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# ICT Use in Livestock Innovation Chain in Ibadan City in Nigeria

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**Abstract**
Using data collected from 300 goat/sheep, poultry, cattle, piggery, aquaculture and dog rearing farmers, this study examined ICT awareness, and its use in innovation chain by livestock farmers in Ibadan, an agrarian community in Nigeria. The study also examined the relationship between ICT use, awareness, and uses in the various innovation links as well as how demographic characteristics of the farmers relate to their ICT use. For all the technologies, listed number of respondents reporting awareness is higher than those reporting use, except for mobile phone where equal number of respondents reported both awareness and use. Marketing is the purpose for which most of the respondents reported using ICT. Computers were used by large famers for feed formulation and knowledge management; mobile phones served the purpose of managing animal health, linking customers, managing of farms and marketing of goods while internet/email was scarcely reportedly used for farming purpose. The findings of the study raises the question of building electronic livestock farmers network as well as training farmers on how ICT could used to meet production and animal health needs.

## Introduction

Agriculture is a major component of Nigeria's economic life, with livestock constituting an integral part. Livestock farming contributes immensely to the livelihood in urban and rural communities through increased food production, farm energy, manure, fuel, transportation and nutritional security and incomes (Tewe, 1997). Livestock accounts for one third of Nigeria's agricultural gross domestic product (GDP). In 2010, livestock production contributed substantially to Nigeria's economy, accounting for about 11% of the total GDP (Encyclopedia of the Nations, 2010). The dominant livestock enterprises mainly engaged in by Nigerian livestock farmers are poultry, piggery, rabbittary, beef diary and pasture production and small ruminant fattening operations (International Water Resources Management, 2005). Like most sectors, agriculture is an information-intensive business, and ICT could play crucial roles in facilitating information exchange ((Todaro, 2000). The role of information could be visualized from the perspective of development, flow and management of information and ideas in the various links in the system of livestock farming namely input/procurement, production, marketing, sales and health management issues.

ICT could help farmers in Nigeria to efficiently access current information and also provide information to buyers and consumers alike through innovative avenues like joining online communities of farmers, advertising in local farmers markets that might host a neighborhood website and joining social network sites such as Facebook to build community interest around the farmer's activities (Jones 1997). Using ICT can also enable farmers use their savings in a number of ways, with many investing their extra income back into their businesses or paying for their children to go to school (Jama, Stuth, Kaitho, Hurissa, 2004). These advantages notwithstanding, ICT deployment in livestock in Nigerian communities is expected to be fragmented and light, with disparities according to the level and quality of telecommunication services, ability and demographic characteristics of individuals as well as the scale of enterprises where those individuals are affiliated among others. Farmers who are highly educated or are engaged in large scale farming, for instance, would most likely deploy ICT more than the others.

Farmers could also easily use the mobile phones and other ICT to inform customers about the availability of products or discuss and negotiate prices. Many farmers live far away from their farms, and may need to regularly link up with those managing their farms to be abreast of the farm conditions. On educational aspects, farmers could learn how to manage farms, formulate feeds, or manage some diseases and others, by browsing through the internet or linking with their vet, fellow farmers and others. Also, ICT will be very useful in animal health management. Like in all health situations, animal health challenges might develop at any time and farmers might need to reach their health care providers to either visit the farms or supply information about what could be done to manage the situation. Farmers could visit the internet, use email or the mobile phones or any other instant messaging devices to seek for information about what to do.

The potential benefits of ICT to farmers and farm processes call for need to understand factors that might influence the use of the technologies by farmers. Similar studies exist ((Kiplang'at, 1999; Heeks, 1999; Bayes, 2001; Dao, 2004), but there is none on Ibadan city, an agrarian and largest semi urban community in West Africa. However, interactions with agricultural extension workers and agro-based entrepreneurs as well as literature sources (Agwu and Uche-Mba, 2010) show that cost of the technology, lack of training, trust level in ICT, lack of ICT proficiency, lack of technological infrastructure and non-awareness and unwillingness to use new technologies could be influencers of use of ICT by farmers in many Nigerian communities. This

evidence emanates mainly from general observations, with a few studies based on the opinions of farmers who are directly involved with the use of the ICT. Furthermore, there are no streamlined studies that show how relevant these general factors are to livestock farming in any Nigerian community with their unique agricultural processes and demands.

According to International Water Management Institute (2007) Ibadan is mainly an agricultural economy and crop production accounts for 72% of the 5082 farms, livestock agriculture accounts for 26% while 1.6% of the farms are used for non-traditional agriculture. Like many other ICT users, farmers in Ibadan are expected to be encountering some challenges in using ICT. ICT is by far an elitist technology, and its maximal deployment has been found on a number of occasions to relate to demographic characteristics of users. Younger and more educated persons use ICT more than those who are older and not educated (Leung 2005). Level of awareness about the existence and benefits of ICT use in agriculture could also affect actual and adequate use of the technology. It will therefore be expected that the challenges confronting ICT deployment by the farmers might vary according to the scale of business, level of education of the farmers and other factors. Technology level in Nigeria has consistently been found to be low (Uwaifo and Uddin, 2009).

International Water Resources Management (IWRM 2005) showed further that livestock farming in the city is significantly undertaken. What are the technologies used by livestock farmers in Ibadan to achieve information exchange in the innovation chains? What are the factors influencing use of ICT by the farmers. What is the level of ICT awareness among livestock farmers? Also, the study elicits and analyses specific experiences of ICT use to facilitate information exchange by livestock farmers in the city. Addressing these questions would yield information that can be useful in addressing how ICT could be further deployed to improve the activities of farmers.

This study is designed to examine ICT awareness, its general use and its use in livestock innovation chain by livestock farmers in Ibadan, an agrarian community in Nigeria. The study also examines the relationship between ICT use, awareness, and use in the innovation chain as well as how demographic characteristics of farmers relate to their ICT use in the innovation chain. In a study in the United States, Mishra and Williams (2006) found that adoption of computers with internet access is positively influenced by age of farmer, educational level of farmer, and other variables. They also found that large farms were more likely to adopt computers with internet access.

## Literature Review

### *ICT in agriculture*

Information and communication technologies (ICT) play inevitable roles in every aspect of human activities today, including agriculture. The key players in agriculture are the farmers, and their ability to use the technologies defines the role of ICT in agriculture generally. ICT use by farmers is now on the increase globally. In increasing access and exchanging of information, ICT offer the potential to increase efficiency, productivity, competitiveness and growth in various aspects of agricultural sector. Farmers that engage in commercial agriculture in large scale might be expected to be using cameras, computing devices, digital imaging, the Internet and Wide Area Networking (WAN), Wi-Fi, SMS services, WAP (Wireless Access Protocol) based Internet access using cellular telephony, and digital media and DVD, among others (2003). Those that engage in agriculture in small scale utilize various other forms of ICT such as mobile phones, computers, and the internet, etc.

Of all technologies, the mobile phone is certainly an instrument of choice for many farmers, both large and small scale. Mobile phones are cheap, easy to manage, power efficient and encourages personalized interactions. Mobile phones enable farmers to compare prices more efficiently and to link up with other buyers who were not previously easily accessible. Mobile phone helps to improve the links between farmers and traders, creating opportunities for small-scale producers to sell to new markets, thereby increasing their incomes and helping to reduce poverty in the area. ICT use in agriculture in Nigeria is still evolving, just like in many developing areas. There is some evidence of application at individual levels as well as initiatives at organizational level. However, it is relatively unknown whether the ultimate beneficiaries – the farmers themselves- actually use the facilities to meet their needs. The major problems in adoption of ICT in rural settings are ICT illiteracy, availability of relevant and localized contents in own languages, easy and affordable accessibility and awareness and willingness to adopt new technologies.

### *ICT in the Innovation*

Generally, ICT can contribute to agriculture in three major ways, and they are: data and information management, agricultural services such as marketing and learning and capacity building. At individual, community and state levels, adequate information is required to manage livestock farming. Policies need to be developed and strategies formulated; activities have to be monitored and impact evaluated to ensure that projects and programmes achieve their expected goals (NEPAD, 2006). Various levels of stakeholders benefit

from data management including farmers and animal owners, farming communities, extension agents and service providers. There also exist marketing intermediaries, consumers and programme managers as well as researchers and research managers and policy makers. These information are required for animal improvement and breeding, animal health and disease surveillance, nutrition and natural resources management and farm management. Furthermore the information is required for community/village level livestock and agricultural production systems management and market related activities. The level of information that is processed range from meeting the needs of individual animal, herds, farm, community, village, and research institute to those for medium production and large scale system such as national, regional or state levels (Bourn and Wint, 1994; Butcher, 1994; Scarborough, 1996)

In respect of marketing, there is an increasing need to "integrate the entire livestock commodity chain from input suppliers, farmers, processors, and market intermediaries to consumers who may be in foreign countries, livestock business being a market oriented business. Marketing aspect of livestock is important because animal products are transient, and they may perish after some time. Transient commodities carry along with them transient information. Information is required about prices and trends, and quality, food and bio-safety and consumer assurance. Marketing involves "tracing back at various levels, farm, processor, market intermediary, packager and ultimately exporting country. The use of ICT is essential to implement a trace back system". ICT is therefore required to efficiently manage this information to ensure that the commodities are disposed of as and when necessary (Barton and Reynolds, 1996; Morton and Matthewman, 1995).

Capacity development is required to explore the potential of livestock production by smallholders and other stakeholders across the entire livestock commodity chain, which also includes service providers, processors, market intermediaries, and consumers, etc. Stakeholders in the livestock system have a duty to spread these innovations in the commodity chain. Information and communication technologies: computers, internet and mobile phones among others will be critical in creating and maintaining this innovation system.

All around Nigeria, there is some consciousness that ICT will benefit farmers and other members of the agricultural innovation system. At the institutional levels such as the universities and other corporate bodies, this consciousness has resulted to some projects. Apart from utilizing computer based approaches in teaching and learning, there is some expression of consciousness about the use of video clips, simulation and digital models have been used in the pedagogy of veterinary and animal science education. Unlike in India Okoro, Chikaire, Anyoha and Ejiogu-Okereke (2011) and Meera, Thamtan and Rao (2004) have said that there is no report of ICT being utilized in distance learning in the veterinary and animal science education in Nigeria. A major aspect of ICT capacity building for smallholder farmers is informal and non-formal learning. A typical example of use of ICT for rural development is M.S. Swaminathan Research Foundation's (MSSRF) Information Villages, Gyandoot and Warana Project, among others, in India. There exist similar projects in Nigeria such as Fantsuan Foundation in Nigeria (Orakpo, 2012). These organizations have various frameworks for structuring and generating information for their clients, such as research or development institutions or individuals using websites, radios, telephones, extension agents and other non-government organizations.

Several studies have shown that ICT could play an important role in agricultural development. In their demonstration on this subject, Lio and Liu (2006) showed that a microwave-radio telephone system installed in the remote region of Tumaca, Columbia, along with community access points resulted in better trade and market opportunities. In their own study, James (2004) reported that rural telephone and community radio services initiated in India and Sri Lanka had received a positive response from farmer communities. The International Institute of Communication Development (IICD) and Manobi, an African telecom company have initiated a collaborative program to help the farmers of Burkina Faso, Ghana, Mali, Uganda and Zambia gain access to market price information via text messages, Wireless Application Protocol (WAP), or the mobile internet as well as personal computers and personal digital assistants (PDA). Bayes (2001) has argued that the Village Phone Program (VPP) of Grameen Bank of Bangladesh can convert telephones into production goods by lowering transaction costs.

Although these studies suggest a significant positive contribution of ICT to development, are others whose results call for caution. For instance, new technologies may co-exist with the old and in doing so enhance the digital divide. Also, the opportunity cost of the resources engaged in bridging the digital divide may lead to the neglect of the other development priorities. Despite positive disposition on use of ICT to leverage challenges in agriculture, Mutula (2005) argues that resources utilized to bridge the digital divide would have more impact if they were directed to meet the basic needs of the poor. Heeks (1999) mentions the question of appropriate deployment of ICT in agriculture, arguing that it is only on this premise that investment in this regard could be justified. Other researchers casting some doubts on the deterministic reliance on agriculture for rural development have called for caution based on the notion that ICT is a western born technology (Nikam *et al* 2004; Leaning, 2005). A summary of their arguments shows that they suggest the bottom up approach that will pay greater attention to the local needs and context rather deploying ICT with the belief that it will meet the needs of the farmer.

***ICT and livestock farming***

ICT in agriculture is a new and growing field that focuses on how agricultural and rural development activities can be enhanced. The major question addressed is about innovative ways which ICT could be used giving the rural nature of much of the domain in which agriculture is undertaken. This question arises because of the awareness that advancements in ICT can aid the provision of accurate, timely, relevant information and services to the farmers so that their activities can be more productive and remunerative. Lio and Liu (2006) have strongly linked use of ICT with farmers' productivity. ICT can increase farmers' bargaining power. Good access to information can reduce the bargaining superiority of large operators in favour of small scale farmers. With ICT farmers can make choices about crops and livestock, create products for the niche markets and connect and sell their products directly to consumers.

In South Africa, most local livestock data is fed into the centralized Integrated Registration and Genetic Information System (INTERGIS) managed by the Animal Improvement Institute) National Recording and Improvement Schemes. The role of the system is to set up national livestock productivity benchmarks to enable comparison of genetic potential of livestock, and then provide policymakers and farmers with a reliable source of reference (Van der Westhuize, 2003). There also exist Livestock Identification Track Bank System (LITS) in Botswana which promotes best practices in livestock management (Burger, 2003).

***ICT and farmers in Nigeria***

In much of Nigeria, as it is in Ibadan particularly, farm sizes are generally small; livestock farms are even smaller. Large scale farming is therefore not very profound. The structure of the agrarian system in Nigeria could be considered as a major impediment for balanced rural development (Rogaly, Harris-White and Bose, 1999). The farmers are bespectacled with a vicious cycle of land tenure obstacles, poor funding support and several other structural and factors. As a result of these and more, the bargaining power of farmers in the input market is not very strong with the result that farmers pay high prices for inputs thereby reducing their net earnings. Farmers also compromise their prices due to lack of bargaining power. On the net, farmers' incomes are reduced due to low the capacity and incentive to increase productivity and investments. Todaro (2000) has suggested that value addition in agriculture requires technological, institutional and price incentive changes designed to raise the productivity of the small farms.

Given the poor conditions under which farmers conduct their business, information could be considered one very crucial need of the farmers. At the macro level, the information cycle is imperfect. Farmers lack relevant information they need to keep abreast of development, leading to high transaction costs, which impedes agricultural marketing process (Dao, 2004). Kizilaslan (2006) has argued that proper dissemination of information for agricultural and rural communities is a crucial tool in the fight against poverty and deprivation. Information is known to have the capacity to help the poor make use of opportunities and reduce their vulnerability to market forces. Dissemination of relevant information to communities can facilitate the effective adoption of agricultural inputs, decision making on markets and adoption of scientific methods.

***Constraints and enablers of ICT use by livestock farmers***

A major challenge to agricultural development in Nigeria and other African countries has been the low level of agricultural information exchange among the different stakeholders in the agricultural sector as a result of limited access to current and relevant information in the form of primary documents and machine-readable databases (Agwu and Uche-Mba 2010). There is also the lack of ICT proficiency, lack of ICT benefit awareness, too hard to use, lack of technological infrastructure, cost of technology, trust level in the ICT system, lack of training, system integration and software availability limit the use of ICT by farmers (Taragola and Gelb 2005).

Agwu and Uche-Mba (2010) have further listed some constraints as hindrances to the use of ICT in agriculture in Nigeria and these constraints include: lack of confidence in operating ICT facilities such as computers, CD ROM, lack of competence in handling ICT facilities, lack of adequate time for training on ICT facilities, and unavailability of hard required by modern ICT. They also mentioned lack of communication infrastructure; fear that things will go wrong in using ICT, inappropriate contents of ICT messages that do not meet the needs of clients, poor benefits in using ICT, and others. Furthermore, they suggested other challenges such as lack sufficient trained computer personnel, erratic and fluctuating power supply, poor finance, lack of adequate awareness about ICT, complexity in using ICT, lack of Internet access to the rural areas, poor communication network, nature of information provided, high cost of ICT soft ware, high cost of ICT hard ware, negative attitude of people to change and general lack of awareness of the importance of ICT in agriculture.

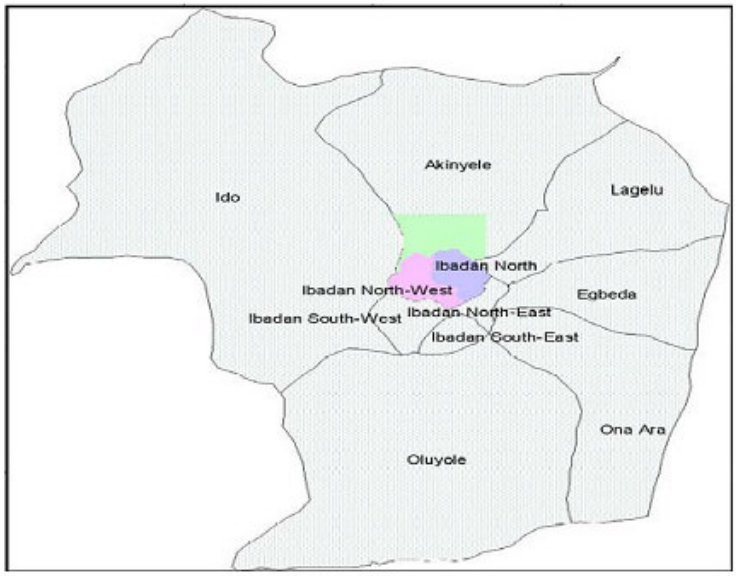
There are also enabling factors such as ubiquity, low cost, ease of use and access and availability of mobile phones and other information technologies. The mobile technology is known to be the fastest growing technology in comparison with any, and have has also achieved the deepest penetration in human communities. This picture is true about Nigeria where almost everyone has access to the technology.

## METHODOLOGY

### *Location of study and research design*

The study was carried out in Ibadan in South-West region of Nigeria. Ibadan was chosen on the account of its size, high number of farmers in the city and commercial activities that obtain therein. Apart from familiarity of the researchers with the norms and values of the people in the area as well as a large number of livestock farmers in the area, agriculture plays a significant role in the economy of the city. A sample survey research design was adopted for this study, involving a systematic collection of information from selected farmers. The consensus of opinions from the selected farmers is expected to provide answers to the research questions.




According to IWRM (2005) the farmers in Ibadan are generally less than 50 years of age, and they have varying forms of formal education with up to 18% having tertiary education, and about 19% reporting having no formal education. More than half of the farmers (55%) engage in farming on full time basis, and 59.0% have farmed for less than 10 years on the average. In addition to farming, the farmers also reported engaging in other income yielding activities such as civil service, petty trading and artisanship and many of the farmers (65%) do not belong to any farmer organization.

The target population for this study was livestock farmers in Ibadan. General information about the population of livestock farmers in the city was extracted from International Water Resources Management (2005) and shown in the table 1.

**Table 1: Population and sampling**

| Livestock farm | Number of farms | Sample |
|---|---|---|
| Goat /sheep | 501 | 124 |
| Poultry | 434 | 114 |
| Cattle | 53 | 17 |
| Piggery | 68 | 21 |
| Aquaculture | 200 | 46 |
| Dog rearing | 58 | 18 |
| **Total** | **1314** | **340** |

***Source: Extracted from IWRM (2005)***

Based on this information, the researchers identified the farmers' society for each of the livestock. The farmer's societies are an authoritative source, where respondents (farmers) can be drawn, and there is some guaranteed access to the registered members of the society. Members of the societies and their farms are spread across the large city.

A proportional to size sampling method was used to decide the number of farmers to be included from each of the livestock categories. The essence of this scheme is to eliminate the effect of differences in the magnitudes of the number of subjects in each category in respect of the number selected as samples. The difficulty of crisscrossing the city in search of these farmers necessitated the choice of a threshold sample of 340 livestock farmers. To execute the proportional to size sampling, the researchers multiplied this number with the ratio of number of farmers in each livestock category to the total number of farmers.

Leaders of each of the societies were approached, and the mission of the research was explained to them in order to obtain their cooperation. Due to long distance to farmers in the rural areas, access was the major

factor that decided the farmers included in the study. The farmers included in the study were mainly those within the city axes; they were larger and most likely to be owned and run by elite farmers compared with those in the rural areas, with increased chances that they are using ICT. The researchers could not identify any societies for pig farmers and dog rearing, but the researcher identified 14 piggery farmers and 10 dog rearers across the metropolis.

The instrument used for data collection was a self-administered questionnaire which contained close and open ended questions administered to the poultry farmers. The questionnaire contained open ended questions requesting the respondents for narrations of specific experiences in using mobile phones, computers and Internet/email to exchange agricultural information. The open ended questions helped obtain firsthand stories from the respondents about their ICT encounter in agribusiness, and also clarify aspects of information collected using the questionnaire. This approach was considered very necessary after preliminary observations hinted of the difficulty of carrying out interviews due to absence of the key respondents in the farms or the tightness of their schedules. In addition to the demographic variables, level of ICT awareness was measured by listing ICT and respondents were asked to supply their response on a 3-level scale consisting of aware, neutral and not aware. The same ICT were listed and respondents were asked whether or not they have used the technologies. Then the innovations were listed and respondents' responses on the use of these ICTs on the innovations were recorded on a five point Likert scale.

For all respondents, the questionnaire was distributed to farmers who were literate in English, and the researchers returned at agreed times to pick up the completed tools. For those respondents who were not literate in English, the questionnaire was administered by the researcher reading out each question, interpreting what has been read in Yoruba language, and helping the respondent tick the response as appropriate. The researchers also translated the narrations of those respondents who could not write. Data collection was spread over six weeks since the respondents were business persons, and might need sufficient time to attend to the tools.

Apart from data collected using this instrument, several visits to the farms granted the researcher a first-hand interaction opportunity to make some observations, and also assess the ICT environment of the farmers. The result of this observation was used to counterbalance the results of the questionnaire survey. Furthermore, the literature provided some useful information about agriculture in the city, although the sources did not examine issues related to ICT. Altogether, 321 of the 340 copies of the questionnaire were completed and returned; twenty one were not usable and were discarded. Given the spread of the farmers in the very large city of Ibadan, and the several visits the researcher had to make to reach the respondents, this response rate of 78% was considered adequate for the survey. Although the sampling scheme adopted a probabilistic technique to decide the number of respondents, the specific subjects elements were not selected using any probabilistic approach. Hence the data set was not considered fit for any inferential analysis. Relationship was sought between pairs of awareness, ICT use, use of ICT in the innovation chain, use of ICT in marketing, production, health and procurement using Spearman's rank correlation. This approach enabled the researchers measure the strength of association between pairs of the variables. Chi square analysis method was further used to measure the association between the demographic variables and the innovations; significant dimensions were further examined using cross-tabulation to establish. The researchers synthesized the narrations in the open-ended questions to strengthen the discussion.

## Result

### *Socio-demographic characteristics of the respondents*

Table 2 presents the frequency distributions of the respondents' socio-demographic characteristics. Of the 234 poultry farmer, males accounted for 70.2%, while 29.8% were females. Married respondents accounted for 71.4% while 23.8% were single, 2.4% separated, 1.2% divorced and 1.2% were widowed. The mean age of the respondents was 40.28 years with a standard deviation of 11.93. Also, 67.9% of the respondents were Christians while Muslims were 32.1%.

***Table 2: Demographic Characteristics of the Respondents***

| Variable | Measurement | Frequency | Percentage |
|---|---|---|---|
| Gender | Male | 210 | 70.2 |
| | Female | 90 | 29.8 |
| Marital status | Married | 214 | 71.4 |
| | Single | 71 | 23.8 |
| | Separated | 7 | 2.4 |
| | Divorced | 4 | 1.2 |
| | Widowed | 4 | 1.2 |
| Age | 19-24yrs | 11 | 3.6 |
| | 25-39yrs | 55 | 18 |
| | 31-34yrs | 34 | 10.8 |
| | 35-39yrs | 34 | 10.8 |
| | 40-44yrs | 44 | 14.4 |
| | 45-49yrs | 37 | 16.8 |
| | >50yrs | 75 | 24 |
| Experience (years) | 1-5yrs | 143 | 46.7 |
| | 6-10yrs | 89 | 29.7 |
| | 10-15yrs | 39 | 13.2 |
| | >15yrs | 29 | 9.6 |
| Farm size (plots) | 1-6 | 235 | 78.6 |
| | 7- 12 | 32 | 10.7 |
| | 13-18 | 11 | 3.6 |
| | >18 | 22 | 7.2 |
| Highest level of education | Primary | 15 | 4.8 |
| | Secondary | 32 | 11 |
| | Polytechnic/College of Education | 111 | 37 |
| | University | 142 | 47.2 |
| Formal qualification/training | Yes | 96 | 32.1 |
| | No | 204 | 67.9 |

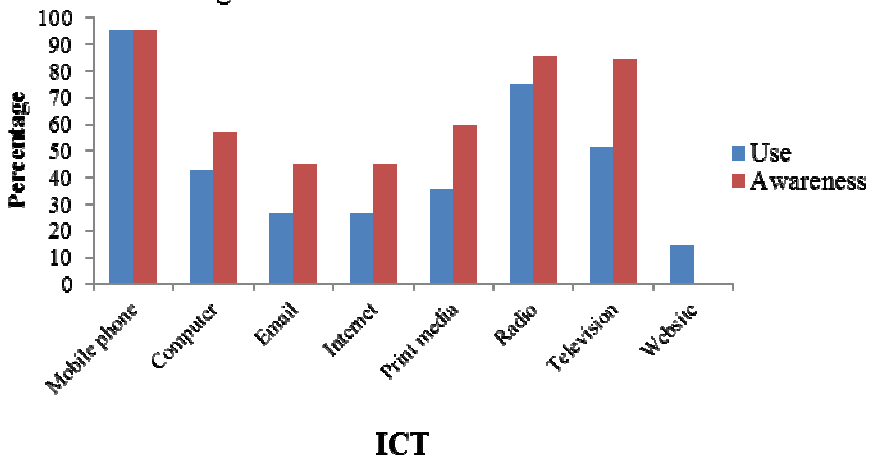
The mean number of years of experience in farming is 8.13 with the largest number of farmers having been in the business in the last 1-5 years experience (46.7%) and the lowest (9.6%) being people who have been in the business 15 years and above. With 78.6% of the respondents having their farms on 1-6 plot of land (an acre equivalent) the farm sizes could be regard as relatively small. Farm sizes were 7-12 plots (10.7%) followed; 3.6% have three acres of land while 7.2% of the respondents own more than 3 acres. Respondents with university education have the highest percentage (47.6%), followed by those with polytechnic qualification (23.8%), 13.1% attended the colleges of education, 10.7% attended secondary school and 4.8% have primary school qualification. Most of the respondents (67.9%) had no formal qualifications in agriculture.

***ICT awareness and use***

The level of ICT awareness among the livestock farmers was examined by asking respondents to tick as applicable to them their level of awareness about the different categories of ICT listed in the questionnaire. Figure 1 shows a very high percentage of the respondents (95.2%) reporting awareness of mobile phones while some of the respondents (57.1%) were aware of the computer. Also, 85.7% of the respondents were aware about radio as an information source, while 4.8% were not; 9.5% were neutral. A large number (84.5 %) were aware of television, 4.8% were not and 10.7% were neutral. Awareness of print media was reported by 59.5% agreed also to being aware of print media, while only 45.2% were aware of the Internet. A relatively low number of respondents (45.2%) reported being aware of the Internet. The lowest level of awareness (28.6%) was reported for wireless technologies, while none of the farmers reported being aware of websites.

Figure 1: Awareness VS use of ICT




Which of the ICT reported above were used by the farmers? Figure 1 also presents the analysis on this question. The highest number of respondents (95.2%) used mobile phones, followed by radio (75.0%), television (51.2%), computer (42.9%), and print media (35.7%). ICT's with the lowest use evidence are the Internet (26.2%), email (26.2%), farming software (16.7%), website (14.3%), and wireless (8.3%) and PDA (3.6%).

***ICT in the livestock innovation chain***

The mean values of responses on use of ICT in the innovation chain were taken, as shown in table 5. Table 5 shows that marketing (Mean=4.78, SD=1.11) has the highest mean value of ICT use. Marketing related activities namely sales (Mean=4.65, SD=2.88) and procurement (Mean= 4.44, SD=2.91) also have high mean use values.

***Table 3: Means of use of ICT in the livestock innovation chain***

| Innovation links | Mean | SD |
|---|---|---|
| Marketing | 4.78 | 1.11 |
| Production | 2.66 | 1.90 |
| Health | 3.49 | 2.01 |
| Procurement | 4.44 | 2.91 |
| Sales | 4.65 | 2.88 |

Table 5 also conveys that production (Mean= 2.66, SD=1.90) and health (Mean=3.49, SD=2.01) have the lowest mean use values.

***Relationship between ICT use, awareness, and use in the innovation chain***

The correlation matrix in Table 4 shows how pairs of ICT use, awareness, and use in the innovation chain are correlated. The highest correlation (r=0.86) exists between ICT use and awareness about ICT use in livestock farming as well as between awareness and marketing.

***Table 4: Correlation between ICT use, awareness, and use in the innovation chain***

| | Awareness | ICT use | Use in.. | Marketing | Production | Health | Proc. | Sales |
|---|---|---|---|---|---|---|---|---|
| Awareness | 1 | | | | | | | |
| ICT use | 0.83 | 1 | | | | | | |
| Use in… | 0.86 | 0.62 | 1 | | | | | |
| Marketing | 0.81 | 0.73 | 0.78 | 1 | | | | |
| Production | 0.16 | 0.23 | 0.32 | 0.02 | 1 | | | |
| Health | 0.13 | 0.32 | 0.37 | 0.29 | 0.03 | 1 | | |
| Procurement | 0.66 | 0.43 | 0.55 | 0.43 | 0.09 | 0.02 | 1 | |
| Sales | 0.63 | 0.74 | 0.88 | 0.84 | 0.02 | 0.11 | 0.71 | 1 |

The result also suggests that sales has high correlation with awareness, ICT use, ICT use in the innovation chain, marketing and procurement, but very low values with production, health, issues and procurement have very low correlation with all other variables.

***Demographic characteristics of farmers Vs. ICT use in the innovation chain***

What is the relationship between ICT use in the innovation chain and the demographic characteristics of the

respondents? Table 5 shows a Chi square analysis addressing this question.

***Table 5: Chi Square analysis of ICT use in the innovation chain by demographic characteristics***

| Demographics | Marketing | Production | Health | Procurement | Sales |
|---|---|---|---|---|---|
| | *Chi Square values* | | | | |
| Gender | 19.180 | 4.176** | 12.001 | 2.113 | 7.230 |
| Marital status | 5.998 | 14.751 | 2.991 | 12.347 | 17.309 |
| Age | 1.111 | 4.601 | 0.909 | 12.000 | 16.313 |
| HEQ | 1.198 | 11.001 | 13.092** | 20.290 | 7.159 |
| Experience | 15.108** | 14.01 | 14.290 | 12.897 | 19.300** |
| Formal qualification | 4.188 | 9.966 | 18.022** | 0.007 | 8.006 |
| Farm size | 0.100 | 12.121** | 129.020** | 6.891 | 13.290 |

***=significant at 5% level*

Gender and HEQ were significantly associated with health and procurement respectively. Experience was significantly associated with marketing and sales, while formal qualification and farm size were significant in term of their relationship with marketing, and health issues. The significant results were cross-examined to uncover the underlying explanations.

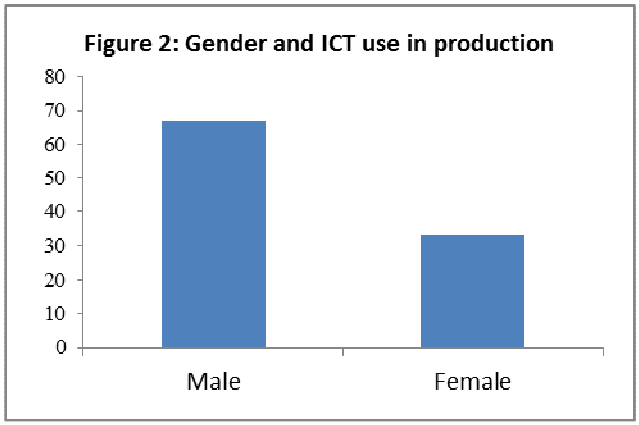



Figure 2 shows that 67.21% of those who reported using ICT for production purposes were males. Also, 65.32% of those who reported using ICT for health related purposes were people that also reported having polytechnic/university education. Those who have been farming over fifteen years ago (35.17%) and those who started farming five years ago (32.65%) used ICT for marketing the most. Furthermore, 56.72% of the farmers who used ICT to meet health needs of their livestock also reported having formal training in livestock farming, while 62% and59,55% respondent with farm sizes larger than 13 plots also reported using the technologies for production and health matters respectively.

**Relevance of ICT to livestock farming**

On a scale of 1 = lowest to 5 = highest, respondents were asked to rate the relevance of ICT in their farming businesses. Since the responses are ordinal mean scores are used to measure the power of the intersection between innovation activity and the livestock type. The expectation is that mean score less than 2.5 could be considered low while higher values could indicate higher likelihood that farmers would utilize ICT to meet the innovation activity.

***Table 6: Mean score of relevance of ICT in livestock innovation chain***

| Livestock farming | Marketing | Production | Animal health | Procurement | Sales |
|---|---|---|---|---|---|
| Goat /sheep | 2.78 | 2.13 | 3.16 | 2.17 | 2.09 |
| Poultry | 4.34 | 2.33 | 4.16 | 3.22 | 4.39 |
| Cattle | 2.01 | 2.14 | 2.24 | 2.15 | 2.02 |
| Piggery | 2.19 | 2.23 | 2.45 | 2.12 | 2.34 |
| Aquaculture | 3.26 | 2.41 | 3.22 | 2.33 | 4.19 |
| Dog rearing | 2.33 | 2.52 | 3.16 | 3.01 | 3.22 |

Table 9 shows that poultry farming has the highest mean score (4.34) with marketing in comparison with other livestock farming activities, while cattle has the least (2.01). With relevance of ICT in production having mean score less than 2.5 for all livestock, it could be concluded that the farmers do not consider the use of ICT for this innovation very highly. The farmers reported a high relevance of ICT in poultry health (4.16) than they did for other livestock; but they also reported that ICT is highly relevant for aquaculture (3.22), dog rearing (3.16) and goat rearing (3.16). With mean score less than 2.5, the relevance of ICT to piggery and cattle was

somewhat low. Except for poultry (3.22) and dog rearing (3.01) where the relevance of ICT was high, the relevance of ICT in innovations in the other livestock generally below the median level. For sales, the relevance of ICT in poultry (4.39), aquaculture THE SUe (4.19) and dog rearing (3.22) is very high; but low for the other livestock (<2.5).

**Discussion of findings**

The focus of this study is to address the question of whether livestock farmers in Ibadan metropolis use ICT in the livestock innovation chain, and for what purposes. Data was collected from 300 livestock farmers. A cursory observation as well as secondary evidence from IWRM shows that poultry and goat/sheep rearing constitute the major livestock farming undertaken by livestock farmers in Ibadan, cattle farming constituting the lowest. Generally, goat/sheep and poultry are obviously the easiest livestock to rise; they could be raised in relative large scale at the "backyard" with less expertise. Moreover, the expertise support required to manage the animals appears to be most available.

Based on interactions with the respondents during data collection, there was some enthusiasm to know how ICT could be used to promote their business much more than the readiness to participate in the survey. The respondents that actually gave time to complete the narrative aspect of the questionnaire actually did so because the researchers first explained to them why they actually need to participate in the study. Except a few relatively large farms, many of the farms were actually small in size. It was the case that the large farms had more staff, better office spaces and coordinated work environment than the small farms which were either located inside or very close to living houses. The large farms were powered by generators, when necessary. The researchers actually saw computers in just a few of seven of farms visited, although all the individuals encountered during the visits had mobile phones. Usually installing information technology facilities would require safe environment and power personnel, among others.

The number of male farmers in this present study is slightly higher than that in the study of IWRM (2005), but the number of married farmers is however much less than that reported by IWRM. With mean of age of about 40 years, it would appear that this present study indicates the participation of younger persons in farming than did the study of IWRM. Remarkably also over 84% reported that they have tertiary education, a finding that is by far higher than that of IWRM. An average farming experience (in years) and a very large number of respondents joining the business in the last 1-5 years as well as a large number of farmers aged 25-39, this result suggests that younger persons have joined the profession since 2005. These differences may also be accounted for by either differences in sample size or periods of study, or even the concentration of the present study in the urban area of the city. The difference between the large number of respondents with tertiary education and those who reported having formal training in agriculture indicates a high number of farmers who have no formal training in agriculture.

Almost all the farmers have knowledge of the use of mobile telephones as at, and about eight out of ten knowing about radio and television. This pattern of response is recurrent in many studies both in urban and rural, and, institutional studies (Nwagwu 2007). Mobile phones are the technologies of the present society. Its portability, cheapness, ease of use and accessibility couple with their multitasking capabilities make it the most useful information technology today. Even the ill-educated can use it, at least to receive calls. Radios have unique qualities, and its mention in this study might even refer to radios embedded in mobile telephones. Radios are portable and can operate on batteries. Radio signals are also generously available just as many community radios stations are beginning to be created. Unlike mobile telephones anyway, radios are just a one way communication system which only enables the user to receive information. It is also lacking in the multimedia facilities that make mobile phones the deepest penetrating technology of all time. None of the respondents reported any awareness about website at all, and those who reported awareness about farming software and email are very few. In a sense, websites and farming software are by far advanced information technologies compared with mobile phones. How does one understand the relationship between pairs of awareness, use of ICT, use of ICT in the innovation chain and the innovations? Awareness about ICT may trigger off use of the technology generally, but the tendency for use in marketing is very high. Awareness of ICT does not seem to relate strongly with health – ICT use in health may require a high level of enlightenment as well as high skill level including using higher and more sophisticated technologies. The very high correlation between ICT use and marketing and sales may also be explicated on the ground that the farmers desiring to dispose products at the right time. The low correlation between health, production and procurement may mean that the farmers require some enlightenment to the effect that they could achieve more than marketing using ICT. In respect of production, it could be speculated that only a few farms, mainly the very large ones or those that have expertise in production, may need to use the technology for the purpose. Generally, except in relation to marketing and related activities such as sales and procurement, relationship between awareness and, use of ICT with other purposes such as production appears very low.

Besides personal use of these technologies, the researchers did not identify any cooperative activities

that could lead to improved use of the technologies for the purpose of livestock farming. Besides mass texts which all the associations use to invite or remind the farmers of meetings, there are no information systems for disseminating information among the farmers or for accomplishing other tasks such as lifelong learning. The major consequence of this observation is that linkages exist among the farmers only at individual levels. Initiatives such as those between International Institute of Communication Development (IICD) and Manobi, to help the farmers gain access to market price information via text messages. There is also no project such as the Village Phone Program (VPP) of Grameen Bank in Bangladesh which could enable the farmers convert their heavy access and use of telephones into business advantages. Those who have been farming for more than fifteen years might have greater command of the market and also have control of the business generally, and this might translate for their advantage in marketing using ICT. For those who came into the business only in the last five years, their success in using ICT for marketing their products might not be unassociated with increasing revolution in ICT.

The responses to the open-ended question turned spice to the findings of the study; they are categorised and as follows.

***The mobile phones***

*Managing animal health*

The first and most common set of narratives came from farmers who have used mobile phones to achieve management of animal health challenges through connecting their vet consultants and other knowledgeable persons. Generally, veterinary doctors appeared open-minded in prescribing drugs for their clients using mobile technology, probably endorsing the reality of mobile animal health. Their responses are very apt: “Four of my pigs gave birth at the same time and one of them was very weak, I had to put her children with another pig for fostering. The foster mother was not producing enough milk so I used my phone to call the veterinary doctor and he told me to give her estrogen and she started lactating well afterwards”. “There was a day that my birds were sick and I don’t know which drug to give them. I called my vet doctor and she told me the drug to give them. Fortunately I had the drug in the farm, but if I had not called the doctor, I wouldn’t have known that I can use the drug to cure that particular disease”. “I used mobile phone one day when I was faced with bird diseases and didn’t know what to use and my doctor made prescription for me”.

Like the foregoing testimonies, another farmer narrated how he used the technology to connect with his vet who instructed him on what to do to prevent his rabbits from having still births. Yet another respondent narrated that he used the phone to link up with his vet who was far away on a journey, but the vet linked him with another vet who rescued the farmer from serious health crisis of the animals. A synthesis of these testimonies show that mobile technologies are leading in information technology applications in animal health management, and applications transcend almost all aspects of animal health needs: drug prescription, drug administration, maternal challenges and disease management, etc. the study did not inquire whether the communication was by text messages or calls, and this is because the whole, study focused on information technology use generally. No mention was made of other technologies.

*Linking customers*

Linking with customers is another benefit of the technology which many farmers were happy to narrate. “The use of mobile phone helps me to communicate with customers effectively. They call me for supply and solution to problems they face when rearing their birds and I also respond immediately. It has helped my family business greatly”. “Mobile phone has strongly been a great and useful instrument in communicating with my customers and other farmers, information is easily gotten whenever a seminar about a new product is about to be introduced to the poultry farmers”. This testimony relates to how information technologies could be used to enable more experienced farmers, and probably farmers in large farms, provide advice to younger farmers. Apart from short-cutting the bill of the vet, this use of the technology could strengthen the relationship among the farmers, and promote horizontal learning. Learning from peers and colleagues has great advantages.

*Remote managing of farms*

Some of the farmers who probably have other businesses or are engaged in other activities that keep them away from their farms, mobile phones have helped them maintain contact with their workers thus promoting efficient farm management. According to one of such persons: “I contacted my workers on the farm to know the state of things so that in case there was any problem, I could think of how to solve it even before getting to the farm”.

*Marketing*

Many of the respondents also narrated how mobile phones have helped them market their products through contacting their customers when their goods are ready. This testimony is an example: “I was with no money and I have pigs that I could sell on the farm, I used my mobile phone to call a customer and he came and purchased

the pigs and I had money to spend. “Mobile phone has helped me in the area of marketing, information collection/gathering from farming organisations and customers”. “Mobile phone has strongly been a great and useful instrument in communicating with my customers and other farmers, information is easily gotten such as whenever a seminar about a new product is about to be introduced to the poultry farmers”

This finding relates to the object of a project by Information Development Network in Nigeria in which rural women were enlightened on how mobile connection could assist them link with their clients in the cities. By this approach, the rural women testified that they were able to sell their wares at their own time and negotiate prices ahead of time. Even buyers who visit rural communities from the cities are able to minimize wasteful trips which were often undertaken with the belief that the goods are available in the rural areas.

*General uses*

Some farmers merely expressed knowledge of how mobile phones could help their businesses and not necessarily how they have used it; their opinions were also very indicative of the important roles of mobile phones in agribusiness. They said that mobile phones could help them market their goods, manage their farms, monitor the performance and activities of farm workers. “It helps me to monitor prices of farm inputs and products in the market”. Some expressed good knowledge about how the phone could be used to contact stakeholders such as feedmill for the supply of feed, contact customers and manage time: “I can use it when I have a problem getting some stuff and I want to get in touch with friends that have ideas about issues”. “It could help me communicate, to receive information on necessary advice on the poultry feeds and marketing research”. “The use of mobile phone saves time, reduces my expenditure and increases my performance and productivity”. Matotay, Furuholt, (2012) has also demonstrated empirically how mobile technology has aided the operations of livestiock farmers in Tanzania.

Some farmers reported knowledge of the possibility that mobiles could help reduce cost of going to meet customers, who they rather would call by mobile phones. According to some of the farmers: “mobile phone is one of the cheapest and quickest means of communication” and “[it] makes connecting people easy for me in my poultry business”. The number of farmers who mentioned any negative aspects of the use of the technology was very few and their observation was either in relation to “poor connections and high cost of phone bills” or the opinion of this respondents who said that “The only problem atimes is network failure”.

***The computers***

*Feed formulation*

Probably suggesting that computers appeared to be *hitec* to agribusiness people in comparison with the mobile phones, one the farmers said that he used computers for “Feed formulation and also knowing the financial position of the farm”, “I use computers for the computation of feed formulas”, “I use computers in feed compounding and to compute for optimization”, “It gives us the actual composition of the feed i.e energy composition, protein fibre and fat”. This farmer was reporting from one of the largest large farms in the study.

*Knowledge management*

Some of the respondents also reported that they used the computers for research purposes: “The use of computer improves my technical know-how, reduces stress and fatigue and gives me proper documentation.” “Use in researching of information on effect and solution to poultry disease.” Apart from those who reported using the computers for research, others used it for records, documentation and preparing of documents. The responses: “It has made sales documentation and purchases easier”, “It helps in keeping proper day to day activities, income and expenditure of the farm for improved production” and “The use has aided operation and decision making process” are apt in these regards. A respondent indicated clearly that he used the computer for publicity purpose, and “I have only used it to produce my handbills”.

***Internet/Email***

Further, some of the respondents reported their use of the Internet when asked questions about computers. This might suggest that the farmers purchased the computers probably because they would want to have Internet access or that they used the computers only for Internet related purposes. “I easily download new ways of solving some poultry problems whenever I do not wish to discuss with my vet doctor or a farmer friend”.”I get information from the website on different questions, for example feed formula, diseases and control”. “I visit some websites to gather information, for example, it was from a site that I got the right mix required for poultry feeds”.

Only a very few respondents reported using email, and their responses at best showed that the farmers have some knowledge about email and that they probably used it elsewhere and not necessarily in their farms. Based on the names of the farms that reported having used the technology, it could also be inferred that they were from owners of somewhat large farms, or persons who are relatively very highly educated: “I get to share

my experience with others on any problem which has been encountered in the course of farm work". "I was able to assess some foreign partners in terms of advice and also relevant information on the farm operations are exchanged via email". "It has provided a means of reaching out to customers who are far away without much travel expenses". "The use of email gets me global connection and improves my knowledge in things happening on the globe". There few experiences showed that the personal experiences of the farmers with the technology probably came from either industrial, highly educated or technology conscious farmers.

Others reported using email to improve communication with suppliers and buyers of their farm products, advice co-farmers, acquire more knowledge, update personal knowledge in poultry keeping and help in circulation of information among colleagues. Many of the respondents were either not conversant with email, did not use email or did not use email for farming purposes.

**Implications of this study for policy and practice**

A very high level of awareness about use of mobile telephone for information exchange could translate to need for policies directed at using this technology to provide information to farmers, particularly in relation to production and health, aspects that may require rigorous training. Using telephone to make calls to veterinary doctors and other experts to get information for meeting immediate needs is important, but channeling the use of these technologies to achieving impartation of knowledge in the farmers could be more advantageous. In line with trends in other aspects of life, information systems aimed at delivering information to farmers should be more mobile driven than being computer based. Also a very high level of awareness about use of television and radio draws policymakers to the continued relevance of these media in lifelong learning. Radio and television have common limitations namely they are one communication way technologies that do not permit immediate feedback from listeners. Also their use could be limited by challenges of poor electric power supply. A major approach that could be adopted to address the challenge of one way communication is to design a programme that combines mobile technology with radio and TV programmes. Participants and listeners to radio or television programmes could use mobile technologies to send in their questions either by calls or SMS.

**Conclusions and Recommendations**

Like in most countries, veterinary education adopts the traditional approaches of providing education for regular students in institutions and start providing veterinary education and learning through mobile technology-based open and distance learning strategies. Apart from enlarging the number of persons who acquire animal management skill and increasing the field of veterinarians and livestock professionals, this approach could be cheap to run, and also affordable to the farmers and other rural dwellers. The challenge however, is how to design appropriate software technologies to drive the information, how to manage the limitations of the mobile technology itself such as the smallness of the keypad, the emerging SMS syntax, among others.

The obvious advantages of ICT to individual, rural and smallholder communities in managing, marketing and acquiring new knowledge about livestock are apt. But this will require appropriate policies on livestock production/research and development, telecommunication, rural development, education, information management and governance. ICT will be very useful to promote information use, community mobilization and building partnerships across the innovation system individual farmers and veterinary and animal health care providers.

The outstanding role of mobile technologies raises the need to seek for innovative ways of utilizing the technology which is becoming cheaper and more available. Nwagwu (2007) demonstrated how SMS could enable farmers collect price information from the urban communities to check the activities of middlemen who buy their goods at cheap prices and sell them in the city at higher prices. SMS could also be very helpful in terms of linking buyers in the cities with producers in the rural communities. A project LINKS, has demonstrated how this methodology could be used to harmonise prices of goods in Eastern Africa. A limitation of the SMS technology, namely that of allowing only 160 characters per single message can be overcome by the instant messaging nature of SMS. Hence, a texter can exchange many messages within a short time.

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