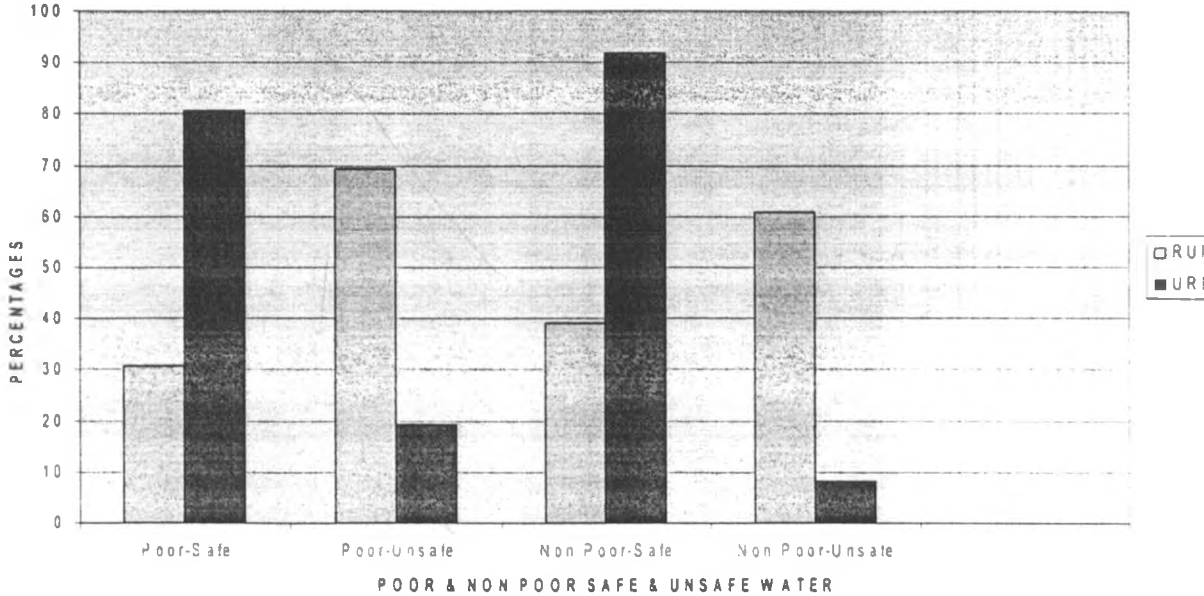
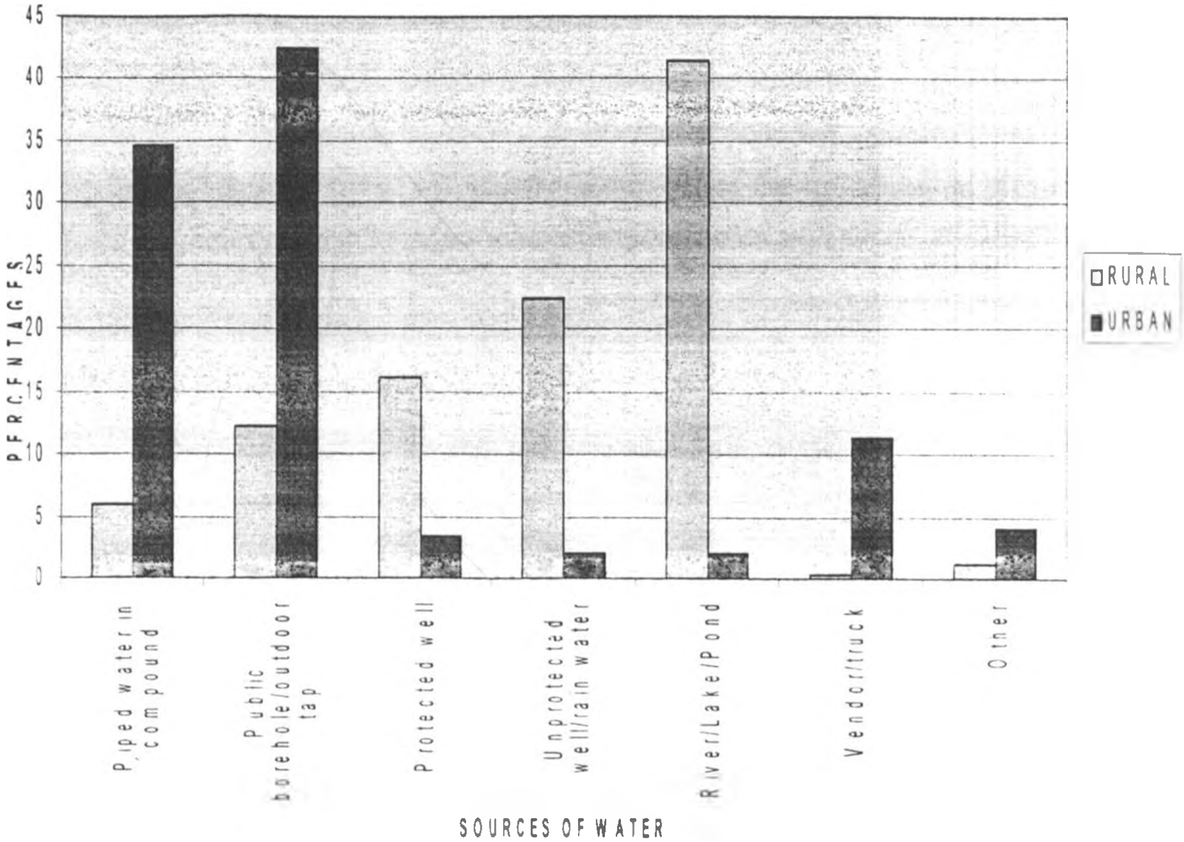
[1] Safe water include piped water in compound, water from public outdoor, tap/borehole and water from protected wells.

Figure 4.1b: Water Access in the wet season for the rural and urban poor and non-poor



The discrimination in the rural and urban water access to safe water may be explained by the uneven distribution of water infrastructure as shown in Figure 4.2.

Figure 4.2:Water Sources for the poor during the dry season.



The urban poor access to water facilities are 34.7%, 42.5%, 3.4%, 2%, 2%, 11.3% and 4.1% for piped water in compound, public outdoor tap/borehole, protected well, unprotected well/rain water, river/lake/pond, vendor/truck and other respectively. Whereas the rural poor water access is at 6%, 12.2%, 16.2%, 22.4%, 41.4%, 0.4% and 1.2% for piped water in compound, public outdoor tap/borehole, protected well, unprotected well/rain water, river/lake/pond, vendor/truck and other respectively. Figure 4.2a reveals that the rural poor have high access to unsafe water i.e 22.4%, 41.4%, 0.4% and 1.2% of unprotected well/rain water, river/lake/pond, vendor/truck and other respectively compared to their urban counterparts at 2%, 2%, 11.3% and 4.1% of unprotected well/rain water, river/lake/pond, vendor/truck and other respectively. Further, the highest level of water infrastructure reliance for the urban poor is public outdoor tap/borehole at 42.5% which is safe water while the rural poor over rely on river/lake/pond at 41.4% which is unsafe water.

Appendix 3 and Appendix 4 in addition reveals the discrepancy in water infrastructure distribution that 69.1% and 49.5% of poor and non-poor households respectively rely on unprotected well/rain water and river/lake/pond water during the wet season. A provincial analysis indicates that majority in Central province 71.7% and 61.9% for the poor and non-poor house-holds Central province rely on unprotected well/rain water, river/lake/pond during the wet season. Whereas, Western province shows the least reliance on unprotected well/rain water, river/lake/pond at 42.6% and 43.1% for the poor and non-poor households during the wet season respectively. On the other hand, during the dry season 64.4% of the poor households depend on river/lake/pond water, unprotected well/rain water compared to 56.6% utility for the non-poor households. In this season, Central province maintains the highest proportion using the unprotected water sources at 72.8% and 60.5% for the poor and non-poor respectively. Coast province is the least in using unsafe[4] water in the non-poor category at 27% while for the poor, Western province takes on at 41.5%.

4.3 Regression Analysis

The estimation results of the double log regression model are presented in Table 4.3. The table shows OLS structural regression results with log of safe water access as dependent variable, while log proportion of the poor population, log of water tariff, log of distance, log of infrastructure, log of water morbidity and log of house-hold incomes are treated as exogenous variables.

Table 4.3: Regression Results on Determinants of Water Access.

LOG OF SAFE WATER ACCESS	COEFFICIENTS	t-values
Log poor population	0.0160945	1.09 (0.283)
Log water tariffs	0.003371	0.53 (0.599)
Log distance	-0.0172359	-2.39* (0.023)
Log infrastructure	1.014737	47.26* (0.000)
Log water morbidity	-0.0381678	-2.76* (0.010)
Log household incomes	-0.0133829	-1.02 (0.315)
Constant	0.2538148	1.03 (0.313)
R-squared	0.9911	(0.000)
F-statistic	594.79	-

* Statistically significant at 5% level of significance
Figures in the parenthesis are the probability values

[4] Unsafe water is defined as including unprotected well/rain water, lake/river/pond water, water supplied by vendor/truck and water from 'other' sources.

From the results, it is important to note that about 99.1% of the variations in safe water access are explained by the independent variables in the model as indicated by the R-squared. The R-squared is very high given that the data used in this study is cross-sectional; hence the model has high explanatory power. In addition, the variable parameters are jointly significant (p-value-0) with F-statistic of 594.79.

The estimates confirm the intuitive expectation of positive effect of water infrastructure on water access. The effect is found to be significant at 5% level of significance. The results reveal that a 1% increase in infrastructure; result to an increase in safe water access by 1.01%. In other words, a 10% rise in infrastructure results in an increase in water access by 10.1%. These closely agree with Kaliba et al. (2003) findings in Dodoma region Tanzania that 64% of the respondents in the study suggested increasing water discharge points and watering points to increase water access. The strong positive relationship between log of water infrastructure on water access may be mostly explained by the fact that an increase in water facilities reduces the distance or time to collect water (attempting to replace ponds, rivers, lakes as sources of water with protected boreholes, piped water, protected wells and protected rain water).

Also confirmed is the negative effect expectation of distance on safe water access. The distance effect is found to be significant at 5% level of significance. These reveals that a 1% decrease in time taken to fetch water results in safe water access increase by 0.017%. Alternatively say, a 10% decline in time taken to fetch water, increase safe water access by 0.17%.

With respect to water morbidity on safe water access the expected negative effect relationship is confirmed to hold. Water morbidity effect is found to be significant at 5% level of significance. The result reveals that a 1% decline in water morbidity is due to a 0.038% increase in water access. In other words a 10% decline in water morbidity is due to a 0.38% increase in safe water access. The World Health Organization estimates confirm that 80% of all diseases and an annual total of approximately 25 million premature deaths in developing countries result from lack of safe water access (Vision 21, 2000). The studies of Arnell, 2000; Turton and Ohlsson, 1999 also indicates that waterborne diseases such as typhoid, cholera are on the increase due to inadequate or lack of safe water. To recap, the (GoK, 2002; WSP, 2003a) have expressed that the increasing epidemiological outbreaks related to waterborne diseases and child morbidity especially in the informal settlements is due to inadequate safe water access.

The effect of poor population on safe water access is positive against the expected negative relationship. The poor population effect on water access is found not significant at 5% level of significance. It reveals that a 1% increase in the poor population results into a 0.016% increase in water access. Asthana (1997) findings confirm that poor households derive high marginal benefit from improved water systems. Therefore the more the poor population the high the demand for safe water access.

Water tariff has positive effect on safe water access contrary to the expected negative effect. This implies that the poor would like to pay an extra shilling that will be used in improving water systems to access safe water. Here the poor regards safe water as a good of necessity. It is also insignificant at 5% level of significance. It reveals that a 1% increase in water tariffs result into a 0.003% increase in water access. In other words a 10% increase in water tariffs effect an increase in water access by 0.03% (very negligible effect). This confirms the findings of Whittington et al. (1991) study on Willingness To Pay for water in Onitsha, Nigeria that people were paying high amounts to water vendors and further that they were willing to pay more for piped water service. In addition, Aguiler et al (1995) and Kaliba et al (2003) established that women and young people were willing to pay more for improved water services since they spend a lot of time primarily in fetching water

Effect of house-holds incomes is insignificant at 5% significance level. The finding negates the expected results of positive effect. The results depict that a1% increase in income results into a decline in water access by 0.013%. This is inconsistent with economic theory of demand. It also further confirms the findings of Whittington et al (1991) and the WBWDRT (2001) that incomes is not a major determinant in improved water access.

4.4 Test for Multicollinearity

It is possible that our explanatory variables in the model may be correlated since it is a major problem of regression. Multicollinearity is shown in the Table 4.1

Table 4.4: Correlation Coefficient Matrix.

	Log poor population	Log water tariffs	log distance	Log infrastructure	Log water morbidity	Log household income
Log poor population	1.0000					
Log water tariffs	-0.1034	1.0000				
log distance	-0.1398	0.1516	1.0000			
Log infrastructure	0.0694	0.3575	-0.1486	1.0000		
Log water morbidity	-0.1121	0.1864	0.2886	-0.0160	1.0000	
Log household income	0.3317	0.3116	-0.0896	0.2754	[illegible]	1.0000

By the rule of the thumb, two variables are said to be correlated if their correlation coefficients is greater than 0.5. The table depict that none of the explanatory coefficients exceed 0.5 hence, variables do not suffer serious multicollinearity.

4.5 Test for Heteroscedasticity

A model is said to be heteroscedastic if its random variable (error term) probability distribution doesn't remain the same over all observations, and in particular that the variance of each error term is not the same for all values of the explanatory variable. If this situation arises in the model estimation i.e no constant variance, the estimation will not be reliable. The consequences are that one, we cannot apply the formulae of the variances of the coefficients to conduct tests of significance and construct confidence intervals. Secondly, the prediction of dependent variable on a given explanatory variable would have a high variance i.e the prediction would be inefficient. Finally, that if the error term is heteroscedastic; the OLS estimates will be inefficient in small samples.

Using Breusch-Pagan/Cook-Weisberg test for heteroscedasticity, our model is found to be homoscedastic and therefore a reliable model

CHAPTER 5: CONCLUSIONS, POLICY RECOMMENDATIONS AND AREAS OF FURTHER RESEARCH

5.1 Conclusions

The main objective of the study was to investigate the factors influencing water services accessibility. The determinants subjected to this examination were the poor population, water tariffs, distance from water source, water infrastructure, water morbidity and house-hold incomes. Seasonal variations was also examined in the process of pursuing the main objective.

From the study findings, it has been established that water infrastructure does affect water access significantly (i.e at 5% level of significance). The fact that a 10% increase in water infrastructure, increase water access by 10.1% is of critical concern. It is necessary that resources be allocated and equitably distributed to the development of new water infrastructure and further towards the renovation and maintenance of the existing infrastructure in the rural and urban areas respectively.

It has also been established that the effect of water morbidity on water access is significant. Emphasis on improved water services provision should be put in water borne disease (diarrhoea and bilharzia) prevalent areas, as it is a key determinant of safe water accessibility.

The analysis showed that distance effect on safe water access; was established to be significant. The findings are consistent with literature since it is expected that as distance from source is wider, safe water access decline. Being a key determinant in safe water access, water facilities (such as public water discharge points, piped water in compound) should be placed at minimum distance to the population as possible to reduce time used in fetching water. Other major determinants of safe water access are the poor population, water tariffs and house-hold incomes.

It has been established that the effect of poor population on safe water access is not significant. The findings are surprising since it is expected from literature that as poor population increase their access to basic services (water included) declines. From the findings, although it is important to be pro-poor in addressing water access, it should not be the core issue. Safe water access to all Kenyans should be addressed as it is a key concern.

Lastly, it has been established that increased water tariffs resulting from water sector privatization will have no major impact on increased safe water access. This is probably due to the concentrated investment on government transferred water facilities by the service providers and charging a premium for their improvement. With regards to household incomes, it is necessary that the key issue should be on the provision of improved water services (safe water) regardless of the income levels. And it is important that appropriate rain water harvesting techniques be disseminated to all Kenyans, since wet seasons is a major influence in safe water access.

5.2 Policy Recommendations

According to the study findings, it is important to address effectively the issue of water infrastructure development, water morbidity and distance from water source so as to improve safe water access in the country. In order to address the above issues, the following policy recommendations need to be explored

1. The Government should be involved and fully participate in the decisions on new water project location of establishment.

2. The Government, NGOs, CBOs should allocate more funds to water infrastructure development.

3. Access to safe water is key to reducing water morbidity. The Government and other organization should facilitate the development of water protection equipments and water chemicals.

4. The Government, NGOs, CBOs and other organization should disseminate information to the public on safe rain water harvesting and other water sources (ponds, rivers, vendors) during the wet seasons.

5.3 Areas of Further Research

Poor population, water tariffs and house-hold incomes parameters has been established to be significant in other studies. These findings contradict the literature and thus the need to further investigate these variables

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APPENDIX

Appendix 1: Descriptive statistics on determinants of water access in log form

VARIABLE	OBSERVATION	MEAN	STANDARD DEVIATION	MINIMUM	MAXIMUM
Log water access	39	2.407944	0.6396806	1 481605	4 169761
Log poor population	41	12.28196	0 8065114	9 653486	13 3334
Log water tariffs	24	0 8625255	1 554895	-1 609438	4 441474
Log distance	39	2.089627	1.274813	-0 6931472	4 067316
Log infrastructure	39	3 383418	0.6179357	1 504077	4 139955
Log water morbidity	41	9 317878	0 8428256	7 575.72	10.57421
Log Household incomes	41	6 542915	0 9731187	3 883624	9 169112

Source Computed

Appendix 2: Source of drinking water during wet season - non-poor households(%)

	Piped water in compound	Public outdoor tap/ borehole	Protected well	Unprotected well/rain water	River/lake/ pond	Vendor/ truck	Other	Total
Central rural	26 6	7 1	4 5	38 4	22 3	0 3	0 9	100
coast rural	4 8	39 6	11 4	10 9	22 8	0	0	100
Eastern rural	17 9	10 3	3 6	34 5	30 5	0 6	2 5	100
Nyanza rural	7 5	6.2	15 6	33 1	34 5	0 2	2 8	100
Rift valley	11 4	15 2	12 1	25 9	33 8	0 6	0 9	100
Western rural	8 2	13 7	35 1	33 4	9 3	0	0 4	100
TOTAL RURAL	**15**	**12**	**12.1**	**31.7**	**27**	**0.6**	**1.4**	100
TOTAL URBAN	**52.8**	**37.8**	**1.3**	**2.1**	**0.9**	4 7	0 5	100
Nairobi	57 4	42 6	0	0	0	0	0	100
Mombasa	31 9	50 4	1 6	0	0	16 1	0	100
Kisumu	25	47 2	0 6	9	0	18 2	0	100
Nakuru	48 5	44 1	0	4 5	0	0 8	2 1	100
Other urban	62 8	20 2	3 5	4 7	3 3	4 4	1 1	100
NATIONAL	**23**	**17.5**	**9.8**	**25.4**	**21.5**	1.4	1 2	100

Source: GoK, Poverty in Kenya: Incidence and Depth of Poverty. Second Report November. 2000

Appendix 3: Percentage distribution of poor households by main source of drinking water during dry season

	Piped water in compound	Public outdoor tap/ borehole	Protected well	Unprotected well/rain water	River/lake/ pond	Vendor/ truck	Other	Total
Central rural	16 1	6 9	4.1	15 9	55 5	0.7	0 7	100
coast rural	4 2	31 3	9 2	15 4	34 4	0	0	100
Eastern rural	7 5	16 5	6 6	22 4	43 4	0 1	3 5	100
Nyanza rural	2 2	8 9	18 3	26 8	43 4	0 5	0	100
Rift valley	5	10 8	11 8	16 6	53 6	0 2	1 9	100
Western rural	5 6	10	42 9	31 6	9 9	0	0	100
TOTAL RURAL	**6**	**12.2**	**16.2**	**22.4**	**41.4**	0.4	1.2	100
TOTAL URBAN	**34.7**	**42.5**	**3.4**	**2**	**2**	11.3	4.1	100
Nairobi	35 6	42	0	0	0	14 4	7 9	100
Mombasa	17 4	71	1 8	0	0	8 4	1 4	100
Kisumu	18 2	54 8	5 2	0	2 8	19	0	100
Nakuru	41.5	54 8	0	0	0	0 8	2 9	100
Other urban	41 9	27 4	9 9	7	6.3	7 4	0	100
NATIONAL	**11.5**	**18**	**13.7**	**18.5**	**33.8**	**2.5**	1.8	100

Source: GoK, Poverty in Kenya: Incidence and Depth of Poverty Second Report November, 2000

Appendix 4: Percentage distribution of non-poor households by main source of drinking water during dry season

	Piped water in compound	Public outdoor tap/ borehole	Protected well	Unprotected well/rain water	River/lake/ pond	Vendor/ truck	Other	Total
Central rural	22 3	9 2	8	14 1	44 8	0 9	0 7	100
coast rural	4 2	39 8	12.6	9 4	17 6	0	0	100
Eastern rural	15 5	19 2	5 9	17 7	36 3	1 5	3 9	100
Nyanza rural	6 3	10 4	16 9	23	42 8	0 6	0 1	100
Rift valley	9 2	17 4	14 9	13 5	42 5	1	1 6	100
Western rural	8 1	13 4	42 5	26 8	9 3	0	0	100
TOTAL RURAL	**12.7**	**15.1**	**15.2**	**17.1**	**37.1**	**1.2**	1.2	100
TOTAL URBAN	**50.7**	**38.5**	**1**	**1.1**	**1.7**	**6.3**	**0.6**	100
Nairobi	56 5	43 5	0	0	0	0	0	100
Mombasa	28 1	52	0 4	0	0	19 5	0	100
Kisumu	24 2	40 3	0	0	0	35 5	0	100
Nakuru	48 5	46 7	0	0	0	1 3	3 5	100
Other urban	59.2	20.5	3 3	3 9	6 1	5 8	1 1	100
NATIONAL	**20.7**	**20**	12.2	13.7	29.6	2.3	1.1	100

Source: GoK, Poverty in Kenya: Incidence and Depth of Poverty. Second Report November, 2000

Appendix 5: Poor households by access to safe water(%) per district

	DRY SEASON		WET SEASON	
	SAFE	UNSAFE	SAFE	UNSAFE
Kiambu	48.1	51.9	31.5	68.5
Kirinyaga	10.2	89.8	16.1	83.9
Muranga	20.3	79.7	27.7	72.3
Nyandarua	32.2	67.8	34.7	65.3
Nyen	25.7	74.3	31.7	68.3
Kilifi	48	52	34 9	65.1
Kwale	37.8	62.2	31.7	68.3
Lamu	34.7	65.3	30.1	69.9
Taita Taveta	50.3	49.7	60.5	39.5
Tana River	40.7	59.3	40.7	59.3
Mbeere	46	54	29.6	70.4
Embu	36.6	63.4	40	60
Kitui	9 8	90.2	5.5	94.5
Machakos	36.4	63.6	21.7	78.3
Meru	57.4	42.6	53.4	46 6
Makueni	14 2	85.8	12.1	87.9
Tharaka Nithi	43.7	56.3	42.2	57.8
Nyambene	46.1	53.9	38.9	61.1
Kisii	62.8	37.2	61	39
Kisumu	38.4	61.6	26 6	73.4
Siaya	36.5	63.5	27.5	72.5
HomaBay	13.5	86.5	4.4	95.6
Migori	4 4	95.6	0.9	99.1
Nyamira	26.2	73.8	27.1	72.9
Kajiado	53.3	46.7	46.3	53.7
Kericho	28 4	71.6	28.5	71.5
Laikipia	15.1	84.9	15.1	84 9
Nakuru	39.6	60.4	31.1	68.9
Nandi	31 8	68 2	32.2	67 8
Narok	0	100	1.4	98.6
Bomet	24.8	75.2	25.7	74.3
Transmara	0	100	0	100
Baringo	21.7	78.3	15.6	84.4
Elgeyo-Marakwe	12.6	87.4	9.1	90.9
Transnzoia	36	64	34.7	65.3
Uasin Gishu	51.2	48.8	51.6	48.4
West Pokot	8.5	91.5	7.8	92.2
Bungoma	56.6	43.4	55.3	44.7
Busia	60.2	39.8	64.1	35.9
Kakamega	54.5	45.5	49.6	50.4
Vihiga	64.7	35.3	63.1	36.9
TOTAL	**34.4**	**65.6**	**30.8**	**69.2**

Source GoK. Poverty in Kenya: Incidence and Depth of Poverty. Second Report November, 2000

Appendix 6: Mean Expenditure of non-food items in poor households by sector (Ksh)

	EDUCATION	HEALTH	WATER
Kiambu	308.7	90.7	4
Kirinyaga	145.4	138.5	2
Muranga	274.6	45.5	0.6
Nyandarua	72.5	21.3	0
Nyeri	177.8	14.1	2.7
Kilifi	89.7	100.7	41.7
Kwale	107	23	17.1
Lamu	98.7	13.1	84 9
Taita Taveta	209.5	16.5	9.7
Tana River	173.1	81.6	0.6
Mbeere	186.6	41.2	0
Embu	136.3	109	4 8
Kitui	128.2	68.7	0.3
Machakos	174.8	103.3	3.8
Meru	329.7	85.5	0.4
Makueni	208 5	70.8	0
Tharaka Nithi	162.7	206.7	5
Nyambene	99.3	66	1 4
Kisii	126.1	45.9	2.1
Kisumu	41.7	66.7	6.9
Siaya	82.5	85.2	0.2
HomaBay	55.4	33.2	0
Migori	138	108.9	0
Nyamira	253.7	66.3	0
Kajiado	112.3	39.5	0
Kericho	124.7	37.2	0
Laikipia	209.4	65.7	0 5
Nakuru	105.2	61.8	4 9
Nandi	157.6	46.5	0
Narok	127	34.9	0
Bomet	143.6	52.7	0
Transmara	206.8	191.9	0
Baringo	161.8	20.3	0
Elgeyo-Marak	191.5	84.1	0
Transnzoia	140.9	109 2	0.4
Uasin Gishu	303.5	71.1	2
West Pokot	134.7	57.6	0
Bungoma	244.4	121.5	4.1
Busia	109.8	42.1	0.6
Kakamega	119.1	92.7	0
Vihiga	219 2	69.1	0
TOTAL	**156.8**	**72.3**	3.1

Source: GoK, Poverty in Kenya Incidence and Depth of Poverty. Second Report November, 2000

Appendix 7: Distribution of poor households members by sex (%)

	N	Male%	Female%
Kiambu	280632	49.7	50.3
Kinnyaga	156168	50.7	49.3
Muranga	381363	47.1	52.9
Nyandarua	100867	46	54
Nyeri	203455	48.4	51.6
Kilifi	422397	45.9	54.1
Kwale	264477	48.1	51.9
Lamu	25725	55	45
Taita Taveta	132526	45.9	54.1
Tana River	15576	50.7	49.3
Mbeere	76058	51.6	48.4
Embu	105419	50	50
Kitui	462117	49	51
Machakos	523045	45.1	54.9
Meru	134150	49.9	50.1
Makueni	450261	51.8	48.2
Tharaka Nithi	168566	45.8	54.2
Nyambene	340856	51	49
Kisii	403082	49.1	50.9
Kisumu	340659	46.8	53.2
Siaya	391839	46.1	53.9
HomaBay	379742	47.8	52.2
Migon	498054	45.9	54.1
Nyamira	617479	48.4	51.6
Kajiado	77396	48.3	51.7
Kericho	312299	49.4	50.6
Laikipia	90523	46.3	53.7
Nakuru	388617	48.6	51.4
Nandi	340556	51.9	48.1
Narok	138052	44.8	55.2
Bomet	342807	51.6	48.4
Transmara	135831	46.2	53.8
Baringo	133866	49.8	50.2
Elgeyo-Marakwe	124742	49	51
Transnzoia	233219	46	54
Uasin Gishu	181674	48.2	51.8
West Pokot	157412	50.4	49.6
Bungoma	447484	49.7	50.3
Busia	280364	46.9	53.1
Kakamega	584760	51.8	48.2
Vihiga	- 377428	46.5	53.5
TOTAL	**11221542**	**48.4**	**51.6**

Source: GoK, Poverty in Kenya: Incidence and Depth of Poverty. Second Report November, 2000

Appendix 8: Time taken by poor households to collect water during dry season(%)

	N	<10 minutes	10_29 minutes	30-59 minutes	60+ minutes
Kiambu	47638	30.9	45.7	20.4	3
Kirinyaga	31824	12.3	73.9	11.5	2.4
Muranga	72627	28.5	63.9	5.7	1.8
Nyandarua	19158	26.8	50.3	6.8	16.1
Nyen	42169	23.1	71.2	4	1 9
Kilifi	58978	13.4	35.7	8.8	42
Kwale	43218	14.1	25.8	28.9	31.1
Lamu	3615	6.1	45.4	0	48 4
Taita Taveta	26169	22.7	60 4	9.4	7.5
Tana River	2175	34.9	52.7	6.7	5.7
Mbeere	15846	11.4	11.1	19.9	57 6
Embu	20709	30.5	64	0	5.5
Kitui	76346	1.4	23.3	17	58 4
Machakos	83626	4.9	37 9	26.9	30 4
Meru	25521	43.8	43.2	2.3	10.8
Makueni	71554	4	60.8	2.5	32.7
Tharaka Nithi	31516	19.6	67.8	2.8	9.7
Nyambene	52615	5.7	77 3	3.5	13.5
Kisii	65271	10.6	53.5	25 8	10
Kisumu	71967	11.5	68.3	14.4	5.8
Siaya	91266	6.7	76.5	6.7	10.1
HomaBay	80198	5.8	46.3	22	25.9
Migori	75268	6.3	48 2	12.4	33.1
Nyamira	113035	1 6	82.6	9 6	6 2
Kajiado	13788	23 8	44.8	10.7	20 6
Kericho	61268	19.4	70.7	7.8	2.2
Laikipia	14567	16	47.7	29	7.4
Nakuru	80657	17 7	59.5	3.4	19.3
Nandi	60715	37.3	61.2	1	0 5
Narok	21876	16.5	60.6	14	8.9
Bomet	55982	35 3	55.5	4.2	5 1
Transmara	24135	0	62.6	22.5	14 9
Baringo	23878	2	62.5	14.5	39.4
Elgeyo-Marakwe	21499	9.9	77.4	10.7	2.1
Transnzoia	44555	27.9	61.9	10.2	0
Uasin Gishu	27228	24.7	71	3.8	0.5
West Pokot	29676	1.6	85 9	7.3	5.2
Bungoma	67223	9.3	75 6	12.8	2.2
Busia	55085	4.9	87.6	5	2.5
Kakamega	110185	17.4	75.5	6	1.1
Vihiga	74535	18.2	78 8	3	0
TOTAL	**2009160**	**14.2**	**61**	**10.6**	**14.1**

Source: GoK, Poverty in Kenya: Incidence and Depth of Poverty. Second Report November, 2000

Appendix 9: Main source of drinking water during dry season-poor households(%)

	N	Piped water in compound	Public outdoor tap/borehole	Protected well	Unprotected well/ rain water	River/lake/ pond	Vendor/ truck	Other	TOTAL SOURCE
Kiambu	47638	17.8	22.4	7.9	10.1	37.1	3	1.7	100
Kinnyaga	31824	3.8	0.3	6.1	21.4	68.4	0	0	100
Muranga	72627	16.6	0.9	2.8	22.1	56.6	0	1	100
Nyandarua	19158	25.1	1.5	5.6	22.7	45.2	0	0	100
Nyeri	42169	18.6	7.1	0	4.7	69.6	0	0	100
Kilifi	58978	1.1	32.8	14.1	18.3	27.2	6.5	0	100
Kwale	43218	6.3	30.6	0.9	13	41.9	5.9	1.5	100
Lamu	3615	1.9	4.6	28.1	65.3	0	0	0	100
Taita Taveta	26169	8.2	35.3	6.7	7.3	41.1	0	1.4	100
Tana River	2175	0	0	40.7	0	59.3	0	0	100
Mbeere	15846	11.4	31.4	3.3	33.2	4.4	0	16.4	100
Embu	20709	24.2	3.8	4.6	12.8	48.7	0	1.8	100
Kitui	76346	0.2	0.3	9.2	13.5	65.1	0.7	10.8	100
Machakos	83626	0.7	23.3	12.4	11	51.9	0	0.7	100
Meru	25521	41.9	5.9	9.6	14.5	28.1	0	0	100
Makueni	71554	0	10.2	4	46.8	37.1	0	1.9	100
Tharaka Nithi	31516	25	15.9	2.8	10.9	45.4	0	0	100
Nyambene	52615	2.2	43.9	0	31.4	22.6	0	0	100
Kisii	65271	8.2	1.4	53.2	15.9	21.3	0	0	100
Kisumu	71967	4.1	19.8	14.5	6.6	51.9	3.1	0	100
Siaya	91266	0	24.9	11.5	22.5	41	0	0	100
HomaBay	80198	0.9	4.2	8.4	9.7	76.8	0	0	100
Migori	75268	0	2.6	1.9	59	36.6	0	0	100
Nyamira	113035	1.6	0.8	23.8	40	33.8	0	0	100
Kajiado	13788	18.2	34	1.1	10.7	30.3	5.7	0	100
Kericho	61268	2	10.2	16.2	2.9	68.7	0	0	100
Laikipia	14567	5.6	1.1	8.4	14.1	58.3	0	12.5	100
Nakuru	80657	7.5	25.3	6.7	10.5	43.8	0	6.1	100
Nandi	60715	2	14.8	15	20	44.1	0.5	3.5	100
Narok	21876	0	0	0	22.9	77.1	0	0	100
Bomet	55982	17.6	6.6	0.6	13.3	61.5	0	0.4	100
Transmara	24135	0	0	0	29.8	70.2	0	0	100
Baringo	23878	1.2	2.7	17.9	25.4	52.8	0	0	100
Elgeyo-Marakwe	21499	2.8	3.1	6.7	4.3	83	0	0	100
Transnzoia	44555	1.3	3.7	31	43.3	20.7	0	0	100
Uasin Gishu	27228	3	10.5	37.7	24.4	24.3	0	0	100
West Pokot	29676	0	6.2	2.3	4.2	87.3	0	0	100
Bungoma	67223	9.3	12.6	23.2	23.2	20.2	0	0	
Busia	55085	1.4	26.5	30.1	30.1	9.6	0	0	100
Kakamega	110185	4	5.6	36.5	36.5	9	0	0	100
Vihiga	74535	7.6	1.8	33.2	33.2	2.1	0	0	100
TOTAL	**2009160**	**6**	**12.2**	**22.4**	**22.4**	**41.4**	**0.4**	**1.2**	**100**

Source: GoK, Poverty in Kenya: Incidence and Depth of Poverty. Second Report November, 2000.

Appendix 10:Earnings by district(Ksh Million)

	1999	2000
Kiambu	600	687.5
Kirinyaga	675.7	774.3
Muranga	593.6	680.1
Nyandarua	351.3	402.6
Nyeri	1665.3	1908.2
Kilifi	835.1	941.4
Kwale	432.1	487.1
Lamu	432.1	487.1
Taita Taveta	520.4	586.7
Tana River	98.3	110.8
Mbeere	571.3	792.9
Embu	634.2	880.2
Kitui	256.2	355.5
Machakos	672.4	933.2
Meru	571.3	792.9
Makueni	256.2	355.5
Tharaka Nithi	286	397
Nyambene	383.6	532.4
Kisii	939.9	1824.3
Kisumu	4944.3	9596.1
Siaya	494.5	959.7
HomaBay	494.5	959.7
Migori	266.1	239.8
Nyamira	939.9	1824.3
Kajiado	540.9	761.9
Kericho	2640.2	3719.1
Laikipia	664.6	936.2
Nakuru	4930.6	6945.4
Nandi	169	238.1
Narok	283.1	398.7
Bomet	283.1	398.7
Transmara	283.1	398.7
Baringo	249.6	351.7
Elgeyo-Marakwe	34.5	48.6
Transnzoia	1157.9	1631.1
Uasin Gishu	1157.9	1631.1
West Pokot	169	238.1
Bungoma	370.1	568.9
Busia	1022.6	1571.8
Kakamega	344.7	529.9
Vihiga	370.1	568.9
TOTAL	**32585.3**	**48446.2**

Source: GoK, Economic Survey, 2003.

Appendix 11: Outpatient water morbidity statistics in 2000

	Diarhoea	Bilharzia	Total
Kiambu	3010	353	3363
Kirinyaga	38760	353	39113
Muranga	25780	353	26133
Nyandarua	35876	353	36229
Nyeri	14890	353	15243
Kilifi	18500	2107	20607
Kwale	17890	2108	19998
Lamu	9594	2108	11702
Taita Taveta	18450	2107	20557
Tana River	25120	2107	27227
Mbeere	9750	624	10374
Embu	18750	625	19375
Kitui	21500	622	22122
Machakos	23400	623	24023
Meru	7200	622	7822
Makueni	21275	622	21897
Tharaka Nithi	12580	622	13202
Nyambene	8670	622	9292
Kisii	10369	245	10614
Kisumu	18740	245	18985
Siaya	15460	248	15708
HomaBay	18750	245	18995
Migori	12560	245	12805
Nyamira	18950	245	19195
Kajiado	4580	58	4638
Kericho	8740	57	8797
Laikipia	3450	57	3507
Nakuru	8452	57	8509
Nandi	7358	57	7415
Narok	5360	57	5417
Bomet	11140	57	11197
Transmara	12450	57	12507
Baringo	22500	57	22557
Elgeyo-Marakwet	6360	57	6417
Transnzoia	29848	56	29904
Uasin Gishu	24580	56	24636
West Pokot	4503	56	4559
Bungoma	1946	10	1956
Busia	1944	9	1953
Kakamega	1944	5	1949
Vihiga	1944	7	1951
TOTAL	**582923**	**19527**	**602450**

Source: GoK, Economic Survey, 2003.

Appendix 12: Source of drinking water during wet season - poor house-holds(%)

	Piped water in compound	Public outdoor tap/ borehole	Protected well	Unprotected well/rain water	River/lake/ pond	Vendor/ truck	Other	Total
Central rural	21.7	4.5	2	41.1	29.6	0	1	100
coast rural	5.3	26	7.5	26.9	30.2	0	0	100
Eastern rural	8	9.6	6.5	35.1	37.7	1.5	1.6	100
Nyanza rural	2.2	5.7	16	34.7	37.2	0.7	3.5	100
Rift valley	6	9.3	10.4	27.4	46	0.1	0.9	100
Western rural	6.1	10.3	40.3	34.7	8.1	0	0.5	100
TOTAL RURAL	**7.1**	**9.2**	**14.5**	**33.2**	**33.7**	**0.6**	**1.6**	100
TOTAL URBAN	**36.1**	**41.5**	**3.1**	**3.3**	**1.3**	**10.6**	**4.1**	100
Nairobi	35.9	41.8	0	0	0	14.4	7.9	100
Mombasa	17.4	70.9	1.2	0.7	0	8.4	1.4	100
Kisumu	18.2	56.6	3.8	9.7	1.9	9.9	0	100
Nakuru	43.2	47.4	0	7.3	0	0	2	100
Other urban	46.2	25.5	9.4	7.6	4	7.3	0.1	100
NATIONAL	**12.7**	**15.4**	**12.3**	**27.4**	27.4	**2.5**	**2.1**	100

Source GoK. Poverty in Kenya: Incidence and Depth of Poverty. Second Report November, 2000