TRANSPORTATION INFRASTRUCTURE AND ECONOMIC GROWTH

IN SUB-SAHARAN REGION

By

JABU, Alex

THESIS

Submitted to

KDI School of Public Policy and Management

in partial fulfillment of the requirements

for the degree of

MASTER OF PUBLIC POLICY

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ABSTRACT

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BY

Alex Jabu

This paper investigates the role of road infrastructure on economic development in Sub-Saharan African Region. We use data from 1990 to 2012 covering 48 countries. The study finds that Road Infrastructure does not contribute to the economic development of a country.

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INTRODUCTION

TRANSPORTATION INFRASTRUCTURE AND ECONOMIC GROWTH IN SUB-SAHARAN REGION

1.0 Introduction

Sub-Saharan Region is the world's poorest region characterized by poor supply of infrastructure – water and sanitation, power and gas and major water works. Yet infrastructure is viewed as a source of economic competitiveness. Many academic papers dwelt much on theoretical and empirical analyses of the contribution of infrastructure development to growth and productivity. Focus has been on the impact of infrastructure on poverty and inequality – Cesar Calderon and Luis Seven, (2008).

However, this paper analyses how well transport infrastructure has developed and its impact on economic development in Sub Saharan African. Transport Infrastructure includes the following: roads, ports, railways, and airports in Sub-Saharan African Countries. Of particular interest to this paper are the paved roads connecting the country's point to point and connecting city to city of neighbouring countries. The SSA include: Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo Democratic Republic, Congo Republic, Cote d'Ivoire, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal Seychelles, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia and Zimbabwe. See the map of Africa on page 29. Even though these countries are in Sub-Saharan Africa, they have different

characteristics in terms of geography, and mineral worth. Many countries such as Malawi, Zambia, and Zimbabwe are landlocked (no access to the sea/ocean). While other countries such as South Africa, Somalia, Tanzania, Kenya, Ghana, and Egypt are close to the sea / oceans. The World Bank classifies the SSA countries into Oil exporters, Middle income countries, Low income countries and Fragile states.

1.1 Motivation and relevance of study

The purpose of study is investigate how well transport infrastructure has developed in this region, its contribution to economic growth and to make suggestions on how to improve the system so that it ignites economic development. The main focus will be on paved roads. China, for example, has achieved significant economic growth and has reduced poverty levels to low levels. The road transport system has contributed enormously to China's economic and social development (Smith Graham, 2007). Can this be replicated in Africa where there is massive underdevelopment and poverty? Can well managed investments in roads lead Africa to prosperity? In China and South Korea, for example, roads investment had positive results. But socioeconomic, geographical, political factors and challenges faced are different from those of the SSA region. It is imperative that researchers come up with policies that will work in this region. The study consists of 42 countries and time span of 22 years. The assumption is that these countries are reasonably similar in economic characteristics.

1.2 Research question and problem statement

Many papers dwelt much on infrastructure in general. They excessively focused on electricity generation, electricity access, fixed telephone, mobile telephone, sanitation, water and internet access. Roads have been given inadequate consideration. Faced

with limited resources, African governments face a daunting task of choosing infrastructure investment project that impacts most in terms of economic growth. Does substantial investment on transportation infrastructure have impact on economic development of a country? By establishing evidence that indeed roads contribute to the economic development will help SSA and the donor community in targeting the transportation sector that impacts most on development other than scatter the scarce resources to multiple sectors of transportation.

2.0 Literature review and hypothesis statement

Previous and current research on Infrastructure will be reviewed mainly on: how the topic has been studied; what has been found; which issues have been highlighted; how have key concepts been used: sample size, findings, research design, measures used, extraneous variables, and relationship to transport infrastructure.

All these reviews will be compared and contrasted. Methodology used, arguments and quality of evidence will be analysed.

Infrastructure contributed over half of Africa's Improved Growth Performance, Africa's Infrastructure lags well behind that of other developing countries, Africa's difficult economic geography presents a challenge for Infrastructure Development, Africa's Infrastructure services are twice as expensive as elsewhere, Power is Africa's largest Infrastructure challenge by far, Africa's Infrastructure spending needs at $93 Billion a year are more than double previous estimates by the Commission for Africa (Foster and Garmendo, 2010). The Infrastructure challenge varies greatly by country type, A large share of Africa's Infrastructure is domestically financed, After potential efficiency gains,

Africa's Infrastructure Funding Gap is $31 Billion a year, mostly in the power sector, Africa's Institutional, Regulatory, and administrative Reform process is only halfway along (Makhtar Diop, 2012/3).

A huge investment on transportation Infrastructure does not necessarily have impact on economic growth of a country.

3.0 Methodology

The paper attempts to assess the impact of roads investment on economic growth of a country using indicators such as the GDP, and human development.

The methodology to be applied will be mainly by secondary data and review of literature published by organizations such as the World Bank, the International Monetary Fund, African Development Bank, the OECD, governments, and Economic Journals. Data on GDP, paved roads, road network were obtained from the World Bank data base.

Table1.0: Gross domestic product growth

Annual growth (%)

	Annual average		2004	2005	2006	2007	2008	2009	2010ᵃ	1980–89	1990–99	2000–10
	1980	1990										
SUB-SAHARAN AFRICA	**4.0**	**1.2**	**6.1**	**6.0**	**6.3**	**6.6**	**5.1**	**2.2**	**5.0**	**2.2**	**2.1**	**4.8**
Excluding South Africa	1.8	2.2	7.1	6.5	6.7	7.2	5.9	4.2	6.1	2.1	2.5	5.4
Excl. S. Africa & Nigeria	0.7	0.7	6.0	6.8	6.9	7.4	5.9	3.4	5.5	2.6	2.4	5.2
Angola	..	-0.3	11.2	18.3	20.7	22.6	13.8	2.4	3.4	4.2	1.0	10.6
Benin	6.8	3.2	3.1	2.9	4.1	4.6	5.1	3.8	3.0	3.1	4.5	4.2
Botswana	12.0	6.8	6.0	1.6	5.1	4.8	2.9	-4.8	7.0	11.5	5.9	4.3
Burkina Faso	0.8	-0.6	4.6	8.7	6.8	3.6	5.8	3.0	7.9	3.7	5.1	5.6
Burundi	1.0	3.5	4.8	0.9	5.4	4.8	5.1	3.5	3.8	4.3	-1.4	3.0
Cameroon	-2.0	-6.1	3.7	2.3	3.2	3.5	2.9	2.0	3.2	4.0	0.4	3.4
Cape Verde	..	0.7	4.3	6.5	10.1	8.7	6.2	3.7	5.2	6.4	5.2	7.1
Central African Republic	-4.5	-2.2	1.0	2.4	3.8	3.7	2.0	1.7	3.3	0.9	1.3	1.1
Chad	-6.1	-4.2	33.6	17.3	0.2	0.2	-0.4	-1.2	13.0	5.4	2.2	8.8
Comoros	..	5.1	-0.2	4.2	1.2	0.5	1.0	1.8	2.1	2.7	1.6	2.0
Congo, Dem. Rep.	2.2	-6.6	6.6	7.8	5.6	6.3	6.2	2.8	7.2	1.8	-5.5	3.9
Congo, Rep.	17.6	1.0	3.5	7.8	6.1	-1.6	5.6	7.5	8.8	6.8	0.8	5.0
Côte d'Ivoire	-11.0	-1.1	1.8	1.3	0.7	1.7	2.3	3.8	2.4	-0.2	2.6	0.7
Equatorial Guinea	..	3.3	38.0	9.8	1.3	21.4	10.7	5.7	-0.8	0.9	20.2	17.7
Eritrea	..	..	1.5	2.6	-1.0	1.4	-9.8	3.9	2.2	..	8.1	0.8
Ethiopia	..	2.7	13.6	11.8	10.8	11.5	10.8	8.8	9.9	2.4	2.7	8.3
Gabon	2.6	5.2	1.4	3.0	1.2	5.6	2.3	-1.4	6.6	1.9	2.5	1.9
Gambia, The	6.3	3.6	7.1	0.3	3.4	6.0	6.3	6.7	6.1	3.9	3.1	4.6

Ghana	0.5	3.3	5.6	5.9	6.4	6.5	8.4	4.0	8.0	2.0	4.3	5.7
Guinea	..	4.3	2.3	37.8	2.5	1.8	4.9	-0.3	1.9	4.5	4.3	5.9
Guinea-Bissau	-16.0	6.1	2.2	3.5	2.1	3.2	3.2	3.0	3.5	2.9	2.0	1.9
Kenya	5.6	4.2	5.1	5.9	6.3	7.0	1.5	2.6	5.6	4.2	2.2	3.8
Lesotho	-2.7	6.5	2.3	2.7	4.3	4.7	5.4	2.9	5.6	2.2	4.1	3.9
Liberia	-4.1	-51.0	-5.1	9.5	9.8	15.7	10.5	13.1	10.3	-4.5	1.2	10.1
Madagascar	0.8	3.1	5.3	4.6	5.0	6.2	7.1	-4.6	1.6	0.4	1.6	3.0
Malawi	0.4	5.7	5.5	2.6	7.7	5.8	8.3	9.0	6.5	1.7	4.1	4.5
Mali	-4.3	-1.9	2.2	6.1	5.3	4.3	5.0	4.5	5.8	0.6	3.6	5.5
Mauritania	3.4	-1.8	5.8	9.0	18.9	1.6	3.5	-1.2	5.2	2.2	2.9	4.6
Mauritius	-10.1	7.2	5.8	1.2	4.0	5.9	5.5	3.0	4.1	4.3	5.2	4.3
Mozambique	..	1.0	7.9	9.6	6.3	7.3	6.8	6.3	6.8	0.4	5.6	7.2
Namibia	..	2.5	12.3	2.5	7.1	5.4	3.4	-0.4	6.6	1.1	4.1	4.6
Niger	-2.2	-1.3	0.1	4.5	5.8	3.4	8.7	-0.9	8.0	0.0	1.9	4.0
Nigeria	4.2	8.2	10.6	5.4	6.2	6.5	6.0	7.0	7.8	0.9	3.1	6.4
Rwanda	9.0	-2.4	7.4	9.3	9.2	5.5	11.2	4.1	7.2	3.2	2.1	7.6
São Tomé and Príncipe	..	..	6.6	-1.4	6.7	6.0	9.1	4.0	4.5	..	..	5.8
Senegal	-3.3	-0.7	5.9	5.6	2.5	4.9	3.7	2.1	4.1	2.4	2.7	4.0
Seychelles	-4.3	7.0	-2.9	7.5	9.3	9.6	-1.0	0.5	6.7	2.1	4.9	2.5
Sierra Leone	4.8	3.4	7.5	7.2	7.3	6.4	5.5	3.2	5.0	1.1	-4.3	9.2
Somalia	-3.9	-1.5	..	..	..	..	..	..	..	1.7	-1.5	..
South Africa	6.6	-0.3	4.6	5.3	5.6	5.6	3.6	-1.5	2.9	2.2	1.4	3.6
Sudan	1.5	-5.5	1.8	6.3	11.3	10.2	6.8	4.0	4.5	3.4	4.4	6.5
Swaziland	12.5	21.0	2.9	2.5	3.3	3.5	2.4	1.2	2.0	8.6	4.9	2.2
Tanzania	..	7.1	7.8	7.4	6.7	7.2	7.4	6.0	7.0	3.8	3.3	6.8
Togo	14.6	-0.2	2.1	1.2	4.1	2.3	2.4	3.2	3.7	2.6	2.6	1.9
Uganda	..	6.5	6.8	6.3	10.8	8.4	8.7	7.3	5.9	3.0	6.9	7.1
Zambia	3.0	-0.5	5.4	5.3	6.2	6.2	5.7	6.4	7.6	1.4	0.4	5.4
Zimbabwe	14.4	7.0	-5.8	-5.7	-3.5	-3.7	-17.7	6.0	9.0	5.2	2.9	-4.4
NORTH AFRICA	**5.2**	**4.1**	**4.7**	**5.0**	**5.6**	**5.3**	**5.2**	**3.7**	**4.2**	**4.3**	**3.3**	**4.4**
Algeria	0.8	0.8	5.2	5.1	2.0	3.0	2.4	2.4	3.3	2.8	1.6	3.6
Djibouti	..	..	3.8	3.2	4.8	5.1	5.8	5.0	..	..	-2.0	3.6
Egypt, Arab Rep.	10.0	5.7	4.1	4.5	6.8	7.1	7.2	4.7	5.2	5.9	4.3	4.9
Libya	..	..	4.4	9.9	5.9	6.0	3.8	2.1	..	..	..	4.3
Morocco	3.6	4.0	4.8	3.0	7.8	2.7	5.6	4.8	3.7	3.9	2.8	4.6
Tunisia	7.4	8.0	6.0	4.0	5.7	6.3	4.5	3.1	3.0	3.6	5.1	4.4
AFRICA	**4.4**	**2.2**	**5.5**	**5.6**	**6.0**	**6.0**	**5.1**	**2.8**	**4.7**	**2.9**	**2.5**	**4.6**

Table 1.1 : TRANSPORTATION

	Access, supply side			Access, demand side	
		Road density		Vehicle fleet (per 1,000 people)	
	Road network (km) 2000–09[a]	Rail lines (km) 2010	Ratio to total land (road km/100 sq km of land area) 2000–09[a]	Commercial vehicles 2000–09[a]	Passenger vehicles 2000–09[a]
SUB-SAHARAN AFRICA		..			
Angola	51,429	..	4.0	38.0	8.0
Benin	19,000	..	17.0	22.0	18.0
Botswana	25,798	888	4.0	133.0	69.0
Burkina Faso	92,495	622	34.0	11.0	7.0
Burundi	12,322	..	44.0	6.0	2.0
Cameroon	28,857	977	11.0	14.0	10.0
Cape Verde	1,350	..	33.0	101.0	73.0
Central African Republic	24,307	..	4.0	0.3	0.3

Chad	40,000	..	3.0	6.0	2.0
Comoros	880	..	39.0	33.0	31.0
Congo, Dem. Rep.	153,497	3,641	7.0	5.0	..
Congo, Rep.	17,000	..	5.0	27.0	16.0
Côte d'Ivoire	81,996	639	25.0	20.0	16.0
Equatorial Guinea	2,880	..	10.0	..	..
Eritrea	4,010	..	3.0	11.0	6.0
Ethiopia	44,359	..	4.0	3.0	1.0
Gabon	9,170	810	3.0	..	..
Gambia, The	3,742	..	33.0	8.0	5.0
Ghana	109,515	..	24.0	30.0	18.0
Guinea	44,348	..	18.0	..	..
Guinea-Bissau	3,455	..	12.0	33.0	27.0
Kenya	61,945	..	11.0	23.0	13.0
Lesotho	5,940	..	20.0	..	..
Liberia	10,600	..	10.0	3.0	2.0
Madagascar	49,827	..	8.0	26.0	7.0
Malawi	15,451	..	13.0	8.0	4.0
Mali	22,474	..	2.0	14.0	8.0
Mauritania	11,066	728	1.0	..	..
Mauritius	2,066	..	99.0	166.0	129.0
Mozambique	30,331	3,116	4.0	12.0	9.0
Namibia	42,100	..	0.0	103.0	46.0
Niger	18,948	..	1.0	8.0	6.0
Nigeria	193,200	..	21.0	31.0	31.0
Rwanda	14,008	..	53.0	5.0	2.0
São Tomé and Príncipe	320	..	33.0	2.0	2.0
Senegal	14,825	..	8.0	22.0	16.0
Seychelles	508	..	110.0	173.0	103.0
Sierra Leone	11,300	..	..	6.0	5.0
Somalia	22,100	..	3.0	..	..
South Africa	362,099	22,051	30.0	162.0	110.0
Sudan	11,900	4,508	1.0	27.0	19.0
Swaziland	3,594	300	21.0	89.0	45.0
Tanzania	103,706	..	9.0	7.0	4.0
Togo	11,652	..	21.0	2.0	2.0
Uganda	70,746	..	29.0	8.0	3.0
Zambia	66,781	..	12.0	21.0	13.0
Zimbabwe	97,267	..	25.0	114.0	98.0
NORTH AFRICA		**11,935**			
Algeria	112,039	3,512	5.0	112.0	74.0
Djibouti	3,065	..	14.0	..	..
Egypt, Arab Rep.	100,472	5,195	10.0	45.0	33.0
Libya	83,200	..	5.0	290.0	225.0
Morocco	58,216	2,109	13.0	70.0	53.0
Tunisia	19,371	1,119	12.0	114.0	76.0

(continued)

TABLE 1.2: TRANSPORTATION (continued)

Quality	Pricing		Financing
		Committed nominal	

Ratio of paved to total roads (%)
Price of diesel fuel ($ per liter)
Price of gasoline ($ per liter)
investment in transport projects with private participation ($ millions)
ODA gross disbursements for transportation and storage ($ millions)

Transportation infrastructure and economic growth

	2000–09[a]	2010	2010	2000–09[a]	2009	2010
SUB–SAHARAN AFRICA		**1.15**	**1.22**		**2,254.6**	**2,714.0**
Angola	10.4	0.43	0.65	53.0	8.3	25.0
Benin	9.5	1.21	1.04	..	92.1	116.6
Botswana	32.6	0.97	0.93	..	12.9	6.3
Burkina Faso	4.2	1.28	1.44	..	60.6	59.8
Burundi	10.4	1.42	1.43	..	46.0	55.7
Cameroon	17.0	1.10	1.20	0.0	92.0	94.7
Cape Verde	69.0	1.33	1.84	..	56.0	73.7
Central African Republic	..	1.69	1.71	..	17.8	27.0
Chad	0.8	1.31	1.32	..	45.3	5.0
Comoros	76.5	..	..	0.5	2.2	1.8
Congo, Dem. Rep.	1.8	1.27	1.28	..	136.6	146.1
Congo, Rep.	7.1	0.84	1.27	0.0	21.2	9.2
Côte d'Ivoire	7.9	1.30	1.68	0.0	17.6	26.8
Equatorial Guinea	..	..	..	..	..	..
Eritrea	21.8	1.07	2.54	..	2.9	3.2
Ethiopia	13.7	0.78	0.91	..	229.6	226.8
Gabon	12.0	..	..	3.9	10.3	25.5
Gambia, The	19.3	..	..	..	9.7	19.4
Ghana	12.6	0.83	0.82	0.0	105.9	136.4
Guinea	9.8	0.95	0.95	159.0	28.6	50.0
Guinea-Bissau	27.9	..	..	..	15.1	1.3
Kenya	14.3	1.27	1.33	404.0	127.3	118.7
Lesotho	18.3	1.07	0.97	..	9.2	16.7
Liberia	6.2	0.96	0.98	120.0	30.8	68.4
Madagascar	11.6	1.26	1.52	17.5	40.3	55.0
Malawi	45.0	1.54	1.71	..	22.3	24.9
Mali	24.6	1.25	1.42	55.4	28.1	65.8
Mauritania	26.9	0.99	1.16	..	27.6	21.0
Mauritius	98.0	1.23	1.55	..	..	6.5
Mozambique	20.8	0.86	1.11	0.0	103.0	109.6
Namibia	14.7	1.09	1.06	..	52.9	42.6
Niger	20.7	1.16	1.07	..	39.2	53.1
Nigeria	15.0	0.77	0.44	382.0	57.7	63.9
Rwanda	19.0	1.62	1.63	..	34.7	20.9
São Tomé and Príncipe	68.1	..	..	..	1.6	1.8
Senegal	32.0	1.34	1.57	264.0	89.7	111.8
Seychelles	96.5	..	..	..	..	0.0
Sierra Leone	8.0	0.94	0.94	130.0	34.1	43.1
Somalia	11.8	..	..	..	1.7	7.9
South Africa	17.3	1.14	1.19	3483.0	0.1	7.4
Sudan	36.3	0.43	0.62	30.0	79.6	85.9
Swaziland	30.0	1.10	1.07	..	0.4	0.8
Tanzania	6.7	1.19	1.22	134.0	145.5	271.1
Togo	21.0	1.17	1.18	..	0.2	1.5
Uganda	23.0	1.11	1.42	404.0	103.1	153.0
Zambia	22.0	1.52	1.66	15.6	35.0	32.9
Zimbabwe	19.0	1.15	1.29	..	0.0	3.9
NORTH AFRICA		**0.57**	**0.71**		**600.8**	**853.6**
Algeria	74.0	0.19	0.32	108.0	76.0	22.4
Djibouti	45.0	1.07	1.63	396.0	15.9	6.7
Egypt, Arab Rep.	89.4	0.32	0.48	640.0	111.3	198.6
Libya	57.2	0.13	0.17	..	..	..
Morocco	70.3	0.88	1.23	200.0	304.3	487.6
Tunisia	75.2	0.82	0.94	840.0	88.4	130.6

a. Data are for the most recent year available during the period specified.

There is robust evidence that Infrastructure Development- as measured by an increased volume of infrastructure stocks and an improved quality of infrastructure services – has positive impact on long-run growth and a negative impact on income inequality; Infrastructure Development offers a double potential to speed up poverty reduction in SSA (Cesar and Serven, 2008).

Trade expansion by upgrading road networks in SSA would exceed its costs by about $220 Billion over 15 years, while generating millions of construction and maintenance jobs in some of Africa's poorest regions (Piet Buys et al, 2010). While (Limao and Venables, 1999), use three different data sets to investigate how transport depends on geography and infrastructure. Landlocked countries have high transport costs which can be substantially reduced by improving the quality of their infrastructure and that of transit countries. Infrastructure – both own infrastructure and that of landlocked countries' transit routes is significant and quantitatively important determinant of transport costs and of bilateral trade flows. For example, improving destination infrastructure by one standard deviation reduces transport costs by an amount equivalent to a reduction of 6500 sea km, or 1000 km of overland travel; Second, being landlocked raises transport costs by around 50 % (for median landlocked country compared to the median coastal economy). However, improving the infrastructure of the landlocked economy from the median to the 25 percentile reduces this disadvantages by 12 percentage points, and improving the infrastructure of the transit economy by the same amount reduces the disadvantages by a further 7 percentage points; Most of Africa's poor trade performance can be accounted for by poor infrastructure (Amos,

2008-2012). In addition to agriculture, trade between countries and blocks can play a significant role in economic growth.

In 2005, it is estimated that road transport worldwide accounted for about 28000 billion passenger – kilometers of travel (about 13 times the traffic of non urban railways) and 9000 billion freight tone – kilometers. Low and middle income countries account for an increasing share of the growth in road transport whereas high income countries have now reached a more mature, lower growth path. There is enormous scope for further growth in vehicle population that could occur in low – and middle-income countries and the big gap in available road capacity.

Two-third of all rural people lack reliable access to all weather roads and this also applies to even a larger number of urban people who live in slums. For both groups, transport and logistics costs are excessive.

Poor and costly transport jams economic development, slows poverty reduction, and hinders efforts to meet the Millennium Development Goals in SSA.

Unit transport costs are typically 3-5 times higher than those of developed countries

High transport costs magnify the impact of distance and reduce trading opportunities

Road crash deaths are predicted to increase by 80 percent between 2000 and 2020.

Banerjee et al. (2012). On the Road: Access to Transportation Infrastructure and Economic Growth in China.

To find out whether access to better transportation enriches the average region that is affected (because it draws in or generates more new economic activities) or impoverishes it (because it becomes easier for human and physical capital to exit).

Whether areas that have better access to transportation networks benefit much more and serve as engines of growth when new economic opportunities arise and growth becomes possible. Better access to transportation networks does not have a large impact on the (relative) economic performance of those areas – same with Fogelian's view that transportation infrastructure by itself does not really do very much. Based on similar logic, China scholars were critical of public investment in transportation infrastructure in China after 1990 (Huang, 2008).

Does the positive correlation between infrastructure and productivity reflect causation? Does public investment offer a continuing, but neglected, route to prosperity? That is by building roads, can we return to a sustained path of high productivity growth? (Fernald, 1997).

Building an interstate network (in USA) might be very productive; building a second network may not – supported by Hulten, (1994). That vehicle – intensive industries benefit more from road building suggests that roads are productive; At the margin, however, road investments do not appear usually productive; When road growth rises, productivity growth tends to rise relative to the average in vehicle-intensive industries and fall in no vehicle intensive industries.

4.0 Analysis:

The methodology used in the analysis is the linear regression analysis in which economic growth (GDP) is measured against level of transport infrastructure development. The analysis uses secondary data from the World Bank development indicators for all variables shown in the appendix from period 1990 to 2012. Data from other countries for other periods is scanty. The analysis uses percentage of paved

roads in the country as proxy for level of transport infrastructure development. Other variables included as independent variables in the regression analysis are Investment (Fixed Capital) and Human Development.

The model is specified as Equation below:

$$\log GDPpc = \beta o + \beta 1\ PAVD + \beta 2\ \log INV + \beta 3\ HD + \varepsilon$$

Where: PAVD is the paved roads as a percentage of total roads in a country,

INV is the investment (Fixed Capital),

HD is total Human Development (Infant mortality rate per 1000 live births),

The inclusion of physical and human capital development as other independent variables in the model is based on economic growth theories such as the Solow growth model which recognizes these variables in determining economic growth. A country needs human resources with skills to drive the economic activities by crafting sound policies, evaluating investment projects, implementing the projects and assessing the impact of such undertakings.

TABLE 3.0 RESULTS OF REGRESSION ANALYSIS

```
. xtreg lgdppc pavedroads linv lhd

Random-effects GLS regression              Number of obs    =      391
Group variable: country                    Number of groups =       42

R-sq:  within  = 0.0437                     Obs per group: min =        1
       between = 0.2080                                    avg =      9.3
       overall = 0.2461                                    max =       20

                                           Wald chi2(3)     =    20.39
corr(u_i, X)   = 0 (assumed)                Prob > chi2      =   0.0001
```

lgdppc	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
pavedroads	.0051778	.0014279	3.63	0.000	.0023793	.0079764
linv	.0347964	.0198508	1.75	0.080	-.0041104	.0737031
lhd	.2580846	.1131304	2.28	0.023	.0363531	.4798161
_cons	5.121155	.4657254	11.00	0.000	4.20835	6.03396
sigma_u	.88290319					
sigma_e	.11732825					
rho	.98264692	(fraction of variance due to u_i)				

The results show that percentage of paved roads in a country has a positive impact on its economic growth. The result is significant even at one percent level of significance as shown by the p-value of 0.000. However, because of the nature of the variables in the model, we need to run the fixed effect model (table 3.3 below) to avoid some bias. Surprisingly, after adding some control variables, the results are very weak.

Table 3.1 Basic Statistics

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
country	1,104	24.50	13.86	1	48
year	1,104	2,001	6.636	1,990	2,012

Transportation infrastructure and economic growth

gdp	1,052	1.325e+10	4.088e+10	7.655e+07	4.630e+11
gdpgrowth	1,049	4.265	9.134	-51.03	150.0
gdppc	1,046	1,444	2,413	50.04	15,099
gdppcgrowth	1,049	1.690	8.623	-50.24	142.1
capital	991	2.502e+09	7.296e+09	-2.061e+07	7.580e+10
inflation	928	59.42	815.5	-11.69	23,773
netoda	294	23.88	21.41	0.361	106.3
investment	902	20.37	11.29	-2.424	113.6
roaddensity	106	23.15	33.59	0	110.4
pavedroads	430	24.12	23.82	0.800	100
roadnetwork	280	41,633	59,584	345	362,099
cpiaprop	292	2.767	0.626	1	4
lifeexpect	1,094	53.38	7.318	26.76	74.54
imr	1,104	79.60	30.87	12.20	165.8
popgrowth	1,104	2.485	1.197	-7.597	10.26
lngdp	1,052	22.04	1.471	18.15	26.86
lngdppc	1,046	6.508	1.103	3.913	9.622
lncapital	990	20.41	1.509	14.49	25.05
lnroadnetwork	280	9.887	1.377	5.844	12.80
_est_fixed_effects	1,104	0.0226	0.149	0	1
_est_random_effects	1,104	0.0226	0.149	0	1
Number of country	11	11	11	11	11

Table 3.2: Pooled OLS

VARIABLES	(1) LogGDP	(2) LogGDPpc
lncapital	0.903***	0.564*
	(0.0764)	(0.315)
inflation	0.00294	-0.0136
	(0.00379)	(0.0156)
netoda	-0.00466**	-0.0292***
	(0.00214)	(0.00884)
investment	-0.0399***	-0.0354
	(0.00848)	(0.0350)
roaddensity	-0.00402	0.0166
	(0.00442)	(0.0182)
pavedroads	0.0178**	-0.0329
	(0.00632)	(0.0261)
lnroadnetwork	0.121	-0.528
	(0.103)	(0.425)
cpiaprop	0.0147	0.347
	(0.0734)	(0.303)
lifeexpect	-0.0326**	-0.140**
	(0.0140)	(0.0578)
imr	-0.00881***	-0.0157

	(0.00254)	(0.0105)
popgrowth	0.0627	0.755*
	(0.0914)	(0.377)
Constant	5.231***	6.969*
	(0.912)	(3.759)
Observations	25	25
R-squared	0.994	0.791

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3.3: Fixed Effect

VARIABLES	(1) Fixed Effects	(2) Fixed Effects
lncapital	0.118	0.305
	(0.301)	(0.147)
inflation	0.00270	0.00159
	(0.00323)	(0.00158)
netoda	-0.00586*	0.00164
	(0.00214)	(0.00104)
investment	-0.00259	-0.0131
	(0.0143)	(0.00698)
roaddensity	-0.0232	-0.00788
	(0.0154)	(0.00751)
pavedroads	-0.0112	0.000281
	(0.00952)	(0.00465)
lnroadnetwork	1.863*	-0.0993
	(0.635)	(0.310)
cpiaprop	0.451*	-0.0180
	(0.181)	(0.0885)
lifeexpect	0.0891*	0.0401
	(0.0368)	(0.0180)
imr	-0.000772	0.00821

Transportation infrastructure and economic growth

	(0.0137)	(0.00669)
popgrowth	0.872	-0.415
	(0.546)	(0.267)
Constant	-7.004	-0.736
	(8.501)	(4.157)
Observations	25	25
R-squared	0.997	0.982
Number of country	11	11
Country FE	YES	YES

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3.4: Random Effect

	(1)	(2)
VARIABLES	Random Effects	Random Effects
lncapital	0.903***	0.564*
	(0.0764)	(0.315)
inflation	0.00294	-0.0136
	(0.00379)	(0.0156)
netoda	-0.00466**	-0.0292***
	(0.00214)	(0.00884)
investment	-0.0399***	-0.0354
	(0.00848)	(0.0350)
roaddensity	-0.00402	0.0166
	(0.00442)	(0.0182)
pavedroads	0.0178***	-0.0329
	(0.00632)	(0.0261)
lnroadnetwork	0.121	-0.528
	(0.103)	(0.425)
cpiaprop	0.0147	0.347
	(0.0734)	(0.303)
lifeexpect	-0.0326**	-0.140**
	(0.0140)	(0.0578)
imr	-0.00881***	-0.0157

	(0.00254)	(0.0105)
popgrowth	0.0627	0.755**
	(0.0914)	(0.377)
Constant	5.231***	6.969*
	(0.912)	(3.759)
Observations	25	25
Number of country	11	11

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

We therefore accept the hypothesis that transport infrastructure investment has no impact on economic growth of a country and therefore conclude that indeed level of transport infrastructure (roads) development has very moderate impact on economic growth. Fernald, (1997) discusses the difficulty nature of interpreting the correlation results between public capital and productivity. It was found that building an Interstate network in the USA might be very productive; building a second network may not. Similar studies in China by Banerjee et al. (2012) on whether areas that have better access to transportation networks benefit much more and serve as engines of growth, discovered that better access to transportation networks does not have a large impact on the economic performance of those areas- findings which are consistent with the Fogelian view that transportation infrastructure by itself does not really do very much. However, Africa is behind other regions of developing world in terms of quantity and infrastructure service quality. Jerome A., (2011). There is need to research further by

investigating other variables that deal with social and institutional variables such as health variables, uprising, wars, regional integration and the rule of law. Other countries in this SSA region are in state of failed state because of wars such as Somali, DRC and South Sudan. A country can have paved roads and good road network. But political unrest can destabilize the country, its neighbours and the entire region. Data has been another problem. Data from other countries for other years have been missing. This could be because of political instability and wars. Furthermore, 40 percent of Africa's population lives in landlocked countries with unique challenges of importing and exporting goods. On average these landlocked countries take four days and nine days respectively for imports and exports to land compared with seaport countries. The location disadvantages restrict regional trade as put forward by Elbadawi, Mengistae, and Zeufack, (2006) and Behar and Manners, (2008). It is therefore imperative that further studies in this respect be carried out to come up with proper policy and avoid misdirected investments. The chart1 from World Outlook Data base of IMF (April, 2014) below (Table 3.7), shows the performance- real GDP growth in percent of SSA over the past years. It was difficult to get data on actual expenditure on road infrastructure. Countries in SSA experience different rates of growth due to nature of the geography of a country, whether the country is Oil exporting or Oil importing country, middle income country, Low income country and Fragile states such as Central Africa Republic, Southern Sudan where there are political instabilities which affect economic output.

It is also important for SSA to develop its Human Capital so that planning, designing and supervising road projects are done at required standard. Only 1% of African adults had completed tertiary education by 2010, a percentage lower than a global average of

3.9% (Kaberuka and Nkube, 2011). The quality of human capital affects the productivity, growth and development of a nation. Africa, as we can see from the tables 3.5, 3.6 and figure 3.0, needs to invest into upgrading the skills, knowledge and competencies of its citizens.

The table notes (These notes borrow very heavily, sometimes verbatim, from the World Bank data bank):

Growth Domestic Product (GDP annual %) is annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2005 U.S. dollars. GDP represents the sum of value added by all its producers.

Net Official Development Assistance (ODA percent of imports of goods, services and primary income) is disbursement flows (net of repayment of principal) that meet the DAC definition of ODA and are made to countries and territories on the DAC list of ODA recipients. It includes loans with a grant element of at least 25 percent.

Inflation (Consumer prices annual %) measured by the Consumer Price Index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used.

Growth Fixed Capital Formation (annual growth %) is average annual growth of gross fixed capital formation based on constant 2005, U.S.dollars. Gross Fixed Capital formation (formerly gross domestic fixed Investment) includes land improvements; purchases of plant, machinery and equipment and the construction of roads, railways, and the like.

Life expectancy at birth indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life. It reflects the overall mortality level of a population. It is important indicator of health status in a country – frequently used to compare socioeconomic development across countries.

Population growth (annual %) is a growth rate of midyear population from year t-1 to t, expressed as a percentage.

Table 3.5: Tertiary Educational Attainment in Africa and the World

Country/Region	Percentage of adult population that has completed tertiary	Average years of tertiary education
World		
Advanced Economies	3,9	0,20
South Asia	7,1	0,79
Latin America & the	1,0	0,37
Middle East	3,0	0,39
Europe & Central Asia	3,2	0,47
East Asia & the Pacific	5,0	0,49
Africa	2,7	0,50
Sub-Saharan Africa	1,0	0,12
Egypt	0,8	0,08
Mauritius	1,2	0,31
Tunisia	0,9	0,09
South Africa	6,2	0,21
Kenya	0,6	0,09
Ethiopia	2,0	0,08
Botswana	0,4	0,02
Botswana	2,7	0,13

Source: Barro and Lee, 2010.

Page 101, Kaberuka and Nkube, 2011.

Figure 3.0: Sub-Saharan Africa: Human Development Index
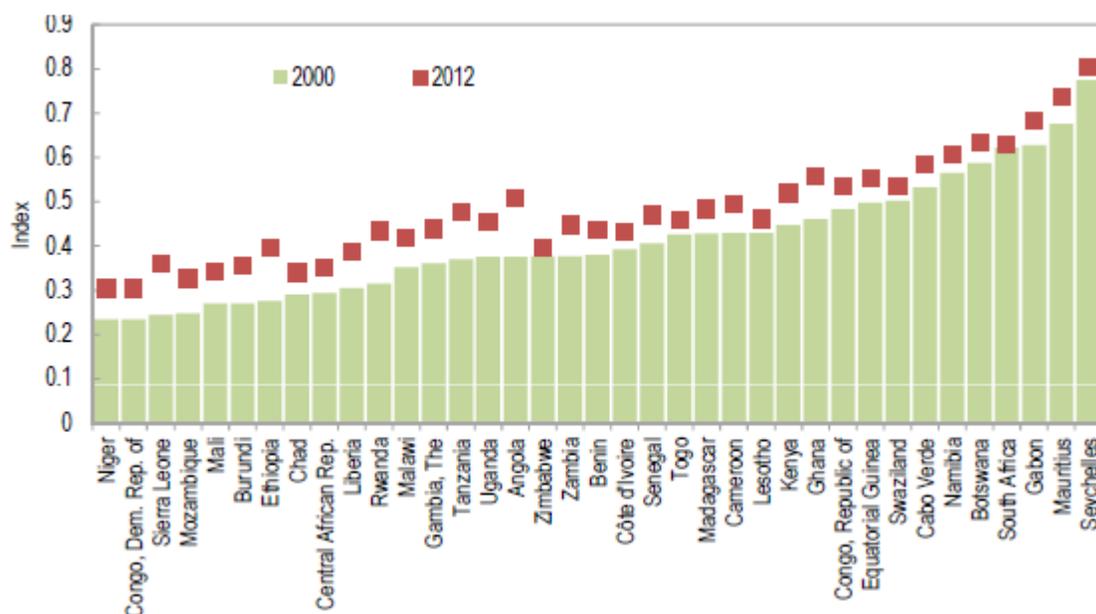
Source: United Nations Development Programme, Human Development Report.

Page 23, IMF, African Department Database.

Table 3.6: Human Capital Indicators in Selected African Countries (2008, unless noted)

Indicators	Angola	Congo Rep.	Ghana	Mauri-tius	Nigeria	Sene-gal	South Africa	Tunisia	Algeria	Egypt	Mo-rocco
Life expectancy at birth, total (years)	47,0	53,6	56,6	72,6	47,9	55,6	51,5	74,3	72,4	70,1	71,3
Adult literacy rate (% age 15 and above)	69,6	--	65,8	87,5	60,1	41,9[d]	89,0	78,0	72,6[d]	66,4[d]	56,4
Youth literacy rate (% age 15-24)	72,9	80,5[a]	79,3	96,4	71,5	50,8[d]	96,8	96,8	91,8[d]	84,9	76,6
School enrolment, secondary (% gross), 2007	--	43,1[c]	55,2	87,6	30,5	30,6	95,1	90,2	83,2[a]	79,3[b]	55,8

| School enrolment, tertiary (% gross) | 3,0 d | 3,9 c | 6,2 e | 25,9 | 10,1 a | 8,0 | 15,4 | 31,6 | 24,0 | 28,9 | 11,3 |
| Scientific and technical journal articles, 2007 | 3,2 | 20,9 | 109,4 e | 17,8 e | 427,4 | 68,4 e | 2 804,6 | 757 | 480,7 | 1 934,4 | 378 |

Note: a2005, b2004, c2003, d2006, e2007.

Source: World Bank data.

TABLE 3.7: SSA: Real GDP Growth

(Percent change)

	2004-2008	2009	2010	2011	2012	2013	2014	2015
SSA, excluding South Africa	7.2	4.3	6.7	6.3	5.8	5.9	6.5	6.5
SSA (Total)	6.4	2.6	5.6	5.5	4.9	4.9	5.4	5.5
of which:								
Oil exporting countries	8.4	4.8	6.7	6.1	5.2	5.7	6.6	6.5
Middle-Income countries1	5.1	-0.8	4.1	4.9	3.4	2.7	3	3.3
of which: South Africa:	4.9	-1.5	3.1	3.6	2.5	1.9	2.3	2.7
Low- Income countries:	7.3	5.1	7	6.5	6.2	6.8	6.9	6.8
Fragile states:	2.7	3.3	4.8	3.3	7.5	6	7.1	7.1
Memorandum item:								
World economic growth:	4.6	-0.4	5.2	3.9	3.2	3	3.6	3.9
SSA resource-intensive countries2	6.4	2	5.4	5.5	4.8	4.1	4.9	5
SSA frontier & Emerging market								
countries3	5.8	2.5	5.4	5.5	4.8	4.4	5	5.2

Source: IMF, World Economic Outlook database

 1 Excluding fragile states

 2 Includes Angola, Botswana, Cameroon, Central Africa Republic, Chad, Democratic Republic of

   Congo, Equatorial Guinea, Gabon, Ghana, Guinea, Mali, Namibia,

   Niger, Nigeria, Sierra Leone, South Africa, Tanzania, Zambia and Zimbabwe.

 3 Includes Cote d'Ivoire, Ghana, Kenya, Mauritius, Nigeria, Rwanda, Senegal, South Africa,

   Tanzania, Uganda, and Zimbabwe.

Source: IMF, World Economic Outlook (April 2014).

5.0 CONCLUSION

Does substantial investment on transportation infrastructure have impact on economic development of a country?

According the results, investment on transportation infrastructure (roads) has little impact on economic development. However, further studies need to be carried out in light of different views expressed by other researchers on this topic. Precise findings can lead to better policy formulation and resource allocations. According to Jerome there is increasing agreement that infrastructure generally matters for growth and production costs, although its impact is higher at lower levels of income than at higher levels of income. This finding is very critical to developing countries in formulating investment projects. Scarce resources can be directed to building roads and rebuilding decaying public infrastructure. Landlocked transport costs increase by 50 percent for median landlocked country as compared to the median coastal economy (Limao, 1999). By improving destination infrastructure by one standard deviation reduces transport costs by a magnitude equivalent to a reduction of 6500 sea km or 1000 km of land travel. Studies conducted by Estache et al, (2006) also concluded that roads, power, and telecommunications infrastructure, except water and sanitation, contribute significantly to long – run growth in Africa. Findings by Banerjee et al. (2009) on China, point to the same conclusion that rural roads provide substantial benefits to households in low– income countries, especially the poorest. But not all roads provide the same benefits. Calderon and Serven, (2004), Estache and Woodon, (2010) contend that the increase in the average growth of GDP per capita of 21 African countries would have been greater if they had been able to rely on infrastructure stocks and quality of South

Korea's between 1996 – 2000. Catching up with South Korea's level would have brought about economic growth of 1.1 percent per year as shown in the table below. The impact would have been bigger in countries such as Ethiopia, Mali, and Mauritania.

Table 4.0: How much faster Africa would have grown if it had enjoyed South Korea's Infrastructure stock and quality?

COUNTRY	ACTUAL GROWTH PER CAPITA (1996-2000)	% POINT INCREASE IN POTENTIAL GROWTH RATE PER CAPITA ASSUMING COUNTRY ENJOYS SOUTH KOREA'S INFRASTRUCTURE QUANTITY AND QUALITY	POTENTIAL GROWTH RATE PER CAPITA ASSUMING COUNTRY ENJOYS SOUTH KOREA'S INFRASTRUCTURE QUANTITY AND QUALITY (1996-2000)
Botswana	5.32%	0.6	5.92%
Burkina Faso	0.59%	1.59	2.18%
Cote d'Ivoire	0.35%	0.64	0.99%
Ethiopia	0.47%	1.47	1.94%
Ghana	1.11%	0.65	1.76%
Guinea	0.07%	1.03	1.10%
Guinea-Bissau	1.19%	0.98	2.17%
Kenya	1.12%	0.91	2.03%
Madagascar	-0.99%	1.21	0.22%
Mali	-0.03%	1.79	1.76%
Mauritania	0.60%	1.57	2.17%
Mauritius	3.71%	0.34	4.05%
Niger	-1.55%	1.87	0.32%
Nigeria	-0.95%	1.01	0.06%
Rwanda	-0.12%	1.23	1.11%
Senegal	-0.28%	0.9	0.62%
Sierra Leone	0.08%	0.92	1.00%
Tanzania	0.58%	1.31	1.89%

Uganda	1.29%	1.16	2.45%
Zambia	-0.76%	0.51	-0.25%
Zimbabwe	1.76%	0.18	1.94%
Sample average	0.07%	1.04	1.11%

Source: Jerome A. January 2011. *Infrastructure, Economic Growth & Poverty*

Reduction in Africa.

Table 4.1: Summary of statistics: averages for the years 1990-2012.

Country	GDP/CAPITA	GDP GROWTH	LIFE EXPECTANCY	INFANT MORTALITY RA	ROAD DENSITY	PAVED ROADS	ROAD TOTAL
Angola	1,651.65	2.8	46	118	4	10	66,449
Benin	511.52	1.3	56	85	17	19	19,000
Botswana	4,953.57	2.8	52	46	4	29	18,980
Burkina Faso	362.91	2.6	51	90	6	17	15,277
Burundi	164.96	- 1.4	49	87	48	8	13,941
Cabo Verde	1,934.65	6.4	70	31	33	77	1,123
Cameroon	889.57	- 0.6	53	82	9	12	37,554
Central African Republic	366.61	1.0	45	106	3	4	23,450
Chad	504.78	2.7	47	103	3	1	33,385
Comoros	649.96	- 0.7	58	71	47	74	885
Congo, Dem. Rep.	161.09	- 2.8	47	110	7	2	156,299
Congo, Rep.	1,713.78	0.2	54	70	5	9	14,286
Cote d'Ivoire	985.00	- 0.6	49	95	22	9	70,799
Equatorial Guinea	7,670.74	13.3	49	97	10		2,774
Eritrea	226.67	0.9	56	59	3	21	3,863
Ethiopia	159.57	3.0	54	84	3	14	31,074
Gabon	6,718.96	- 0.1	61	54	3	9	8,064
Gambia	429.78	0.2	55	62	30	24	2,777
Ghana	482.96	2.9	58	64	29	22	51,790
Guinea	290.70	0.3	52	101	16	14	34,398
Guinea-Bissau	453.13	- 0.5	52	103	10	11	4,201
Kenya	531.09	0.4	56	63	12	13	67,695
Lesotho	679.00	2.9	50	77	20	17	5,368
Liberia	161.22	2.6	53	112	10	6	10,165
Madagascar	282.35	- 0.7	58	67	7	14	45,714
Malawi	212.91	0.9	49	95	13	45	14,181
Mali	406.09	1.5	50	108	2	14	16,123
Mauritania	692.00	1.1	60	74	1	30	8,600
Mauritius	4,618.44	3.6	71	16	99	96	1,959
Mozambique	270.35	3.6	47	109	4	19	29,481
Namibia	3,321.26	2.1	59	43	5	12	54,889
Niger	270.26	- 0.3	51	98	1	23	14,263
Nigeria	699.65	3.1	48	107	21	15	170,965
Rwanda	261.00	3.2	47	85	50	11	13,628
Sao Tome and Principe	764.17	1.7	64	54	33	66	320
Senegal	719.13	0.5	59	63	7	30	14,470
Seychelles	11,006.74	2.8	72	12	108	82	474
Sierra Leone	321.52	1.0	40	139	16	9	11,415
Somalia			50	102	3	12	21,873
South Africa	4,999.30	0.8	57	46	30	20	356,055
South Sudan		- 13.3	49	105			
Sudan	614.96	2.5	59	66	-	35	11,377
Swaziland	2,227.65	1.4	51	69	20	29	3,166
Tanzania	346.26	2.2	53	73	9	9	87,118
Togo	394.61	- 0.0	55	76	17	29	7,842
Uganda	290.26	3.4	51	80	29	23	70,746
Zambia	636.22	0.7	46	91	11	18	56,315
Zimbabwe	564.39	- 1.6	50	58	25	33	92,029

29
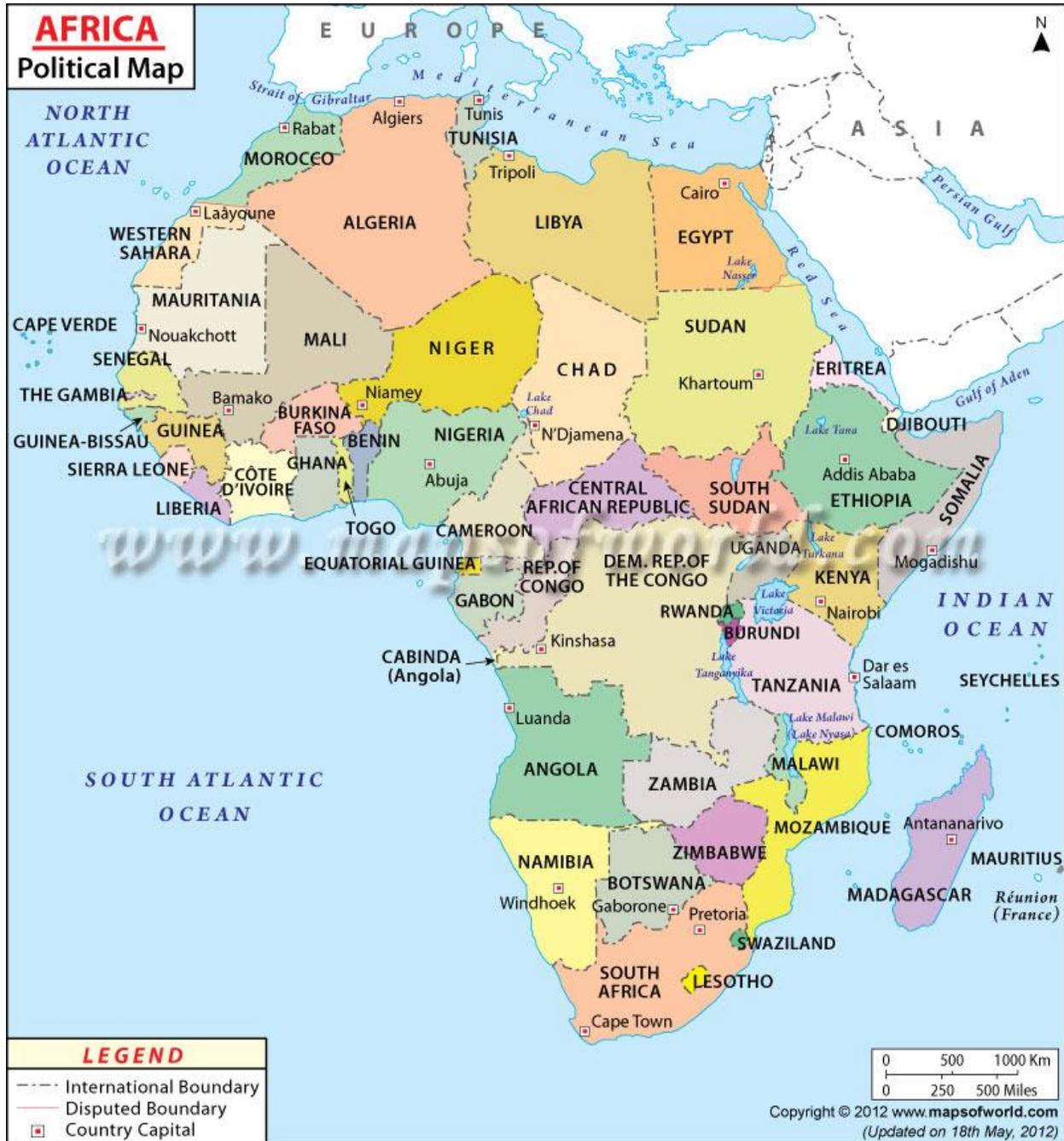
Source: Maps of world

http://www.mapsofworld.com/africa-political-map.htm#

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