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SCIENTIFIC PAPER

OCCUPATIONAL CHOICE AND AGRICULTURAL LABOUR EFFICIENCY IN NIGERIA: IMPACT OF ICTS

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Abstract: *Increased labour efficiency is imperative in the developing world and particularly in Nigerian Agriculture which should be in its leaping phase. The interaction between labour efficiency and ICTs is inevitable in the realisation of the nation's agribusiness potentials. Following a vivid descriptive statistics on main occupations and access to ICTs among the Nigerian populace, this study assessed effects of ICTs on the probability that a working aged Nigerian chose agricultural occupation over non-agricultural occupations. In doing so, the study analysed the effects of access to ICTs on agricultural labour efficiency in Nigeria. Data used for the analysis were drawn from the Nigerian General Household Survey-Panel held in 2010-2011 period. Analytical framework for the study include: Logistic Regression and Multiple Regression Models. Results show that access to mobile phones, using the internet to obtain information, and using the internet to send or receive mails were significant factors of the probability that a Nigerian chose agriculture or its related activities as a main occupation. Again, access to personal computers, use of the internet for e-banking, e-learning and for reading e-newspapers had significant impact on agricultural labour efficiency in Nigeria. The study recommends that labour policies should find a place for the role of ICTs, particularly the internet.*

Keywords: *Labour, Efficiency, ICTs, Agriculture (JEL. Code:* Q12)

INTRODUCTION

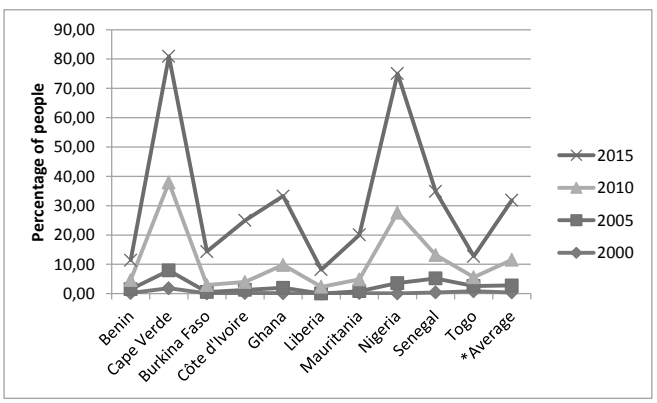
Stepping up labour efficiency which is synonymous with labour productivity in this context is imperative for economic progress in Nigeria as it is for the generality of the low income countries. Labour productivity growth is especially imperative in Nigerian agricultural sector where the nation's labour force is mainly channelled. Raising agricultural labour productivity is vital for the required change in poor agrarian economies. CHRISTIAENSEN et al. (2011) in: DORWARD (2013) enumerated some of the multiple foundational roles of agricultural revolutions that raise agricultural labour productivity can play in wider development processes. Firstly, new technologies and resources that increase labour productivity also increase food availability per worker. Because higher labour productivity lowers the cost (and hence price) of food relative to agricultural worker income and raises agricultural workers' budget surpluses after food expenditures there is increased real labour income which stimulates demand for non-food goods and services.

Increased agricultural labour productivity in Nigeria will not only address the country's need for productivity growth in itself, but it will as well release abundance of labour to other sectors of the economy, increase real income of the labour force, and motivate supply and demand of manufactured goods and services. Although there have been several development interventions with respect to increasing labour productivity, there exist big disparity between agricultural labour efficiency in Nigeria and in the developed countries. World Development Report in: GUTIERREZ (2000) shows that average agricultural GDP per worker in low income countries was US $293 (at 1987 U. S. Prices) between 1994 -1996. This statistics implied that a worker in the Netherlands produced as much in three days as an average farmer produced in low income country in one year. Given the temporal consideration, the present gap in Nigeria may not be as much as stated but the need for economic progress via increased labour efficiency in the agricultural sector is glaring. Perhaps "Labour Augmenting Technological Progress" is vital to closing Nigeria's agricultural labour efficiency gap. According to TODARO AND SMITH (2011), economic development in form of Labour Augmenting Technological Progress occurs when the quality or skills of the labour force are upgraded. That is, the productivity of an existing quantity of labour is

raised by general education, on the job-training programs, etc. Use of ICTs for example, to seek information about farming, to order or purchase farm inputs, to enhance access to finance via e-banking and e-money transfers will likely increase the productivity of the labour force. However, the question of accessibility of these ICTs to the Nigerian agricultural labour force needs to be answered. Accessibility of ICTs in developing world context seeks to expand the geographic access to ICTs of the population at large, and often for the very first time including minimum coverage, especially of remote communities, thereby allowing all citizens to "use the service, regardless of location, gender, disabilities, and other personal characteristics" (DYMOND et al. 2010 in: BARRET & SLAVOVA, 2011).

Positive move towards accessibility of ICTs is rife in Nigeria as the country is often rated as one of the fastest growing telecoms nation in the world and the fastest in Africa (NIGERIA COMMUNICATION COMMISSION (NCC), 2016). Statistical reports of INTERNATIONAL COMMUNICATION UNION (ITU) (2017) showed that the percentage of Nigerians who use the internet grew from 0.06% in 2000 to 47.44% in 2015 (Figure 1). Beginning from 2005, percentage users of internet in Nigeria far outstripped the relative average from the ten selected West African Countries depicted in figure 1. In 2015, for example the percentage of Nigerians who use the internet was 47.74% in contrast to relative average of 20.30% in the selected ten West African countries. By July 2016, 81.7% of Nigerian population were active telecoms subscribers, with the mobile segment accounting for more than 99% of subscriptions (OXFORD BUSINESS GROUP (OBG), 2017).

Figure 2: Percentage of people using the internet from 2000 to 2015 in selected West African Countries

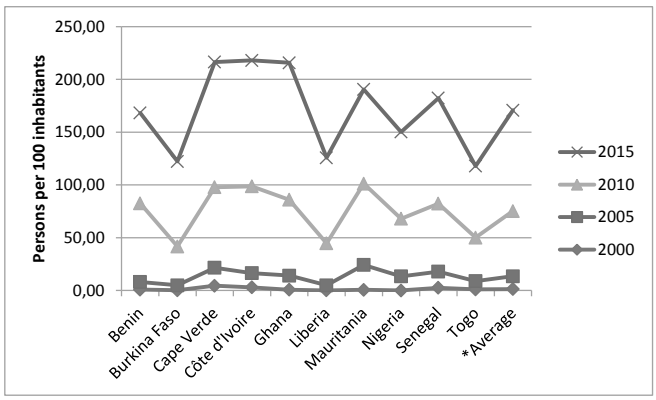


Average is the mean percentage per year for the countries depicted
Source: Authors analysis from ITU COUNTRY ICT DATA UNTIL 2015 (2017)

The rapid growth in internet users in Nigeria may be linked to increased investment in the telecoms sector. Investments made by Nigerian banks in 2004 under the Small and Medium Enterprises Investment Scheme constituted about 56% (NCC, 2005 in: URAMA & ODUH, 2012). In 2015 ICT-related activities accounted for nearly 11% of Nigerian GDP, up from 6% in 2012 and less than 1% as recently as 2001 (OBG, 2017). According to NCC report in 2017, the Nigerian telecoms contributed N1.580 trillion (US$5.18 billion) to gross domestic product (GDP) in the second quarter of 2016, or 9.8 per cent, which represents an increase of 1.0 per cent points relative to the previous quarter. Moreover, there are a few international and multilateral agencies investing in the Nigerian telecommunications industry. Such agencies include the Export-Import Bank of the US (US Exim Bank), African Export-Import Bank (AFREXIM), African Development Bank, Development Bank of South Africa and the International Finance Corporation (IFC).

Until recently, connectivity in rural areas where agriculture is domiciled was limited to slow dial-up lines. Satellite connections now make broadband access possible in these remote areas. Use of mobile phones has seen an enormous increase in recent years, especially in agrarian areas in Africa including Nigeria. Nevertheless, big differences still exist in broadband access between developed and developing countries, with Africa having only three per cent of global broadband users. Although Nigeria is reputed as fast growing telecommunication nation, it is clear from figure 2 that the growth still needs to reach its leap and bounds.

Figure 2: Mobile subscription per 100 inhabitants in some West African Countries in 2000 to 2015



****Average is the mean percentage per year for the countries depicted***
Source: Authors analysis from ITU COUNTRY ICT DATA UNTIL 2015 (2017)

Despite the rapid growth of mobile subscribers in Nigeria after 2000, it has remained below the average subscription rate among West African countries (figure2). In 2010 and 2015 for example, Nigeria had 54.66 and 82.1 subscriptions per 100 inhabitants whereas regional averages were 61.84 and 95.42 mobile subscriptions per 100 inhabitants, respectively (figure2). This study analysed the impact of ICTs on Nigerian agrarian sector, given its growths in the past two decades.

Based on the forgoing, the paper established the effects of access to ICTs on the Labour efficiency in Nigerian agricultural and agribusiness occupations. Following descriptive statistics, the preliminary analysis determine the effects of access to ICTs on the probability that a Nigerian worker chose an agricultural/agribusiness occupation in place of non-agricultural occupations.

METHODOLOGY

Nigeria was chosen as the geographic location of the study. The country is located in West Africa on the Gulf of Guinea and in the tropical zone. It lies within latitude 40° and 140° north of the equator and longitudes 30° and 140° east of the Greenwich meridian. It is bounded on the West by the Republic of Benin, on the North by the Republic of Niger and on the East by the Federal Republic of Cameroun. On the North-East border is Lake Chad which also extends into the Republic of Niger and Chad and touches the northernmost part of the Republic of Cameroun. On the South, the Nigerian coast- line is bathed by the Atlantic Ocean. The country occupies a land area of 923,768.00 square kilometres, 86.2 percent of which is agricultural land and 102,700 square kilometres was forestland as at 2007 (WORLD BANK, 2009). Nigerian population was 151.21 million (2.3 percent annual growth rate) in 2008; 78,141,389.6 was a rural population (WORLD BANK 2010 in: IFAD, 2010).

Cross sectional data were drawn from the General Household Survey-Panel (GHS) conducted in 2010/2011. The survey was conducted by the Nigerian Bureau of Statistics in conjunction with the World Bank. Amidst other important data, the survey elicited information on access to ICTs and labour. The GHS (2011) is a two-stage probability sample. In the first stage, the primary sampling units termed "enumeration areas (EAs)" were selected based on probability proportional to size of the total EAs in each state and the Federal Capital Territory giving a total of 500 EAs. In the second stage, households were selected randomly using the systematic selection of ten (10) households per EAs giving a total of 5,000 households. The final number of households at end of these wave one surveys were 4,851 with a total of 22, 990 individuals providing response to the questionnaires from which data were elicited for this analysis.

After a preliminary descriptive statistics of occupational distribution, labour variables and access to ICTs, the following logit transformation for the probability of a worker choosing agribusiness occupations in place of non-agricultural occupations was specified. The logit model is an outcome of several trials of alternative sets dependent variables measuring access to ICTs:

$$\ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + \beta_{13} X_{13} + \mu \quad (1)$$

Where:
$\ln\left(\frac{P_i}{1-P_i}\right)$ = natural log of the odds ratio in favour of choosing agribusiness occupations
X_1= Access to Mobile phone (1-4 ranking)
X_2 = Access to Personal computers (1= accessed, 0 =not accessed))
X_3 = Access to the internet (1-4 ranking)
X_4 = Rate of use of the internet (1=frequently, 0=not frequently))
X_5 = Used the internet to obtain information (1=yes, 0= no)
X_6 = Used the internet to obtain information (1=yes, 0= no)
X_7 = Used the internet to send/receive mails (1=yes, 0= no)
X_8 = Used the internet to send/receive instant messages (1=yes, 0= no)
X_9 = Used the internet to make/receive voice calls (1=yes, 0=no)

With most of the independent variables (access to mobile phones, access to television, access to radio, etc) having distorting impact dropped, the following linear multiple regression model used to determine the effects of ICTs on agricultural labour efficiency is specified as:

$$L=\alpha_0 + \alpha_1 Q_1 + \alpha_2 Q_2 + \alpha_3 Q_3 + \alpha_4 Q_4 + \alpha_5 Q_5 + \ell$$

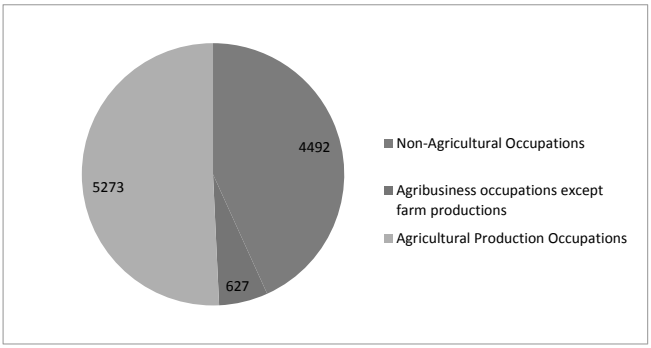
Where:
L: Individual's labour earning per hour in last working year before February, 2011(in Naira)
Q_1: Rate of Internet use (1=frequently, 0= not frequently)
Q_2: Used the Internet For Electronic Banking (1=yes, 0= no)
Q_3: Used the Internet For Electronic Learning (1=yes, 0= no)
Q_4: Used the Internet to read electronic newspapers (1=yes, 0= no)
Q_5: Access to personal Computers (Ranked 1 to 4)
α_0: constant intercept.
α_1 to α_5: parameters of independent variables

ℓ : error term
Apriori, Q_1 to $Q_5 > 0$,

RESULTS AND DISCUSSIONS

Figure 1 provides frequencies of Occupational distribution of the sampled working population in Nigeria. Out of the 22900 sampled individuals, only 10, 392 of them stated their main occupations. The figure is perhaps showing that only 45.38 percent of the population were engaged or were in their active working age. Of those who stated their occupations 5273 (50.74%) engaged in agricultural production which included crop production, animal husbandry, forestry, fishery and wildlife management.

Figure 1: Frequency Distribution of the Respondents Occupations



Approximately 0.06 percent (627) of the sampled individuals were engaged in secondary agricultural activities classified agribusiness occupations. Agribusiness involves a wide range of activities related to agricultural production including: supplies of agricultural inputs, processing of agricultural raw materials, marketing and distribution of agricultural produce/ products, etc. Contrastingly, 4492 individuals representing 42.23 percent of those who reported work status had non-agricultural activities as their main occupation.

Table 1 present frequency distribution of the respondents' access to ICTs. Precisely 69.2 percent of the workers had access to radio, 21 percent owned radios making their access to radio of highest rank. Again, 59.2 percent of the population have access to mobile phones but only 29.9 percent of them owned phones while 26.3 percent of the population accessed mobile phones through their family, friends or neighbour. Majority (41.3 percent) of the individuals did not provide information about their access to mobile phones.

On accessibility of television, 9467 of the 22900 individuals had access to television with only 2414 or 10.5 percent owning the television, 29.5 percent viewed television owned by their family member, friend or neighbour. Contrastingly, only 3.2 percent of the individuals reported access and most (2.5 percent of them accessed the internet via a paid internet café. Only very few individuals (0.3 percent) had the top ranked access to the internet by owning an internet subscription. A comparative study done in Nigeria showed that radio and mobile phone, followed by television were the most accessed and utilized ICTs among the agrarian households (CHIKAIRE et al. 2017).

The logistic regression results (table 2) unveil that access to mobile phones, and seed cost significantly (at P< 0.01) favoured the choice of agricultural occupation against non- agricultural occupation as a main source of income. Antilogarithm of the coefficient (-2.1074) of access to mobile phones was 0.121 implying that an individual leaping from one level of mobile phones accessibility to the next higher level is 0.121 time likely to choose an agricultural occupation than a non-agricultural occupation. This result also imply that if there were 1000 chances for choosing an occupation due to increased access to mobile phones in Nigeria, only 121 of those chances are likely to be allotted to the choice of agriculture. This result concord the claim of HWANG et al. (2004) that investments in ICTs have a moderately positive relationship with the share of wage employment in non-agricultural sectors. A study of South African economy further show that with development in ICTs, employment in agriculture fell by 21% from 2001 to 2012 while occupational changes among skilled agricultural workers declined by 3.9% (BHORAT et al. 2013).

Such result may be linked to the fact that often people drift from agriculture to non-agricultural sectors so long as they are informed of available opportunities. Mobile phones bridges the information gap which favours out-migration of the labour force from agriculture. Table 2 further show that although very small population had access to the internet (table 1), use of the internet had a significant (at P< 0.1) effect on the likelihood that an individual within the Nigerian population chooses agriculture or its related activity as a primary occupation.

Specifically, increased browsing of the internet for information (P=0.076< 0.10) and increased use of the internet to send or receive e-mails (P=0.064 <0.10) had significant positive relationship with the likelihood that agricultural occupation is chosen over non-agricultural occupation. The antilog of the coefficient of use of the internet for information surfing (0.7751) is 2.1708 implying that if an individual responded 'yes' to the question, "do you use the internet to surf information?"

Table 1: Frequency Distribution of Acess to ICTs by the Respondents

Had access to a radio?			Acess to Radio-Ranked by Source of Access			
	Frequency	Percent	Source of Access	Rank	Frequency	Percent
No	2,789	12.1	Business Centre	1	8	0.0
Yes	15,904	69.2	Workplace	2	11	0.0
Missing	4,297	18.7	Family member, friends or neighbour	3	10,974	47.7
Total	22,990	100	Owned	4	4,832	21.0
			Missing	None	7,165	31.3
			Total		22,990	100
Had access to mobile phone?			Acess to mobile phone-Ranked by Source of Access			
	Frequency	Percent	Source of Access	Rank	Frequency	Percent
No	5,022	21.8	Business Centre	1	570	2.5
Yes	13,621	59.2	Workplace	2	4	0
Missing	4,347	19.0	Family member, friends or neighbour	3	6,035	26.3
Total	22,990	100	Owned	4	6,883	29.9
			Missing	None	9,498	41.3
			Total		22,990	100
Had access to television?			Access to Television-Ranked by Source of Access			
	Frequency	Percent	Source of Access	Rank	Frequency	Percent
No	9,187	40	Business Centre	1	172	0.7
Yes	9,467	41.2	Workplace	2	7	0
Missing	4,336	18.9	Family member, friends or neighbour	3	6,790	29.5
Total	22,990	100	Owned	4	2,414	10.5
			Missing	None	13,607	59.2
			Total		22,990	100
Had access to the internet?			Access to the Internet-Ranked by Source of Access			
	Frequency	Percent	Source of Access	Rank	Frequency	Percent
No	17,808	77.5	Internet Café	1	573	2.5
Yes	726	3.2	Workplace	2	41	0.2
Missing	4,456	19.4	Family member, friends or neighbour	3	29	0.1
Total	22,990	100	Owned	4	76	0.3
			Missing	None	22,271	96.9
			Total		22,990	100

Source: Results of Authors Analaysis from Nigerian General Household Survey, 2011

Table 2: Logistic Regression Results: Effects of Access to ICTs on Choice of Occupation
Dependent Variable: Choice of Occupation (1=agribusiness, 0=otherwise)

Independent Variables: Access to ICT Variables	Coefficient	Standard Error	Z	P>IzI
Access to Mobile phone (1 -4 ranking)	-2.1074	0.7976	-2.64	0.008
Access to Personal computers (1= accessed, 0 =not accessed)	-0.3481	0.3988	-0.87	0.383
Access to the internet (1-4 ranking)	-0.2011	0.2252	-0.89	0.372
Rate of use of the internet (1=frequently, 0=not frequently)	-0.1981	0.4250	-0.47	0.641
Used the internet to obtain information (1=yes, 0= no)	0.7751	0.4369	1.77	0.076
Used the internet to send/receive mails (1=yes, 0= no)	0.9959	0.5369	1.85	0.064
Used the internet to send/receive instant messages (1=yes, 0= no)	-0.5625	0.4626	-1.22	0.224
Used the internet to make/receive voice calls (1=yes, 0=no)	0.1880	0.6653	0.28	0.778
Used the internet to order for goods or services (1=yes, 0=no)	-0.6702	1.0873	-0.62	0.538
Used the internet for electronic banking (1=yes, 0= No)	-1.1094	0.7816	-1.42	0.156
Used the internet for electronic learning (1=yes, 0= No)	0.354	0.4102	0.86	0.392
Used the internet to read or download newspapers (1=yes, 0 = no)	-0.4999	0.4726	-1.06	0.290
Constant	6.3919	3.1276	2.04	0.041
Log likelihood: -97.415	Number of Observations:		287	
LR Chi-Squre(12): 29.59	Prob>Chi-Square:		0.0032	
Pseudo R-Square: 0.1319				

Source: Results of Authors Analysis from Nigerian General Household Survey, 2011

(Dummied as 1) as against 'no' (dummied as 0), such individual was more than 2times likely to choose agriculture as an occupation than an individual who responded 'no' to the same question. Also, the antilog of the coefficient (0.9959) of use of internet to send or receive mails was 2.7071, that is, an individual who used the internet to send or receive mails was 2.7 times more likely to choose an agricultural occupation over non-agricultural occupations. These results gave an indication that ICTs, particularly access to the internet measured by its various usage have the capacity to contribute to agricultural growth and consequently economic progress which is earlier described as labour augmenting technological progress.

Linear multiple regression results on table 3 show that access to the internet measured by its some of its uses by the study group in the year preceding the survey had positive and significant effects on agricultural labour efficiency. Result on the table show that a worker who used the internet banking earns 517.696 Naira (US$3.372) per hour more than a worker who did not. The effect was positive and significant (P<0.05).

Similarly, a worker who used the internet to read online newspapers earned (349.394Naira or US$2.276 per hour) significantly (P<0.05) more than a worker who is indifferent about online newspapers. In contrast, a worker who used the internet for e-learning activities earned 189.802Naira (US$1.236) per hour less than a worker who did not use the internet for e-learning. This may be due to the fact that e-learning may be channelled towards new ideas or a formal online training which does not enhance productivity of the present occupation of the worker.

Finally, increased access to personal computers (ordered measure, say from being a borrower to an owner) increased agricultural labour productivity by 66.652 Naira (US$0.434) per hour. This increase is significant at 90 percent confidence interval (P<0.10). Overall, the F-value of 9.463 is significant at 99 percent confidence interval, showing that all the variables measuring access to ICTs variables accounted for 79.4 percent (Adjusted R-square = 0.794) variation in labour efficiency. These findings are not at variance with those of a macroeconomic study conducted by the AUSTRALIAN PRODUCTIVITY COMMISSION (2004). The commission found that IT-capital deepening contribution to labour productivity growth accounted for about a third of the very strong labour productivity growth of 3.2 per cent a year in the later part of the 1990s. More so, various growth accounting studies for Australia in later years showed that stronger IT-capital deepening has contributed about 2 or 3 tenths of a percentage point to acceleration in labour productivity growth. EVA HAGSTEN and SABADASH (2014) found that a 1% increase in the share of highly skilled ICT employees in a firm's labour force increase firm productivity by 0.5% in Denmark, 0.6% in Finland, 0.7% in France, 0.9% in Norway, 0.7% in Sweden and 0.4% in the United Kingdom.

Among other factors, EU-US labour productivity gap was associated with the different productivity growth rates in their telecom industries (BIAGI, 2013 IN: EUROPA, 2016). In Iranian manufacturing sector, IT had a positive and statistically significant effect on productivity (ABRI & MAHMOUDZADEH, 2015). A more recent corroborating study shows that access to ICT increased the efficiency of maize marketing efforts in Nigeria by 20.035% at 99% confidence interval. These evidences corroborate this research finding to affirm that labour efficiency in agribusinesses in Nigeria was significantly enhanced by ICTs growth. It is noteworthy that the extent of the effect of ICTs on labour efficiency varies by country and according to the industry. This is so because ICT led development requires complementary factors such as reorganization of business models, high-quality management, high-level labor and economic competitive environment (ABRI & MAHMOUDZADEH, 2015) which varies from country to countries and from one industry to another.

Table 3: Linear Multiple Regression Results: Effects of Access to ICTs on Agricultural Labour Efficiency
Dependent Variable: Agricultural Labour Efficiency (wage per hour)

Independent Variables	Coefficients (Unstandardised)	Std. Error	Coefficients (Standardised)	t-Value	Prob(t-Statistics)
Rate of Internet use (1=frequently, 0= not frquently)	55.062	101.666	0.095	0.542	0.608
Used the Internet For Electronic Banking (1=yes, 0= no)	517.696	139.943	0.57	3.699	0.01
Used the Internet For Electronic Learning (1=yes, 0= no)	-189.802	87.381	-0.356	-2.172	0.073
Used the Internet to read electronic newspapers	349.394	93.295	0.603	3.745	0.01
Access to personal Computers (Ranked 1 to 4)	66.652	28.566	0.381	2.333	0.058
Constant	53.492	78.602		0.681	0.522
R:	0.942		Standard Error Estimate:		119.092
R-Square	0.887		F-Value:		9.463
Adjusted R-Square:	0.794		Prob(F-Statistics):		0.008

Source: Results from Authors Analysis of Nigerian General Household Survey, 2011

CONCLUSION AND RECOMMENDATIONS

Moderate numbers of Nigerian workers have access to certain forms of ICTs such as radio, television and mobile phones but very few agricultural workers had access to the internet which has been growing in its presence and impact since the last two decades. Interestingly, although use of mobile phones was more likely to cause a drift away from the agricultural occupation, the use of the internet for information surfing and the use of the internet in for emails made the few individuals who had access to have a positive disposition towards agricultural occupation. More so, agricultural labour efficiency was spurred by increased use the internet for e-banking, e-newspaper reading and increased access to personal computers.

Governments is largely to support that the agricultural sector development not only investment in physical resources but also via investments in ICTs and promotion of the innovative use of ICTs, including diffusion of the internet technology within the Nigerian Agricultural sector. Scaling up the proliferation of the internet and it accessibility has the capacity to upscale existing labour productivity through human capacity building from e-information bank, e-learning facilities, and easier/faster service delivery to the labour force e-banking, e-money transfers and e-purchases, e-voice calls, etc.

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