EFFECT OF WATER AND SANITATION INFRASTRUCTURE INVESTMENT ON KENYAN ECONOMIC GROWTH

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ABSTRACT
The impact that water and sanitation infrastructure investment has on the growth process of any economy should not be underrated. With high population growth and increasing urbanization rates especially on developing countries, adequate and efficient water delivery systems are needed due to their high demand. United Nations recommends that developing countries should commit 1% of their Gross Domestic Product to Water and Sanitation infrastructure investment for them to realize high economic growth. Though the Kenyan government has not met this benchmark, it has continued to invest in water and sanitation with the aim of achieving the envisioned 10% growth rate which still has not been met since 2012. The main objective of this paper was to determine the effect of water and sanitation infrastructure investment on economic growth in Kenya from the year 1974 to 2015. A causal research design was used to establish the cause - effect relationship among the study variables. Vector Error Correction Model was estimated using Ordinary Least Squares technique. The paper found that water and sanitation infrastructure investment has a positive coefficient of 0.3165 and significant effect on GDP growth with a p-value 0.0000<0.05. This means that unit increase in WSii will increase the GDP growth in Kenya by 31.65% when other factors are held constant. Both urbanization rate and population growth had negative and statistically insignificant effect on economic growth. The dummy variable representing the Water Act reforms of 2002 was positive and statistically significant and the one representing the 1984 drought and 1997/98 Elnino was negative and statistically significant. Therefore, the study concluded that water and sanitation infrastructure investment has a positive and significant effect on Kenyan economic growth. The study recommends the government to increase development spending on water and sanitation for universal access to clean water and adequate sanitation services to be achieved by 2030 together with mitigating the adverse effect of recurrent droughts and floods to realize the 10% economic growth rate.
Keywords: Infrastructure, Investment, Vector error correction model, Gross Domestic Product

INTRODUCTION

Access to adequate, safe and reliable water and sanitation is a vital prerequisite for economic growth as well as promoting the well- being of mankind in any economy. Infrastructure is a heterogeneous term which refers to physical structures of various types which provide the basic services without which primary, secondary and tertiary productive activities cannot function (Hirschman, 1958). Generally, infrastructure is categorized into economic and social infrastructure, with water and sanitation classified as a type of economic infrastructure (investments and related services that raise the productivity of other types of physical capital) together with transport, energy and Information and Communication Technology (Hansen, 1965; Perkins, 2003; United Nations Settlements Programme, 2011). The two major approaches used to measure infrastructure include physical and financial measures (Fedderke & Garlick, 2008). The financial measure is used commonly when examining aggregate infrastructure stocks or flows. However, according to Gramlich (1994) this measure can also be used for infrastructure data disaggregated by type. On the other hand, physical measure is used when examining specific types of infrastructure, for instance total length of paved roads. Nevertheless, Romp and De Haan (2007) assert that this measure neither provides clarity nor correct for quality. Therefore, there is no consensus on the effective measure of infrastructure.

Conceptually, water and sanitation infrastructure can be defined based on availability, accessibility and affordability to water and waste systems within a certain locality. Access to clean drinking water and sanitation reduces health risks and frees-up time for education and other productive activities, as well as increases the productivity of the labour force (Organization for Economic Cooperation and Development [OECD], 2011). According to OECD reports 884 million of the people around the world lack safe drinking water and 2.6 billion do not have sanitation facilities. Nyaosi (2011) reports that in 2010, the percentage of the population in Low Income Countries accessing water and sanitation facilities was 65% and 35% respectively, 94% and 79% for Latin America and Caribbean countries in the same year compared to Kenya which had 59% and 32% respectively. As at 2015, the Kenyan population accessing improved water and sanitation reached 63.2% and 30.1% respectively (Kenya Institute for Public Policy Research and Analysis [KIPPRA], 2016). Additionally, Water Services Regulatory Board [WASREB] Strategic Plan 2018-2022 aims at increasing water and sanitation supply coverage to 65% and 30% respectively by year 2022.

Africa Infrastructure Country Diagnostic [AICD] (2010) reports that the current Kenyan water storage capacity is 124 m^3 per capita compared to South Africa, Australia, Brazil and Zimbabwe which have per capita water storage capacities of 750m^3, 4729 m^3, 3,225m^3 and 7500m^3 respectively. Mati (2016) attributes the low water storage capacity in Kenya to the fall in Mt. Kenya glaciers from 18 in 1900 to 7 of late. In addition, this low storage capacity is attributed to low investment level in water management infrastructure especially large reservoirs for many years, catchment degradation arising from poor farming methods, population pressure and deforestation which has reduced forest cover from 12% in 1963 to 1.7%. According to Africa Development Bank [AfDB] (2014), infrastructure for surface-water storage has decreased from 11.4m^3 per capita in 1960 to 5.3m^3 in 2012, due to population growth and loss of infrastructure through climate change events like severe droughts and floods which have occurred since the 1970s like in 1972, 1974/75, 1977, 1980, 1982, 1983/84, 1991/92, 1995/96, 1997/98, 1999/2000, 2004, 2006, 2009 and 2010/2011. As a matter of fact, according to AICD (2010), it estimated that overall cost of the El Niño flood of 1997–98 led to damages that costed the economy $1.4 billion while destroying water infrastructure valued at $0.8bn, while the La Niña drought of 1998–2000 generated cost amounting to a further $2.4 billion, with agriculture, transport, energy and industry worst affected. According to AfDB low water storage volumes means low water security for irrigation, hydropower and domestic supply with rural inhabitants typically hit the hardest.

Vision 2030 identifies the main consumers of water in Kenya as industries, agriculture; horticulture and livestock, energy production and domestic consumption. The government in line with Sustainable Development Goals (SDG) aims to provide all Kenyans with access to adequate water and sanitation by year 2030. Besides, WASREB (2018) reports that water is a key enabler for the successful delivery of the Big Four Agenda. Consequently, WASREB assures of its committment to ensuring appropriate regulation of water services sector so as to support sustainability, good governance, arrangements for the delivery and management of water services across housing, manufacturing, affordable health care and food security priority agendas. According to the United Nations Environmental Program [UNEP] (2010), more than 40% of the world's population live in river basins suffering from moderate water stress and this percentage will rise to nearly 50%.by 2025. Kenya is classified as water scarce country with renewable fresh water per capita of 647m^3, which is less than the global benchmark of 1,000m^3 per capita of renewable freshwater resources for a country to be considered as adequately supplied with water. This makes Kenya to compare unfavorably with neighbouring countries of Uganda and Tanzania, which have per capita levels of 2,940m^3 and 2,696m^3, respectively. Additionally, Kenya Vision 2030 projects that these 647m^3 will fall to 235m^3 by 2025 if the supply of water does not keep up with population increase and also if the resource base continue to deplete. But in order to meet Vision 2030 goals, these cubic meters are expected to increase by three fold something that has not occurred.

Solow (1956) neoclassical theory argues that high population growth has a negative effect on economic growth simply because a higher fraction of saving in economies with high population growth has to go to keep the capital-labour ratio constant. With reference to the Water Sector Strategic Plan 2009-2014, annual population growth rates increased from 2.5% per annum in 1948 to a high of 3.8% in 1979 and then declined to 2.9% p.a. in 1999. In addition, the WSSP further reports that the rate of urbanization has increased from 15% in 1979 to 18% and 19 % in 1989 and 1999 respectively. Urban population size also increased from 2.3 million in 1979 to 3.9 million in 1989 reflecting a growth rate of 5.2 % p.a. The expected average growth rate of 3.9% per year is expected in the period 2005-2010 and the population will reach more than 60 million by 2030. As a result, the growing population increases the demand for water for domestic use, food security and industrial development and this as a consequence has resulted in reduction of per capita water availability.

Economic growth refers to sustained increase in the productive capacity of a country. Following the rebasing of GDP in 2014, Kenya became a lower-middle-income country with a Gross National Income per capita of US$1,160 which is according to World Bank's Atlas method (World Bank, 2016). At independence, Kenya's growth of GDP averaged 6.7% and compared favorably with some of the newly industrialized countries of East Asia such as South Korea, Taiwan and Malaysia. Between 1974 and 1979, GDP grew at an average of 5.2% per annum, however, this growth declined in subsequent years, averaging 4.1%, 2.5% and 1.3% per annum over the periods 1980-89,1990-95 and 1996-2002 respectively. Among the factors that contributed to this decline were the cumulative effects of oil shocks of early 1970s and 1980s, political wrangles of 1992 and 1997. With implementation of the Economic Recovery Strategy for Wealth and Employment Creation (ERSWEC) in 2003-2007, the GDP growth increased steadily from below 1% in 2002 to 7% in 2007. However, in 2008 the growth rate experienced a sudden fall of GDP due to postelection violence but recovered in 2010-11 with the growth rates higher than 5%. For the period 2013-2016 the GDP has grown at an average 5% and International Monetary Fund (2014) projects this growth rate would continue up to 2018. Further, Business Monitor Intelligence (BMI) as cited by Deloitte (2016), forecasts Kenya's economy is to grow by an average of 6.1% between 2016 and 2020 when supported by strong public investment in infrastructure, a dynamic services sector and favorable demographics. Taking the IMF and BMI projections this means that the economy is not in line with its estimated growth potential as stipulated in Vision 2030 and the economy is operating below its projected level. Nevertheless, the Medium Term Plan II (2013-2017) aimed at high-growth trajectory reaching 10% in 2017/18, with priority areas being infrastructure development (Republic of Kenya, 2013).

Because of the importance of water services for the economic growth of a country and the wellbeing of its population, United Nations Development Programme (UNDP) recommends that governments should provide WS investments equivalent to 1% of the GDP annually (National Water Services Strategy [NWSS], 2007; WASREB, 2018). But as reported by the National Water Master Plan [NWMP] 2030 of 2013 the government's development grant to the water sector remains below 3% of the government's total budget and is equivalent to less than 1% of the country's GDP. According to Poverty Reduction and Economic Management Unit Africa Region (2011) water infrastructure investments during the last two decades have not kept pace with rapid population growth, particularly in urban areas. In addition, the Annual Water Sector Review 2013/14 reports that investments in urban water and sanitation alone amounted to Ksh 12 billion in 2013/14 compared to an investment need of around Ksh 75 billion annually. Moreover, WASREB strategic plan 2018-2022 assert that more investment in water and service sector is needed from the current Ksh 29 billion to the required Ksh72 billion in order to increase water and sanitation coverage to 100% by year 2022.

To increase water supply in the country, the government has been able to compete the construction of Kiserian and Chemusus dams, 266 small dams and 15 medium dams and constructed new flood control sites along Narok (Narok County), Mogotio (Baringo County), Turkana (Turkana County), River Tende (Homa Bay County) and River Kuja (Migori County) [National Water Conservation and Pipeline Corporation (NWCPC) strategic plan, 2015]. Besides, in a public-private paternship running for 5 years, semi-arid counties of Northern Kenya, that is, Garissa, Isiolo, Marsabit, Turkana and Wajir, will get improved water supply in a Ksh 3.5 billion plan between a US development agency and the Ministry of Water (Kenya Institute for Public Policy Research and Analysis [KIPPRA], 2018). In addition, in order to tackle the global sanitation crisis and to manage the spread of water borne diseases like cholera, typhoid, bilhazia, malaria, the United Nations General Assembly in 2013 designated November 19 as the World Toilet Day. Nevertheless, the water supply subsector has contributed an average of 0.6% to GDP from 2007 to 2009, 0.7% to GDP from 2010 to 2011 and 0.8% to GDP in 2015 (KIPPRA, 2016). NWSS also reports that in Sub-Saharan countries, Kenya included, every year 5% of national product is lost because of insufficient access to safe water and basic sanitation. Furthermore, the NWCPC Strategic Plan 2015-2020 acknowledges that about 47% of the Kenyan population does not have access to clean and safe drinking water due to lack of water harvesting policies and inadequate water infrastructure development. Empirically, limited studies explore the relationship between water and sanitation investment and economic growth. Moreover, Mburu (2013) did a study on government investment in water infrastructure and economic growth in Kenya for a period of 10 years (2005 - 2012). Mburu admits the small sample size posed serious drawbacks in drawing clear cut conclusion from the results since it limited the number of lags that can be used in data analysis. This study determined the effect of water and sanitation infrastructure investment on Kenyan economic growth for the period 1974 to 2015.

Water and sanitation infrastructure investment and management remain a crucial part of economic growth, development and poverty alleviation. UNDP recommends that governments should provide water and sanitation investments equivalent to 1% of the GDP annually for water services to promote economic growth. This benchmark has not been met in Kenya since the water and sanitation development expenditure is less than 1% of the country's GDP (NWMP, 2013). Further, as WASREB strategic plan (2018) reports, the current investment in water and sanitation accounts Ksh29 billion against the required Ksh72 billion and this limits achievement of water and sanitation coverage by 100% as aspired by Kenya Vision 2030. In addition, despite the efforts of investments provided in the past years by the Government and development partners, existing facilities have continued to deteriorate and failed to meet the demand of the increasing population, particularly in many rural areas and the very rapidly growing settlements of the urban poor (NWSS, 2007). This signifies that water and sanitation infrastructure development in the country is insufficient. Besides, the current water storage capacity is 124 m^3 per capita and compares unfavourably with South Africa, Australia, Brazil and Zimbabwe which have per capita water storage capacities of $750m^3$, $4729m^3$, $3,225m^3$ and $7500m^3$ respectively. This low storage capacity is attributed to low investment level in water management infrastructure and population pressure among others. Moreover, water sector contribution to GDP from 2007 to 2015 accounts only 0.6% and 0.8%

respectively signifying a small margin increase. As a consequent, this raises the question on the possibility of water and sanitation services contributing to the envisioned 10% growth rate which has not been met since 2012. Apperently in literature, a few studies documenting how water and sanitation investment has influenced economic growth in Kenya is evident. Additionally, Mburu (2013) while evaluating the relationship between water infrastructure and economic growth in Kenya used small sample size of 10 years, descriptive research design and analyzed data using SPSS. In view of the above, this study sought to fill these research gaps by determining the effect of water and sanitation infrastructure investment on economic growth in Kenya while using causal research design, analysing data with the aid of Eviews and OX metrics statistical softwares, using a longer study period of 45 years (1974-2015) and employing Vector Error Correction Model in data analysis.

The objectives of the study were: to determine the effect of water and sanitation infrastructure investment on economic growth in Kenya; to analyze the moderating effect of population growth on the relationship between water and sanitation infrastructure investment and economic growth in Kenya; and to establish the moderating effect of urbanization rate on the relationship between water and sanitation infrastructure investment and economic growth in Kenya.

LITERATURE REVIEW

This section reviews the evolution of Kenya's Water Act and Policy, empirical and theoretical literature on WSS infrastructure investment and economic growth.

Evolution of Kenya's Water Act and Policy (1963-2016)

At independence, Kenya's water policy placed a lot of emphasis on the participation of all stakeholders, including the department of Water, the private sector, non-governmental organizations (NGOs) and the local people through self-help projects in line with the spirit of Harambee. The focus of water management in the country was solely on the provision of water for domestic, industrial and agricultural uses. However, the water policy achieved little owing in part to limited financial resources, lack of skilled manpower on the part of the local communities, the country's weak and flawed environmental and land policies, poor governance and limited investment in new water projects. The Water Act of 1974 purported to ensure availability of potable water within a reasonable distance to all households by the year 2000. However, due to increased and haphazard human settlements, agriculture, and forest and wetland destruction, surface-and ground-water quality and quantity deteriorated drastically. Thus, by the late 1980s, the demand for water had outstripped its supply in not only urban but also rural areas of the country. The situation was made worse in the late 1980s and the 1990s when the Kenyan government started experiencing budgetary constraints. It became clear to the government that it could not deliver water to all Kenyans by the year 2000 by acting alone. This Act underwent major revisions in 1999 and 2002 with the main focus of decentralizing of water services and separating water policy formulation from regulation and services provision (Ogendi & Ong'oa, 2009).

Water Act of 2002 emphasized the role and active participation of local communities. Under the Act, there was decentralization of the water services to 91 local Water Services Providers (WSPs). The oversight institutions created under Water Act 2002 were Water Services Regulatory Board (WSRB) responsible for overseeing water services provision and licensing, Water Services Trust Fund (WSTF) responsible for financing of water development in rural and low income areas of the country, Water Appeal Board (WAB) dedicated to resolve dispute and 7 water services boards (WSBs) responsible for water and sanitation services provision and asset development. In 2015, the government separated the Ministry of Environment, Water and Natural Resources (MEWNR) into two ministries, namely: Ministry of Water and Irrigation (MWI) and Ministry of Environment and Natural Resources (MENR), as one strategy towards improving government service delivery in the water sector (KIPPRA, 2016). In addition, the enactment of Water Act 2016 has led to further decentralization of water and sanitation services to 47 counties leading to creation of 47 water works development while leaving the development of water policies to national government under the ministry of Water and Irrigation.

Empirical Literature

Musouwir (2010) analyzed the correlation between investment in the water sector and economic growth of developing countries. The analysis revealed that there is a statistically significant relationship between national budget on water supply and sanitation and GDP per capita, and also between Official Development Assistance (ODA) in all sectors and GDP per capita. An interesting finding of the research is that national budgets on water supply and sanitation in all 22 African countries have a much larger multiplier effect on GDP per capita compared to ODA in all sectors in those countries. The study recommended governments of developing countries to spend more of their annual budgets on the water sector. Additionally, Musouwir considered several developing countries together, but this study specific to Kenya was conducted and findings compared.

Manase *et al*. (2008) analyzed the strategic role of water in South Africa's economy at the macro and sectoral levels. At the macro-economic level, an analysis of the correlation between precipitation and economic growth showed that although the country is relatively water scarce, investment in water infrastructure and diversification has played an important role in building the economy and reducing vulnerability. At the sectoral level, the study recommended that efficiency and water productivity issues required urgent attention especially in agriculture. Their study concluded that there is a strong correlation between water and the economy highlighting the impact of floods and droughts in other South Africa Development Community (SADC) countries and thus investing in water infrastructure, management and services is absolutely essential and indispensable for sustainable economic growth, poverty alleviation and social development.

Fasoranti (2012) found that water sources had long run relationship with economic growth in Nigeria while investigating the effect of government expenditure on infrastructure and economic growth for the period 1977 to 2009. In Kenya, Mburu (2013) conducted a study on the relationship between government investment in infrastructure and economic growth in Kenya for the study period 2005 to 2012. Mburu adopted a descriptive research design, used SPSS for data analysis and established that water infrastructure has a positive and significant effect on economic growth with a coefficient of 7.27. Thus, a similar study was conducted and comparisons of the findings made.

Theoretical Literature

This study was based on Musgrave-Rostow theory. This theory sees public expenditure as a prerequisite of economic development, its level being directly related to the stage of development which a country has reached. The early stage of development is viewed as the period of industrialization during which the population moves from the countryside to urban areas. To meet the needs that results from this, there is a requirement for significant infrastructural expenditure in the development of cities. The typical rapid growth experienced in this stage of development results in a significant increase in expenditure and the dominant role of infrastructure determines the nature of expenditure. In this stage, public investment as a proportion of the total investment of the economy is high. The public sector is seen to provide social infrastructure overheads such as roads, transportation systems, sanitation systems, law and order, health and education and other investments. This public sector investment, it is argued, is necessary to increase productivity and to gear up the economy for take-off into the middle stages of economic and social development.

In the middle stages of development, the infrastructural expenditure of the public sector becomes increasingly complementary with expenditure from the public sector. Developments by the private sector, such as factory construction, are supported by investments from the public sector, such as the building of connecting roads. As urbanization proceeds and cities increase in size, so does population density. This generates a range of externalities such as pollution and crime. As a result, an increasing proportion of public expenditure is then diverted away from spending on infrastructure to the control of these externalities. Finally, in the developed phase of the economy, there is less need for infrastructural expenditure or for the correction of market failure. Instead, expenditure is driven by the desire to react to issues of equity and human capital. This results in transfer payments such as social security, education and health, becoming items of expenditure. Once such forms of expenditure become established, they are difficult to ever reduce. They also increase with heighted expectations and through the effect of aging population. The theory ignores the productive expenditure of public sector and assumes that government plays major role in development, which may not be the case always (Brown & Jackson, 1996).

Conceptual Framework

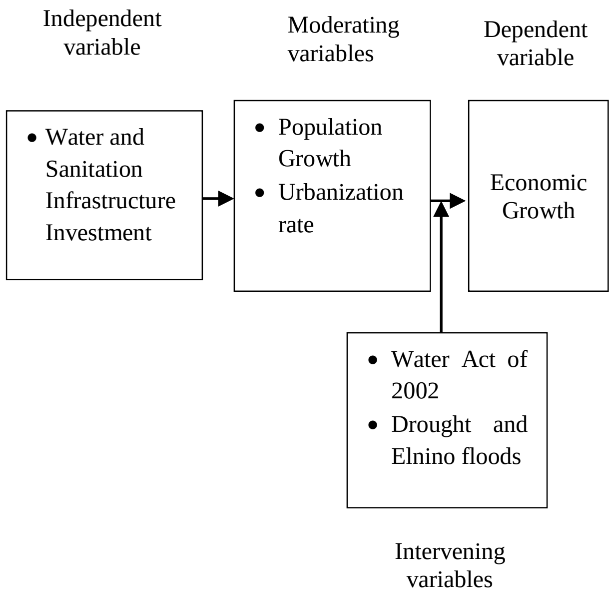

Figure 1: Relationship between water and sanitation infrastructure investment and economic growth

Model Specification and Analytical Techniques

This section presents the model to be specified and the various analytical techniques.

Model Specification

Romp (2007) argues that the manner in which infrastructure is incorporated into the production process will not make a difference provided the production model is estimated through Cobb-Douglas function. The study adopted neoclassical model framework as developed by Solow (1956). This model has been used by Sahoo *et al.* (2010).

Therefore, the production function is given as:
Y= f (G, PP, URB, Z), Where Y refers to output, as a function of public capital, G, which comprises government investment in water and sanitation infrastructure, PP is the population growth as a moderating variable; URB is the urbanization rate as a moderating variable and Z representing others factors influencing economic growth.

The empirical model predicted is given as:

$$\Delta logGDP_t = \beta_0 + \beta_1 \Delta logWSii_{t-i} + \beta_2 \Delta logPP_{t-i} + \beta_3 logURB_{t-i} + \beta_4 D_{de} + \beta_5 D_{wr} + e_t$$

Where: Log GDP - Logarithm of GDP
Log WSii - Logarithm of water and sanitation infrastructure investment
Log PP - Logarithm of population growth
Log URB - Logarithm of urbanization rate
D_{de} - Dummy variables representing structural breaks of the 1984 drought and 1997/98 El Nino floods
D_{wr} - Dummy variables representing reforms of the water Act of 2002.

Economic growth was measured by use of real GDP growth as proxy, water and sanitation infrastructure investment was measured by real development expenditure, while urbanization and population growth rates were measured in their annual rates.

Analytical Techniques

The study analysed data with the help of E-Views and Ox Metrics statistical softwares. This was after time series properties of unit root, granger causality test and cointegration tests were conducted. Ordinary Least Squares (OLS) technique was employed to estimate the relationship between water and sanitation infrastructure investment and economic growth in Kenya.

RESULTS AND DISCUSSION

This section presents the results of data analysis and discussions of the findings.

Stationarity Test

Time series data is said to be stationary if the mean, variance and covariance do not vary with time. Augmented Dickey-Fuller (ADF) test was used to test stationarity. The decision rule to accept the null hypothesis, indicating presence of unit root would occur if ADF statistic is greater than critical value at 5% level of significance. The results of ADF test are presented in the Table 1 below:

The results in Table 1 show that LnGDP and LnPP were stationary in level form because their computed values were less than the critical values at 5% significance level, but LnWSii and LnURB were not. Upon taking the first difference these variables too became stationary.

Granger Causality

This test helps in deciding the direction of relationship between two or more variables. The null hypothesis of no causality would be rejected if p-value > 0.05. This test was conducted with the aid of Eviews and the results are presented in Table 2.

Table 1: Stationarity test statistic on data in level form and first difference

Variables	Form	ADF Test C.L at 5% = -3.53	Status
LNGDP	Level	-4.683	Stationary
LNWSii	Level	-1.411	Not Stationary
DLNWSii	1st Difference	-5.870	Stationary
LNURB	Level	-2.851	Not Stationary
DLNURB	1st Difference	-4.448	Stationary
LNPP	Level	-4.843	Stationary

ADF test Critical Level at 5% Significance Level -3.53

Table 2: Granger causality test results

Null Hypothesis:	Obs	F-Statistic	Probability
LNWSii does not Granger Cause LNGDP	41	7.48285	0.00941
LNGDP does not Granger Cause LNWSii	41	0.23802	0.62844
LNURB does not Granger Cause LNGDP	41	0.19889	0.65815
LNGDP does not Granger Cause LNURB	41	0.35564	0.55448
LNPP does not Granger Cause LNGDP	41	0.15566	0.69539
LNGDP does not Granger Cause LNPP	41	0.55444	0.46109

From Table 2, unidirectional causality running from water and sanitation infrastructure investment to GDP was found since a p – value of 0.00941 < 0.05 was found. This means that WSii could explain economic growth and thus in this case it should be on the right side of the equation as an independent variable. Neutral causality was found between URB, PP and GDP since their p-values was greater than 0.05, meaning these variables are independent of each other.

Test for Cointegration

Cointegration test establishes long run relationship between variables. The test postulates that if the residuals from the OLS estimation of the non-stationary variables are stationary, then the series is cointegrated. Therefore, the null hypothesis would be rejected if ADF statistic is found to be greater than the critical value. Table 3 shows the results.

The results from Table 3 show that the residuals are stationary, meaning there is presence of cointegration, since the ADF statistic is less than the critical value at 5% significance level.

Estimated Model Results

The results of VECM are presented in Table 4.

Table 3: Test results for stationarity of results

D-Lag	t-ADF at Critical Value at 5%= -1.95
2	-3.885
1	-4.420
0	-5.743

Table 4: Vector error correction model results

	Coefficient	Standard Error	t-value	p-value
Constant	0.1162	0.1528	0.760	0.4539
DLNWSii	0.3533	0.05033	7.02	0.0000
DLNWSii_1	0.3165	0.04777	6.63	0.0000
DLNURB	-0.2063	0.2291	-0.900	0.3761
DLNURB_1	-0.1918	0.2310	-0.830	0.4139
LNPP	0.1966	1.197	0.164	0.8708
LNPP_1	-0.2409	1.192	-0.202	0.8414
Dummy de	0.4095	0.07953	5.15	0.0000
Dummy de_1	-0.4057	0.07699	-5.27	0.0000
Dummy wr	-1.1815	0.1424	-8.30	0.0000
Dummy wr_1	1.2095	0.1646	7.35	0.0000
ECT	1.01273	0.02452	41.3	0.0000
ECT_1	-0.8051	0.06417	-12.5	0.0000

R2 0.9894 F (13, 26) =186.9 [0.000] DW = 1.59

Table 4 presents regression results for VECM which can be restated as follows:

GDP = 0.1162 + 0.3165WSii - 0.1918URB - 0.2409PP - 0.4057D de + 1.2095D wr - 0.8051ECT.

The results in Table 4 show that the R^2 is 0.989411, meaning that 98.94% of variations of economic growth in Kenya is explained by water and sanitation infrastructure investment, population growth rate and urbanization rate. The remaining 1.06% is attributed to variables not included in the model.

The F-statistics was 186.9 with a p-value of 0.000 indicating the overall significance of the model. The DW- statistic of 1.59 indicates absence of autocorrelation in the model since it is greater than the R^2. The lagged ECM term was negative as expected and statistically significant. The coefficient of ECT indicates a speed of adjustment of 80.51% from actual growth in the previous year to equilibrium rate of economic growth. Water and sanitation infrastructure investment was found to have a positive coefficient of 0.3165 and significant effect on GDP growth with a p-value 0.0000 < 0.05. This means that a unit increase in WSii will increase economic growth in Kenya by 31.65% when other factors are held constant. Since the p-value 0.0000 was less than 0.05, the null hypothesis was rejected. This finding conforms to economic theory and implies that increased public spending on water and sanitation infrastructure will improve economic growth in the country. The finding coincides with Manase *et al*. (2008) who found that investment in water infrastructure had a strong correlation with economic growth in South Africa and Fasoranti (2012) who found that water sources had long run relationship with economic growth in Nigeria. Mburu (2013) found that government investment in water infrastructure had positive effect on economic growth in Kenya for the period 2005 to 2012.

The study also found that urbanization rate had a negative coefficient of 0.1918 and statistically insignificant with economic growth with a p-value of 0.4139 > 0.05. This denotes that a unit increase in urbanization rate in the country will decrease economic growth by 19.18%. Since the p-value 0.4139 > 0.05, the null hypothesis was not rejected. In addition, population growth was found to have a negative coefficient of 0.2409 and statistically insignificant with economic growth with a p-value of 0.8414 > 0.05. This means that unit increase in population will decrease economic growth by 24.09% holding others factors constant. Population growth was found to have a p-value of 0.8414 which is greator than 0.05 and hence, the null hypothesis was not rejected at 5% significance level. This finding agrees with Solow (1956) that population growth impacts growth negatively.

Further, the dummy variable representing the 1984 drought and 1997/98 Elnino was negative and statistically significant with a coefficient of 0.4057 and p-value 0.0000 < 0.05. This signifies that the droughts and floods in Kenya impact negatively the relationship between water and sanitation infrastructure investment and economic growth. On the other hand, the dummy variable representing the water Act reforms of 2002 was a positive of 1.2095 and statistically significant with a p – value of 0.0000 < 0.05. This means that any reform the government makes on water and sanitation will impact the aforementioned relationship positively.

CONCLUSION

The study analyzed the effect of water and sanitation infrastructure investment on Kenyan economic growth from the year 1974 to 2015. From data analysis the study established a positive and significant effect of public spending on water and sanitation infrastructure investment and economic growth in Kenya. Thus, a conclusion was reached that by the government investing more funds on water and sanitation infrastructure investment, high economic growth in Kenya will be realized. Further, both population growth and urbanization rates had negative and insignificant effect on economic growth in Kenya. The dummy variable representing the Water Act reforms of 2002 was positive and statistically significant and the one representing the 1984 drought and 1997/98 Elnino was negative and statistically significant.

RECOMMENDATIONS

For the government to achieve universal water and sanitation access to all Kenyans by year 2030, to mitigate the adverse effects of recurrent droughts and floods in the country and to realize the 10% growth rate by the year 2030, it should increase its development spending on water and sanitation infrastructure to 1% of GDP annually as recommended by the UNDP.

The government should use the high population growth in the country as a stepping stone to its desired growth by providing the fast growing population with education that will give it suitable skills to start their own jobs or get employed. This is important in boosting productivity and consequently ensuring high economic growth.

The government needs to plan adequately urban areas development in order to accommodate the country's increasing urban population. This will result to positive correlation between levels of urbanization and national economic growth, as countries that are higly urbanized tend to have higher incomes.

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