THE INTERNATIONAL JOURNAL OF SCIENCE & TECHNOLEDGE

Monitoring Role of ICT in Quality of Artificial Insemination Services in Nyeri County, Kenya

Alex Mirara
Ph.D. Student, University of Nairobi, Kenya
Lecturer, Kenya School of Government, Kenya
Timothy Maitho
Professor, University of Nairobi, Kenya
Ursulla Okoth
Senior Lecturer, University of Nairobi, Kenya

Abstract:
Privatization of artificial insemination (AI) services led to a situation where government control of monitoring and evaluation of the services was drastically reduced. The privatization was also concomitant with the introduction and rapid growth of information and communication technology (ICT). However, the use of ICT in rural farming areas has been documented to be low. This study investigated whether the usage of ICT in monitoring artificial insemination services has an influence on the quality of the services. A cross sectional survey was carried out involving 188 farmers and 57 AI service providers. The study found that verbal communication through mobile telephones was the most commonly used technology for communicating AI related information. It was further found that use of the internet was very low among the rural farmers. This was attributed to the fact that most of the farmers were above 60 years of age and had not embraced the application of computers in their activities. The study further found that the application of ICT has a significant positive influence on quality of AI services. It was therefore recommended that there is a need for extension service providers to invest more in ICT related extension.

Keywords: *Information and communication technology, quality of artificial insemination services, dairy management database*

1. Introduction

The use of information and Communication technology in Kenya can be traced back to the late 1950's when the East African Railways imported the *ICT 1202* model to be used in payroll management (Couperus, 2015). Since then, computer use in Kenya grew very slowly until the 1990's when it started getting widespread. Before privatization of artificial insemination (AI) services, there was no use of ICT in the industry hence tasks related to data collection, analysis and dissemination of data were performed using pen and paper, which made them prone to error, difficult to conduct on a large scale, and high in transaction costs. Information and communication technology (ICT) tools, including hardware and software that allows users to upload data to storage facilities in real-time have reduced the conventional challenges associated with remote data collection (e-Agriculture, 2012).

In the current world, the use of digital electronic media to perform tasks which include data collection, analysis, transmission, reporting, storage and developing solutions to problems in AI service provision has become an integral part of any type of business process. The use of ICT in the AI field is supported by advantages such as a much faster processing of data; information systems can be used to develop information repeatedly with consistent quality; faster and accurate archival and retrieval of data; ease of storage of large quantities of data without consuming much space and; extremely fast communication over vast geographical areas (Ogbomo and Ogbomo, 2008).

Advancement in ICT has taken place to the extent that package software has been developed to aid in solution of various problems in the dairy industry, including genetic matching to establish propensity scores for preferred genetic traits in offspring (Diamond and Sekhon, 2012). Both proprietary and package softwares have been developed to enhance data collection, analysis and use in the AI field of practice. Such softwares have also been developed for specific projects and incorporated into project management information systems making the use of specialized ICT technologies in monitoring and evaluation an unavoidable process. The advantage of having proprietary ICT technologies is that they address specific issues or programme information needs. Their disadvantage, however is that they may be quite expensive and may be prone to mistakes in programming, thus may translate into the production of invalid data (Bouras, Kokkinos and Tseliou, 2012), which in AI can lead to immense losses for farmers. Software produced today for purposes of monitoring and evaluation undergoes repeated improvements to the extent that any errors in the processed data are more likely to be attributed to user error than to coding. Feder *et al* (1985) found that the relationship between farm size and ICT adoption

depends on many factors such as fixed costs, risk preferences, human capital, credit constraints, labour requirements and tenure agreements.

Technology application has been argued to be one of the key success factors for firms, mainly because the world is shifting to a techno – economic paradigm, both in commodity and service firms. This is well demonstrated in the AI field where technological advancement among all players including small scale farmers, AI service providers and Veterinary Officers is growing rapidly. Sapprasert (2006) demonstrated that both productivity and profitability growth were significantly linked to the level of ICT usage intensity in service firms especially when undertaken jointly with non-technological innovations.

The application of ICT in the Rural Development sector has been relatively slow. The main reasons for this are poor ICT infrastructure in rural areas, poor ICT awareness among agency officials working in rural areas and local language issues (Kumar and Singh, 2012). However, various authors have shown that technology advancement in dairy farming is taking place continuously (Thomas, 2015; Larson, 2014; Karabinus et al, 2014 and Ogbomo and Ogbomo, 2008). This study investigated how the usage of ICT as a monitoring tool affects the quality of AI services in Nyeri County, Kenya.

2. Methodology

The study adopted a descriptive cross-sectional survey design and used a multi-method approach in order to obtain qualitative and quantitative data. The survey targeted 188 farmers in Nyeri County, Kenya. These farmers were sampled from a population of 162,427 farm holdings in the County (RoK, 2013). In order to add credence to the data obtained from farmers, further data was obtained from a sample of 57 AI service providers out of the 104 service providers working from the County. Transect mapping was used to identify the farmers for the study while simple random sampling was used for the service providers. Data collection was done through self-administered questionnaires with open and closed ended questionnaires for both respondent groups.

3. Results

Information and communication technology use is highly integrated in urban areas (Waema and Ndungu, 2012). However, its penetration and usage in rural areas is still not very well mapped. In order to establish the level of use of ICT in facilitating artificial insemination services and its influence on quality of the services, data on various aspects of its use was analysed as shown in the following sections. Where a Likert scale was used, scores were based on a scale of 1 – 5 where 1 was "never"; 2 was "rarely"; 3 was "only when needed"; 4 was "frequently" and 5 was "very frequently".

3.1. Channels of Information Received by Farmers

The study sought to find out how ICT is applied in dairy farming in Nyeri County. In order to achieve this, farmers were asked to indicate the frequency in which they receive AI related information from various channels. The aforementioned Likert Scale was used to gauge the responses. A descriptive presentation of the results is shown in Table 1.

	N	Minimum	Maximum	Mean	Standard Deviation
Radio	176	1	5	3.05	1.220
Television	176	1	5	2.31	1.135
Mobile Telephone	174	1	5	1.68	1.074
Landline Telephone	172	1	3	1.10	0.336
Internet	172	1	5	1.69	1.110

Table 1: Channels of Information Received by Farmers

Table 1 indicates that the commonest channel of receiving information by farmers was the radio with a mean of 3.05 which implies that it was frequently used. Television had a mean of 2.31 implying that it was often used as a source of AI related information. Internet, mobile and landline telephones had means of 1.69, 1.68 and 1.10 respectively meaning that they were seldom used for acquiring AI related information.

3.2. Channels of Communication by Farmers

The study investigated the channels used by farmers in order to communicate with AI service providers. This was in recognition of communication is a two-way process of sending and receiving information through a medium. Farmer respondents were therefore asked to indicate the frequency of using various ICT media and the results shown in Table 4.43 were obtained. The results were based on the earlier mentioned Likert Scale.

Channel	N	Minimum	Maximum	Mean	Standard Deviation
Email	170	1	5	1.22	0.692
Mobile Telephone	174	1	5	3.09	1.291
Landline Telephone	172	1	4	1.12	0.408
Hand Delivered Notes	169	1	5	1.34	0.793
Oral Intermediary	170	1	5	1.64	1.074
Message Kiosk	173	1	5	2.16	1.199
Physical contact	173	1	6	3.87	1.285

Table 2: Channels of Communication by Farmers

Table 2 shows that physical contact had a mean of 3.87 which implies that farmers frequently communicate with AI service providers through physical contact. This, according to the data, is the most common channel of communication to service providers. The data also shows that mobile telephones had a mean of 3.09, which implies that farmers communicated with AI providers using mobile telephones when there is a need. This was the second most common channel of communication for farmers to AI service providers. The third most common channel was the use of a message collection point (message kiosk) which had a mean of 2.16 indicating that it was rarely used. Other channels were oral intermediary, hand – delivered notes, email and landline telephones with means of 1.64, 1.34, 1.22 and 1.12 respectively. This implies that majority of respondents rarely used these channels to communicate with AI service providers.

3.3. Presence of Database

The presence of a database may indicate a demand for information, while the location of the database may indicate the level of plurality in managing the data and the level of ICT usage in accessing the data. This study therefore sought to find out if a database for AI information existed and whether it was centrally located or scattered. The study also sought to find out who maintained the database. Table 3shows the results obtained in respect of these questions.

		Frequency	**Percentage**
Presence of Database	Yes	45	78.9
	No	12	21.1
	Total	**57**	**100.0**
Location of Database	Central	28	49.1
	Scattered	17	29.8
	Not Applicable	12	21.1
	Total	**57**	**100.0**
Who Maintains Database	Government	16	28.1
	Private Practitioners	17	29.8
	Suppliers	7	12.3
	Cooperative Societies	5	8.8
	Not Applicable	12	21.1
	Total	**57**	**100.0**

Table 3: Presence of Database

Table 3 shows that 78.9% of the service providers knew that there was a database on AI while 21.1% were not aware of the existence of any database. Among the respondents who were aware of a database, 49.1% indicated that the database was centrally located while 29.8% indicated that the database was scattered. In regards to who maintains the database, Government, private practitioners, suppliers and cooperative societies were pointed out by 28.1%, 29.8%, 12.3% and 8.8% respectively.

3.4. ICT Use and Quality of AI Services

The hypothesis in this study was that there is a significant relationship between ICT application by farmers and their judgement of quality of AI services. A linear regression analysis was used to determine the relationship between the use of ICT and quality of AI services. The assumptions of normality, homoscedasticity, and independence of the data were maintained in this test. The results of the regression analysis are shown in Table 4.

Model		**Unstandardized Coefficients**		**t**	**Sig.**	**Adj r^2**
		B	**Standard Error**			
1. Farmers	Constant	2.722	0.210	12.988	0.000	0.046856
	ICT Use	0.284	0.091	3.122	0.002	
Dependent Variable: Average Quality Rating						

Table 4: Linear Regression of ICT use on Quality of Service

Table shows that the linear regression equation for service providers had a y-intercept of 2.722 and a slope of 0.284. This implies that based on the equidistant distribution of responses in respect of the Likert Scale, the service providers believed that without the use of ICT, quality of AI services was good and increased slightly as ICT was applied. The presentation of this relationship was thus,

Quality of AI Services (Farmers) = 2.722 + 0.284 ICT Use

A further analysis of the relationship between ICT use and quality of AI services using a t-test revealed a t statistic of t(farmers)=3.1225 with a significance level of p=0.0021 which was below the threshold of $\alpha = 0.05$. This implies that at $\alpha=0.05$, there was a significant positive relationship between the use of ICT and the quality of AI services experienced by farmers. Qualitative data

from AI service providers supported this finding where mobile phones were reported to have a tremendous influence on service delivery to farmers as shown in the following responses:

→ "The use of ICT in AI is growing. Almost all farmers have access to mobile telephones. The use of internet is only confined to the younger generations. Landlines were used in the past but are no-longer used."

An adjusted Pearson Product Moment Correlation coefficient of 0.046856 indicated a very weak correlation coefficient of the relationship between ICT use and quality of AI service. The implication of the coefficient is that only 4.6856% of the data can be explained by the regression equation while the rest is influenced by the error term.

4. Discussion

It was found that the use of ICT had a significant influence on quality of AI services as adjudged by farmers. Findings on the use of information and communication technology revealed that use of mobile telephones was the most common mode of communication between farmers and service providers. The use of the internet either to communicate or to access AI related information was very low. This was attributed to the fact that even though mobile phones are easily available and easy to use, most farmers have not appreciated the internet as a means of transferring and sharing information. This fact is aggravated by the low internet connectivity in some of the rural areas in the study area. The study further found that the use of internet in AI was confined to younger people aged 40 years and below. Data showed that majority of farmers (79.6%) were above 40 years of age meaning that only 20.4% of the farmers were likely to have a high propensity to use the internet. ICT illiteracy among older people may also be a factor hindering the use of internet in the study area. This tends to agree with the assertion by Chapman and Slaymaker (2002) that rural areas are often characterized as information-poor. The potential of ICTs to support the improvement of currently inadequate extension and education services, and to ensure that farmers have access to reliable information about agricultural technologies and markets, is the subject of considerable interest for researchers and Governments (Zijp, 1994; FAO, 1998).

It was also found that unlike other modes of communication, use of mobile telephones was the most widespread with both farmers and service providers stating that they used them very frequently. The mobile phone is the most available ICT equipment in the study area hence its widespread use for communication. This agrees with Sapprassert (2006) that current trends in technological advancement are relying heavily on ICT. The implication of this is that any shift in the communication technologies should be towards mobile phone related applications if they are to be useful in rural agricultural areas

The study showed that sources of AI information for service providers and farmers were many and scattered. This implies that there is a necessity for the enhancement of the use of ICT both for extension services and for research on farm related issues. According to Ogbomo and Ogbomo (2008), use of remotely located data may attract the use of ICT if it is to be accessed quickly over vast geographical areas. Nagesh, Khandelwal and Caicedo (2014) suggest that accessing data from remote locations has many advantages such as zero maintenance of local databases, unlimited storage space to store both data and images and as a result fewer memory leaks and application crashes.

5. Conclusions

The study concludes that there is a need for government and other agricultural extension service providers to invest in the improvement of ICT infrastructure as a means of enabling farmers to acquire extension services and to receive advisories promptly and accurately. As the technologies are changing, the effectiveness, economy and practicability of extension-farmer contact may reduce while the need for current information is increasing. At the same time the age profile of farmers is such that most of the land owners are ageing hence they have to be replaced by young techno-savvy entrepreneurs.

The development of farmer-friendly information acquisition software would be another important step towards making ICT applications more available to the less ICT literate farmers. This would make it easier for farmers who mostly don't own smartphones and cannot cope with the complexities of the available internet browsing software.

6. Acknowledgements

The authors wish to acknowledge the University of Nairobi and Kenya School of Government for their support while carrying out this study.

7. References

i. Bouras, C., Kokkinos, V. and Tseliou, G. (2012). Selecting Between Open Source and Proprietary Software: the Public Administrators' Case. IADIS International Conference E-Society, 2012
ii. Chapman, R. and Slaymaker, T. (2002) ICTs and Rural Development: Review of the Literature, Current Interventions and Opportunities for Action. Overseas Development Institute, London.
iii. Couperus J, (2015). The First Computers in East Africa –and what became of them. Owaah. Accessed form http://owaahh.com/the-first-computers-in-east-africa-and-what-became-of-them on 26th October, 2016.
iv. Diamond, A. and Sekhon, J. S. (2012). Genetic Mapping for Estimating Causal Effects: A General Multivariate Matching Method for Achieving Balance in Observational Studies. Review of Economics and Statistics, March 14, 2012. Retrieved from http://sekhon.berkeley.edu/papers/GenMatch.pdf accessed on 15th January, 2014

v. e-Agriculture. (2012). ICT for Data Collection and Monitoring and Evaluation. e-Sourcebook, Forum 3, June 2012, accessed from http://www.fao.org/docrep/017/aq003e/aq003e.pdf, on 15th May 2013.

vi. FAO. (1998) Communication for Development Report 1996–1997. Rome: Communication for Development Group. Extension, Education and Communication Service. Research, Extension and Training Division. Sustainable Development Department, FAO.

vii. Feder, G., Just, R. J. and Zilberman, D. (1985). Adoption of Agricultural Innovations in Developing Countries: A Survey. Economic Development and Cultural Change, 32 (2), 255-298

viii. Karabinus, D. S., Marazzo, D. P., Stern, H. J., Potter, D. A., Opanga, C. I., Cole, M. L., Johnson, L. A. and Schulman, J. D. (2014). The Effectiveness of Flow Cytometric Sorting of Human Sperm (MicroSort®) for Influencing a Child's Sex. Reproductive Biology and Endocrinology 2014, 12:106 accessed from http://www.rbej.com/content/12/1/106 on 18th May 2015.

ix. Kumar A. and Singh K. M. (2012). Role of ICTs in Rural Development with Reference to Changing Climatic Conditions. in Krishna M. S. And Meena M. S. (Eds.), ICT For Agricultural Development Under Changing Climate. India, Narenda Publishing House. Accessed from or http://dx.doi.org/10.2139/ssrn.2027782 on 27th October, 2016

x. Larson, J. E. (2014) Estrus Synchronization in Dairy Cattle. Mississippi State University.

xi. Nagesh, A., Khandelwal, K. and Caicedo, C. E. (2014). Accessing External Databases from Mobile Applications. Centre for Convergence and Emerging Network Technologies – CCENT. Syracuse University

xii. Ogbomo, M. O. and Ogbomo, E. F. (2008). Importance of Information and Communication Technologies (ICTs) in Making a Healthy Information Society: A Case Study of Ethiope East Local Government Area of Delta State, Nigeria. Library Philosophy and Practice, Nebraska-Lincoln. ISSN 1522-0222

xiii. RoK. (2013). Percentage Distribution of Agricultural Parcels. Kenya OpenData. Accessed from https://opendata.go.ke/Counties/Percentage-distribution-of-Agricultural-Parcels-by/yfyr-2v86 on 28th May, 2013

xiv. Sapprasert, K. (2006). The Impact of ICT on the Growth of the Service Industry. Oslo, Norway: University of Oslo, Centre for Technology, Innovation and Culture. Accessed from http://www.druid.dk/conferences/viewpaper.php?id=399&cf=8 on 18th December, 2013.

xv. Thomas, H. S. (2015). Sexed Semen is now a Reality for Cattle Breeders. Cattle Today. Accessed from http://www.cattletoday.com/archive/2008/February/CT1428.shtml on 18th May, 2015.

xvi. Waema T. M. and Ndung'u M.N. (2012). Understanding what is happening in ICT in Kenya: A supply- and demand side analysis of the ICT sector. Evidence for ICT Policy Action Policy Paper 9, 2012 accessed from http://www.researchictafrica.net/publications/Evidence_for_ICT_Policy_Action/Policy_Paper_9_-_Understanding_what_is_happening_in_ICT_in_Kenya.pdf on 1st November 2016

xvii. Zjip, W. (1994) Improving the Transfer and Use of Agricultural Information: A Guide to Information Technology. Washington: World Bank, World Bank Discussion Paper 247.