

ICT, Development and Poverty Nexus in Africa: Way Forward

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Abstract: Information and Communications Technologies (ICTs) have proven very important in every facet of development. It has become a critical tool in almost all areas of human endeavours that engender development through reduction of poverty. Africa has been known as an impoverished continent in spite of its abundant resources. Hence, it is imperative that an investigative study be carried out to know ICTs effects on development and poverty reduction, especially in Africa. This study was carried out to investigate the inter-relationship existing among ICT, development and poverty. It employed cross-sectional dataset of 43 African countries. The study used descriptive statistics, Cobb Douglas production function and three-stage simultaneous equation to analyse the data. It also made use of student's t-test for the test of hypotheses. It was observed that mobile subscription, internet access and adult literacy positively and significantly influenced ICT development. Also, mobile subscription, adult literacy and per capita GNI (gross national income) positively and significantly influenced human development. However, inequality level negatively and significantly influenced both ICT and human development. Inequality level positively and significantly affected poverty, while internet access had significant negative influence on poverty. Lastly, the study showed a significant association between ICT development, human development and poverty level in Africa. Conclusively, ICT development and poverty rate were significantly inversely related. It was concluded that African governments should embark upon programs and policies that would incorporate ICT and education programs which would improve the livelihoods of their peoples with all required sincerity of purpose.

Keywords: ICT, human development, poverty rate, Africa

1. INTRODUCTION

Africa is endowed with abundance of both human and material resources. These are pre-requisite to economic growth and development. However, amidst these abundant resources the continent grapples with greatest problems of poverty. Poverty in Africa is both awkward and ludicrous. In

spite of the fact that the continent boasts of several resources ranging from crude oil, gold, diamond, countless mineral resources, agricultural and forest resources to mention few, poverty rate is most predominant in Africa (Pew Research Centre, 2015). The major factors that may be accountable for this incidence of poverty are lack of access to information and gaps in skills compared

to the rest of the world. These hamper the process of embracing available technologies, and reduce the technical efficiency of productive practices. It is therefore vital to consider the relevance of information and communication technologies (ICTs) in condensing these gaps. Annan (2002) stated that new ICTs were among the dynamic forces of globalisation that bring people together, and also enhance decision making process. This is not without the support of remarkably innovative tools to facilitate development. Conversely, there is expanding gap which concurrently subsists between the information 'haves' and 'have-nots'. Such gap would definitely result in severe menace in the segregation of the poor from the promising knowledge-based global economy.

The developed countries have 22 percent of world population and control over 85 percent of the global internet usage. The remaining 15 percent is being shared among the 78 percent residing in the developing third world. Africa only struggles with less than ten percent of global internet usage (Internet World Stats, 2016) while it has more than 20 percent of developing world's population (Wikipedia, 2016).

ICTs open up innovative prospects to lessen poverty. International Institute for Communication and Development (IICD) (2005) reported the use of radio and internet in giving out market price information. This has given small-scale producers better bargaining power and also enhanced the communication proficiency for development. ICTs are helpful for endowing the people with useful environmental

information such as climatic conditions and natural disasters. ICTs provide better opportunities to the poor through easier access to better health and education services which reduce their propensity to be poor (Harris, 2004).

ICTs have pervaded all sectors of the economies. The effects are felt in virtually all areas of industrial activities. The features and scope of their adoption have been plausibly explored in recent times (e.g. Mpofu and Gono (2016); Benabderrahmen, Brahmi and Hmida (2016); Makiwa and Steyn (2016)). Nonetheless, Africa has been bedeviled with inadequacy in similar research. This kind of study in Africa has been dealt with in too few research works (e.g. Ismail, Jeffery and Van Belle (2016) and Nalumaga (2016)). This information is valuable in understanding the inter-links that exist among the trio of ICT, development and poverty in African continent, which has not been adequately investigated. Hence, this study intends to fill part of the gap. The aim of this study is to investigate into the factors that affect ICT development, human development and poverty incidence in Africa, as well as examine the inter-relationships existing among the trio.

Hypotheses

- (i) There is no significant relationship between ICT development and poverty.
- (ii) There is no significant relationship between human development index (HDI) and poverty.
- (iii) There is no significant relationship between ICT

development and human development.

2. Review of Literature

Several studies have been carried out on the effects of ICTs on development and poverty in both developed and developing countries. These studies are of enormous assistance in the conduction of this study. UNDP (2002) demonstrated that information technologies have been used in India for poverty eradication. Such information was basically on weather predictions, rainfall patterns, meetings and workshops which were reported to be made available via ICT. It was noted that limited level of literacy had hampered use of ICT. Munyua (2000) asserted that traditional and modern ICTs could be used concurrently to hasten the information flow. It was discovered that inconsistent and incomprehensive ICT was a major hindrance to development. On the other hand, Kole (2000) found that African women's organizations needed to repackage information from the Internet and redistribute such orally, or by the use of traditional print publications, radio and television. Harris (2004) reported that governments and civil society organizations successfully utilized ICTs in reducing poverty in Brazil. The ICTs were said to be used in knowledge management and sharing of best management practices. United Nations (2006) also reported that automation of land ownership enhanced cheaper and quicker access to statements of land holdings. It was further stated that though ICTs offer vast development opportunities, those that were mostly in need of them often have the least access to them. UN (2006)

listed the low income groups, rural communities, women, and those with no formal education as categories of people with least access to ICTs. Huyer et al. (2005) affirmed that Guinean and Djiboutian women represented less than 10 percent of the Internet users; less than 20 per cent Nepalese women used internet; and less than one-quarter Indian women were users of internet. Sagna (2005) identified rural dwellers as been neglected with respect to internet services. UNDP (2001) revealed that the well-educated persons were most chanced in usage of internet services. It was affirmed that 89 percent of Chilean internet users were those who had tertiary education. Kenny et al. (2000) argued that there was link between development of telecommunications and economic development.

The ICT sector has been disclosed to have significant impact in developing countries. Burgess and Pande (2005) and Levine (2005a, b) showed that ICTs were used in the agricultural sector for food and agricultural production. They also revealed that ICTs improved access to financial services which significantly impact on economic growth and poverty reduction. Aker and Mbiti (2010) and Sen and Chowdhary (2011) observed that exploiting of mobile money in Kenya by households helped in management of negative livelihood shocks. Aker and Mbiti (2010) and Chavula (2012) revealed the outcome of mobile technology developments on farmers' livelihood. They showed that mobile phones helped farmers to compare market prices for grain and fish which helped them to guard against spoilage and

waste by effortlessly locating the consumers. Halewood and Surya (2012) discovered that ICTs resulted into 36 percent increase in farmers' and traders' earnings. ICT also helped them to have access to price information. ICTs were also found to facilitate agricultural growth through enhancement of market interaction efficiency and provision of access to information that resulted in better pricing proficiency. This was achievable by employing trading platforms on the internet by means of web/mobile applications (Driouchi et al., 2006). McKinsey (2013) reported that online virtual market resulted in improved revenues. This was achievable through phone or SMS. Addo-Dankwa (2002) confirmed that ICTs enhanced increased revenues of small and medium enterprises and improved management practices through access to information. Chowdhury (2000) illustrated ICTs as means of combating poverty and child malnutrition by guaranteeing accessible information to the household, particularly the mothers.

Flor (2001) stated that human poverty index had inverse relations with the number of telephone lines, personal computers and TV sets per 1000 persons. Also, it was observed that the value of ICT indicators was inversely related with poverty rank. ITU (2002) revealed existence of digital dichotomy within countries, between developed and less-developed regions, between urban and rural areas, between the poor and the rich, between the educated and the illiterates, between genders, and between the young and the old. Yunus (2008) envisaged that the future of poverty would

be determined by the technological devices and services that were intended for the poor. There would be increased potentials if individuals or groups have the inherent capacity to be able to apply new technological resources (Warshauer, 2003), which are also enhanced by ICT usage. Spence & Smith (2009) suggested that ICT-enabled communications built human potentials and provide economic services, as well as personal, family and social interactions. Ssewanyana (2007) found a positive correlation between investment in ICTs and economic growth. Also, it was established that there was relationship between telephone usage and economic growth, and that households without ICT were more likely to be poor compared to their counterparts with ICT. Dalvit et al. (2007) reported that an e-commerce platform had tendency to contribute to rural development and poverty alleviation. Kwapong (2008) showed that efficient use of ICT was crucial to any reliable effort for enhancing higher levels of growth and development of human condition.

Even though ICTs have the potential to reduce the digital divide within and between countries and regions, Torero and von Braun (2005) asserted that ICTs and their benefits are not yet getting to the poor countries at the same magnitude as the developed countries, especially the poor rural areas. ICTs have been said to have the potentials to contribute to the development of socioeconomic conditions in developing countries through reduction of costs of information sharing, enhancement of timely accessibility and provision of prospects for network creation between people who share

particular information needs. In spite of established ICT success in helping to cut rural poverty, priority has not been accorded to rural ICT development (von Braun, 2010). The effects of ICTs for rural households were listed to include time and resource savings, access to better information resulting to better decision making, enhancement of better efficiency and productivity (Tschang et al. 2002; Andrew et al. 2003; von Braun, 2010), and expanded market reach (von Braun, 2010). Jensen (2007) demonstrated that availability of information to fishermen through mobile telephones in Kerala had consequence on market performance by improving the welfare of the people, enhancing more resourceful allocation of the catch along the markets, and decreasing price variation. Aker (2010) reported that the introduction of mobile phones was associated with 20 percent decline in grain price disparity across markets in Niger. Camacho and Conover (2011) found that when farmers in Colombia received regular price and weather information through text messages they had a significant drop in crop failure. Beuermann (2011) also asserted that availability of payphones in Peru villages elevated rural income by about 16 percent, which was ascribed to decline in information asymmetries between farmers and traders. Goyal (2010) linked the prevalence of ICT adoption by firms and households with improved market performance which was accompanied with resultant improved resource allocation and prompt growth. However, Forman et al. (2012) opined that Internet investments tended to worsen income inequality between regions. De los

Ríos (2010) indicated that Internet users experienced faster income growth than non-users. May et al. (2011) found that gaining access to ICTs is associated with 2.5 percent improvement in household's poverty status. Di Maggio and Bonikowski (2008) and Mossberger et al. (2007) confirmed the connection between ICT skills and earnings. ICT has a significant impact to socio-economic performance of countries and regions, and has tendency to impact positively on economic growth as shown by these literatures.

3. METHODOLOGY

The study makes use of cross-sectional data from forty-three African countries. The selected countries were those with complete information with respect to all the variables necessary for the study. The variables considered include ICT development index, mobile cellular subscription, internet bandwidth, adult literacy level, GNI per capita, inequality level, human development index (HDI) and poverty level. The data were obtained from International Telecommunication Union, United Nations and World Bank databases for 2015. Descriptive statistics were used to consider the average, minimum and maximum levels of the aforementioned indices. Cobb-Douglas production function was used to show the factors that influenced ICT development, HDI and poverty among the selected countries. Also, a three stage least square estimation that examines a simultaneous equation model was used to reveal the links that exist among ICT development, HDI and poverty.

The analysis employed for this study follows the works of Yeh (2009), Al Farooque et al. (2005) and Obi et al. (2016). A system of simultaneous equation is considered suitable for two main reasons. Firstly, the model helps to increase the efficiency of the estimates compared to single-equation models. Secondly, the model helps to check the robustness of the results obtained by single-equation methods (Benos, 2004). Furthermore, t-test was used to test for the hypothesized relationships between poverty and ICT development, poverty and HDI, and HDI and ICT development. The models for the Cobb-Douglas production function can be stated thus:

$$\ln Q = \ln a_0 + a_1 \ln x_1 + a_2 \ln x_2 + a_3 \ln x_3 + a_4 \ln x_4 + a_5 \ln x_5 \text{-----}(1)$$

$$\ln Y = \ln a_0 + a_1 \ln x_1 + a_2 \ln x_2 + a_3 \ln x_3 + a_4 \ln x_4 + a_5 \ln x_5 \text{-----}(2)$$

$$\ln Z = \ln a_0 + a_1 \ln x_1 + a_2 \ln x_2 + a_3 \ln x_3 + a_4 \ln x_4 + a_5 \ln x_5 \text{-----}(3)$$

4. RESULTS AND DISCUSSIONS

Table 1. The mean, minimum and maximum values of development indices for African countries

Indices	Maximum	Minimum	Mean	Number of countries below mean	Percentage of countries below mean
Literacy level	95.30	31.9	69.3	17	39.53
ICT development index	5.41	1.17	2.71	28	65.12
Mobile subscription/100	210.37	6.39	89.36	23	53.49
Internet bandwidth	149542	27	11054.19	34	79.07
Inequality level	63.4	30.8	43.71	26	60.47
Poverty level	76.8	8.0	42.77	21	48.84
HDI	0.78	0.39	0.54	27	62.79
GNI per capita	13990	250	2805.47	29	67.44

The three-stage simultaneous equation is stated thus:

$$Q = \alpha + b_{11}x_1 + b_{12}x_2 + b_{13}x_3 + b_{14}x_4 + b_{15}x_5 + b_{16}Y + b_{17}Z + e_1 \text{-----} (4.1)$$

$$Y = \beta + b_{21}x_1 + b_{22}x_2 + b_{23}x_3 + b_{24}x_4 + b_{25}x_5 + b_{26}Q + b_{27}Z + e_2 \text{-----} (4.2)$$

$$Z = \gamma + b_{31}x_1 + b_{32}x_2 + b_{33}x_3 + b_{34}x_4 + b_{35}x_5 + b_{36}Q + b_{37}Y + e_3 \text{-----} (4.3)$$

Where, Q is used for ICT development index; Y = Human development index (HDI); Z = poverty status (can be computed by with poverty index); x_1 = mobile subscription (number of subscriptions of mobile telephones per 100); x_2 = access to internet (bandwidth); x_3 = adult literacy (percent); x_4 = GNI per capita (dollars); x_5 = inequality level (Gini coefficient); a_i 's, b_{ij} 's = coefficients of the parameters to be estimated; α , β and γ are the constants.

According to the table as depicted in Table 1, 65 percent of the selected African countries had below 2.71 average value of ICT development index; 53 percent had below average mobile subscription per 100; 79 percent had below average internet bandwidth; about 63 percent of the countries

were below average HDI; and 67 percent had less than average GNI per capita on the continent. Also, about 60 percent of the countries had above mean literacy level; about 40 percent had above average inequality level; and about 51 percent had greater than average level of poverty.

Table 2. Determinants of ICT development in Africa

Variables	Coefficient	Standard error	t-statistic
x1 (mobile subscription)	0.3306	0.0588	5.6238***
x2 (access to internet)	0.0681	0.0218	3.1190***
x3 (adult literacy)	0.5629	0.1370	4.1100***
x4 (GNI per capita)	0.0503	0.0389	1.2929
x5 (level of inequality)	-0.3914	0.1738	-2.2522**
Constant	-2.3623	0.6994	-3.3777
R ² = 0.8299; Standard error = 0.1734; N = 43; Dependent variable = ICT development			

*** - 1% level of significance

Table 2 presents the determinants of ICT development in Africa. The most significant factors that influenced ICT development in the continent were mobile subscription, access to internet, adult literacy and level of inequality within individual countries in the continent. The result showed that a percentage increase in mobile subscription resulted in 0.33 percent increase in ICT development. A percentage point increase in internet bandwidth had 0.06 percent resultant increase in ICT development; while 1 percent point increase in adult literacy resulted into 0.56 percent increase in ICT development. However, a percentage point increase in level of inequality within

respective countries resulted in 0.39 percent decrease in ICT development.

It could be implied that increased volume of mobile subscription and internet bandwidth enhanced ICT development in the continent. It could also be implied that improvement in literacy level of adult Africans would result in improvement in ICT development in the continent. On the other hand, the implication of negative coefficient of level of inequality was that unequal distribution of wealth within African countries would slow down the development of ICT in the continent. The R² value implies that the exogenous

variables were responsible for about 83% variations in the endogenous variable.

Mauritius, Seychelles, South Africa and Tunisia were examples of countries that had high ICT development index which were accompanied with high levels of mobile subscriptions, internet bandwidths, and literacy levels. The countries except South Africa had inequality levels that were lower than African average. Most of the countries

that had high inequality levels had low ICT development index. On the other hand, countries like Djibouti, Togo, Zambia, Mozambique, South Sudan, Guinea Bissau and Malawi had low ICT development index that were accompanied with low mobile subscriptions, low internet bandwidths, low levels of literacy, and high levels of inequality.

Table 3. Determinants of human development in Africa

Variables	Coefficient	Standard error	t-statistic
x ₁ (mobile subscription)	0.0904	0.0251	3.5948***
x ₂ (access to internet)	0.0152	0.0093	1.6219
x ₃ (adult literacy)	0.2624	0.0586	4.4779***
x ₄ (GNI per capita)	0.0890	0.0166	5.3533***
x ₅ (level of inequality)	-0.1445	0.0743	-1.9443*
Constant	-2.3817	0.2992	-7.9603

$R^2 = 0.8743$; Standard error = 0.0742; N = 43; Dependent variable = Human development

*NB: *** - 1% level of significance; * - 10% level of significance*

Table 3 presents the determinants of human development in Africa. The most significant factors that influenced human development in the continent were mobile subscription, adult literacy, per capita GNI and level of inequality. The result showed that a percentage increase in mobile subscription resulted in 0.09 percent increase in human development. A percentage point increase in per capita GNI had 0.09 percent resultant increase in human development; while 1 percent point increase in adult literacy resulted into 0.26 percent increase in human

development. On the other hand, a percentage point increase in inequality level resulted in 0.14 percent decrease in human development.

It could be implied that increase in volume of mobile subscription resulted in improvement of human development in Africa. Also, any policies that engender increase in per capita GNI has high tendency to improve human development. Moreover, education had been a very crucial tool for human development; hence, any government

that sincerely desires development of its citizenry must enshrine education programs in its policies. On the other hand, the result implies that unequal distribution of income is a bane to human development in Africa. The R² value implies that the exogenous variables were responsible for about 87% variations in the endogenous variable.

Mauritius, Seychelles, Gabon and South Africa were examples of countries that had high HDI that was attended with high levels of mobile subscription, GNI per capita and

Table 4. Determinants of poverty status in Africa

Variables	Coefficient	Standard error	t-statistic
x ₁ (mobile subscription)	-0.0805	0.1427	-0.5645
x ₂ (access to internet)	-0.1295	0.0530	-2.4432**
x ₃ (adult literacy)	-0.5295	0.3324	-1.5930
x ₄ (GNI per capita)	-0.0877	0.0943	-0.9293
x ₅ (level of inequality)	0.9841	0.4217	2.3336**
Constant	4.2554	1.6973	2.5072
R ² = 0.6684; Standard error = 0.4208; N = 43; Dependent variable = poverty status			

NB: ** - 5% level of significance

Table 4 presents the determinants of poverty incidence in Africa. The most significant factors that influenced incidence of poverty in the continent were access to internet and level of inequality within individual countries in the continent. The result showed that a percentage increase in internet bandwidth had 0.13 percent resultant reduction in poverty in the continent; while a percent point increase in inequality level

adult literacy. All these countries had relatively high HDI with low inequality levels except South Africa. Countries that had high inequality levels with low HDI include Zimbabwe, Lesotho, Zambia, Rwanda and Guinea Bissau. However, Botswana and Namibia had high inequality levels accompanied with high HDI.

resulted into 0.98 percent increase in poverty.

It could be implied that increase in the level of internet bandwidth would engender a significant reduction in poverty rate in Africa. On the other hand, the result implies that unequal distribution of wealth is an impious stimulant to poverty incidence in the continent. The R² value implies that the exogenous variables were responsible for

about 67% variations in the endogenous variable.

Countries like Zambia, Lesotho, Guinea Bissau, Zimbabwe, Togo, Equatorial Guinea, Eritrea and Nigeria were instances of occurrence of low internet subscriptions

and high inequalities which were accompanied with high level of poverty. On the contrary, countries like Mauritius, Seychelles, Tunisia, Cape Verde, Morocco, Algeria and Gabon had low poverty levels that were coupled with high internet bandwidths and low levels of inequality.

Table 5. Determinants of ICT development, human development and poverty, and their inter-relationships

Variable	Q (ICT development)	Y (Human development)	Z (poverty status)
Q (ICT development)	--	0.0960	-0.8813**
Y (Human development)	0.4781	--	-1.1876
Z (poverty status)	-0.1500**	-0.0406	--
x ₁ (mobile subscription)	0.2753***	0.0554*	0.3181*
x ₂ (access to internet)	0.0415*	0.0034	-0.0515
x ₃ (adult literacy)	0.3581**	0.1869***	0.2781
x ₄ (GNI per capita)	-0.0055	0.0806***	0.0623
x ₅ (level of inequality)	-0.1747	-0.0671	0.4676
Constant	-0.5854	-1.9824	-0.6546

*NB: *** - 1% level of significance; ** - 5% level of significance; * - 10% level of significance*

Theoretically, the three dependent variables in Tables 2 – 4 may not be isolated from one another. Practically, all the three variables interconnect among themselves. The result of simultaneous equation (Table 5) showed the inter-relationship among the dependent and independent variables. The variables that significantly influenced ICT development were poverty rate, mobile subscription, access to internet and adult literacy. All of these variables positively influenced ICT development, except the rate

of poverty which had an inverse relationship with ICT development in the continent. The variables that had significant influence on human development were mobile subscription, adult literacy and per capita GNI. All these variables were directly related to human development within the continent. The variables that significantly influenced rate of poverty in Africa were ICT development and mobile subscription. ICT development had an inverse relationship with poverty rate in the

continent, while mobile subscription had direct relationship with rate of poverty. This direct relationship between mobile subscription and poverty rate is unexpected. It may imply that mobile subscription is more common among the rich than the poor in the continent. In addition, this result summarily implies that poverty is a curse against every form of development on African continent. Examples of countries that had high ICT development accompanied with low poverty levels were

Mauritius, Seychelles, South Africa, Tunisia, Cape Verde, Morocco, Algeria, Egypt, Ghana, Botswana and Namibia. Cases of countries that high poverty levels attended with low ICT development were Nigeria, Senegal, Gambia, Congo Republic, Mali, Equatorial Guinea, Togo, Zambia, Rwanda, Liberia, Mozambique, Burkina Faso, Congo DR, South Sudan, Guinea Bissau, Malawi, Madagascar and Eritrea.

Table 6. Correlation and significance of relationship between various pairs of poverty, ICT and human developments

Items	Poverty & ICT development	Poverty & Human development	ICT development & Human development
Correlation	-0.6363	-0.6785	0.8525
t Statistic	41.7361	21.0085	41.0861
t Critical	2.0181	2.0181	2.0181
Decision	Reject H_0	Reject H_0	Reject H_0

Table 6 revealed high but negative correlation coefficients between poverty and ICT development, and poverty and human development. However, there is a positive and high correlation between ICT development and human development. The t-Statistic values which are higher than t-Critical values show that the earlier stated hypotheses should be rejected. In other words, there are significant relationships among the variables.

5. CONCLUSION

The study has displayed significant relationships between ICT and human development and poverty. ICT is very vital in improvement of human development and reduction of poverty level in Africa. However, poverty has offered disservice to every form of development in the continent. Therefore, it is very crucial that all poverty alleviation programs should be taken seriously and embarked upon passionately. Finally, the study has shown that ICT in itself cannot solve African poverty problem. An enduring solution could only be achieved

through improving the living standard of African people, and by sufficiently supporting the educational system within respective African nations. Based on the findings from this study, the paper recommends the following:

- Governments of African countries should integrate ICT with the poverty alleviation programs being embarked upon. They should go beyond lip service to actually committing themselves to implementing such programs.
- Education must be considered as a major tool for socio-economic development which ought to be given due prominence by all stakeholders, if lasting development is desired.
- ICTs should be effectively incorporated into schools' curriculum at all levels. African countries should integrate ICT education into their education policies.
- ICTs should be made an integral part of most entrepreneurial activities especially in rural sector which is the geographical domain of the poor. This would bring about reduction of information asymmetry between the rural entrepreneurs and the well-endowed urban businessmen.
- Telecommunication service providers should fashion out plausible ways whereby tariffs would be reduced and internet and communication services would be improved with respect to volume and quality of networks.

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