Use of ICT in agricultural extension services, Gedarif State, Sudan

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Abstract. This study investigates the use of ICT in agricultural extension services in Gedarif State, Sudan. A field survey was used to collect data from 94 extension officers in the State in 2016/2017 growing season using the full count method. The collected data were statistically analyzed and interpreted using percentage, frequency distribution and chi-square test. The descriptive statistics showed that the majority of the respondents 72.3% used the ICT in their extension services given to farmers and the majority of them 93.6% reported that there are many constraints facing the use of ICT in agricultural extension services in the State. Chi-square test revealed that there was no significant association between ICT and constraints facing the use of them in the delivery of agriculture extension services to the targeted audience in the State. Thus, the authors recommend that the extension officers and farmers should be trained in the use of ICT and the constraints facing the use of ICT in the agricultural extension services in the State should be solved in collaboration with all partner organizations.

1. Introduction

Agriculture is the backbone of Sudan’s economy and food security. As in developing countries, the majority of Sudanese people live in rural areas and depend on agricultural production as the main source of their income and food security. The country has two main agricultural subsectors irrigated and rainfed (traditional and mechanized) subsector. The traditional rainfed sector represents 60% of the total cultivated area in the country. Agriculture contributes 46% of the country's GDP and it accounts for about two thirds of the employment and supplies about 60% of the raw material needed by the manufacturing sector [1].

The emergence of new agricultural development paradigms has led to challenging the conventional methods of delivering important services to audience and the transformation of traditional societies into knowledge societies [2]. Information and Communication Technology (ICT) has become the most important and influential tools of disseminating information required by the audience of agricultural extension worldwide. Therefore Information and Communication Technology (ICT) has become the cornerstone of agricultural development in contemporary times. Unagha [3] defined (ICT) as an omnibus term that encompasses computer and telecommunication technology. They are a technologies that can be used in producing, organizing and distributing information.

ICT can be seen as an effective communication methods, particularly where time and distance are constraints. The ICT has the potential to use as cost effective alternative for some of the traditional
agricultural extension teaching methods used by the agricultural extension officers. The ICT can overcome barriers of time and distance in technology transfer as it can facilitate reaching information beyond the local/regional level to the national and international levels [4].

Agricultural extension organizations play important role in helping rural people access and use the (ICT) as tools to improve their income and standards of living. ICT can play a key role in providing farmers with all information needed for their crops production about credits, input supply, pest and disease control, post-harvest techniques and improving market access. Agricultural extension systems can help rural people to adopt and effectively use these tools in obtaining their needed services once they are available, in ways that will have positive impact on their production, and income [5].

In the majority of African countries agricultural extension services are weak, unsatisfactory or even do not exist. In Sudan as in most developing countries ministry-based agricultural extension services are adopted and established after the Second World War as part of American Aid for developing countries in 1959. Therefore agricultural extension services are still depend largely on the use of traditional communication methods in the delivery of these services to extension clientele [6]. When using traditional communication methods, extension officers cannot reach all the targeted clientele because of long distances, bad roads, poor communication infrastructure in most rural areas in the country, low financial support in addition to high farmers’ extension officer ratio (Approximately 1500:1), while the ration recommended by FAO is 1:400. In the majority of developing countries there are few extension officers to serve many farmers, for example in Kenya the ratio of farmers to extension officer is 753:1.

There is a need to assess the use of ICT in the delivery of agriculture extension services to extension clientele in Gedaref State, Sudan. The main objective of this study was to assess the use of ICT in the delivery of agriculture extension services to extension clientele by extension officers in Gedaref State, Sudan. This study measured the personal characteristics of extension officers based on several parameters (sex, social status, education level, age and work experience). Kinds of ICT used were also identified (mobile phone, TV, computer, radio, audiovisual). Moreover, this study also assessed the purpose of ICT use (extension method, source of information, source of problem solving practice and multi purpose) and determined the constraints of ICT use for extension (lack of ICT, lack of technical know-how, high cost and collective constraints).

2. Materials and Methods

2.1. Area of the study
The Gedarif State is located in Eastern Sudan bordered by Kassala State at the north, Khartoum State at the northwest, and Sinner State at the south, Gezira State at the west and Eritrea at the east. The state covers a total area of 75,263 Km. It is 600 meters above the sea level. About 1,348,378 people live in Gedarif area according to UN Population census 2003. The state is characterized by vast land suitable for agriculture, and the largest projects for rainfed agriculture in Sudan. The most important cultivated crops are sesame, maize, millet, gum Arabic, sunflower and horticultural crops such as lemon, watermelon and vegetables such as tomatoes and okra, squash and others.

2.2. Population and sample size
The total number of agricultural extension officers working for the Agricultural Extension and Technology Transfer Administration, Gedarif State is 94 agricultural extension officers. This number represents the population size of the study.

2.3. Data collection
The study was based on primary (qualitative) data. Qualitative methods are ways of finding out what people do, know, think and feel by interviewing, observing and analyzing data from documents [7]. The data were gathered by administering a questionnaire among all agricultural extension officers of the State using the full count method in 2016/2017 growing season.
2.4. Data analysis
The collected data were statistically analyzed and interpreted using percentage and frequency distribution and chi-square test. Chi square is given by:

$$\chi^2 = \sum_{r=1}^{R} \sum_{c=1}^{C} \frac{(O_{rc} - E_{rc})^2}{E_{rc}}$$

With degrees of freedom (v) given by (R-1) (C-1), where:
R : Rows of the contingency table
C : Columns of the contingency table
O_{rc} : Observed frequency in row (r) and column (c)

3. Results and Discussion

3.1. Socioeconomic profile of extension officers
The data presented in Table 1 indicated that 50% of extension officers were males, while 50% were females. Selected socioeconomic characteristics of agricultural extension officers and farmers such as gender, age, and education level play a key role in the adoption and use of ICT [8-10]. The majority of extension officers (61.7%) were married while (35.1%) (2.1%) (1.1%) of them were single, divorced and widowed respectively. Research has shown that married people are more creative and have more stability.

The majority of extension officers (91.5%) reported that they are bachelor holders, compared to (3.2%) (3.2%) of them reported that they are MSc and Diploma holders respectively. (2.1%) of them reported that they are secondary school certificate holders. Educational level of extension officers contributes directly to job performance and impact of extension work with rural people. Education level of extension officers is one of the most serious problems of extension in many countries as shown in the literature; therefore the success of extension services depend mainly upon selection of qualified and motivated extension officers. Tata and McNamara [10] found that extension officers with advanced degrees (MSc) in Southern Africa encountered no technical challenges when using ICT in comparison to less-educated colleagues. Strong et al. [9] mentioned that education level was the important socioeconomic factor that influenced technological preferences and competency in Caribbean agricultural extension officers. Mwansa [11] reported that agricultural extension officers attitude towards technology was the primary reason for a lack of ICT use when teaching and transferring information to farmers.

The majority of extension officers (62.8%) were between 26-33 years old, (24.5%) of theme between 36-45 years old, (5.3%) of theme between 15-25 years old and (7.4%) of theme have 45 and more years old. Research showed that employing young people can be cost effective and can provide the skills and workforce needed in the future and a source of future management. About 42.6% of extension officers reported that their work experiences less than 5 years. About 31.9% of them reported that their work experiences five to ten years and 25.5% reported that their work experiences 11 years and above. In Nigeria showed that significant relationships exist between sex, age, level of education, years of working experience of the extension agents with the level of use of ICT.

3.2. Use of ICT in the delivery of agriculture extension services
Table 2 revealed that the majority of extension officers (72.3%) reported that they used ICT in the delivery of agriculture extension services to their audience, while (27.7) of them reported that they did not use ICT in the delivery of agriculture extension services to their audience. Farmer’s demand for information has increased in recent years due to greater market instability, more complex production technologies among others. Lack of timely information can prevent good quality decision and thus lower the efficiency of production decision among farmers. Therefore ICT can be used to strengthen the capacities of rural development workers, farmers, farmer organizations and rural communities as a
whole. Similarly, in Gezira State Sudan the majority of extension officers used ICT in their agricultural extension services.

Table 1. Distribution of the extension officers according to their selected socioeconomic characteristics.

| Socioeconomic characteristics | Frequency | %   |
|-------------------------------|-----------|-----|
| **Sex**                       |           |     |
| 1-Male                        | 47        | 50  |
| 2-Female                      | 47        | 50  |
| **Social status**             |           |     |
| 1-Married                     | 58        | 61.70|
| 2-Single                      | 33        | 35.10|
| 3-Divorced                    | 02        | 2.10 |
| 4-Widowed                     | 01        | 1.10 |
| **Education level**           |           |     |
| Secondary school certificate  | 02        | 2.10 |
| Diploma                       | 03        | 3.20 |
| BSc.                          | 86        | 91.50|
| MSc.                          | 03        | 3.20 |
| **Age group**                 |           |     |
| 15-25                         | 05        | 5.3  |
| 26-35                         | 59        | 62.8 |
| 36-45                         | 23        | 24.5 |
| 45 and more                   | 07        | 7.4  |
| **Work experience**           |           |     |
| less than 5 years             | 40        | 42.6 |
| 5 to 10 years                 | 30        | 31.9 |
| 11 years and more             | 24        | 25.50|

Table 2. Distribution of the extension officers according to their use of ICT in the delivery of agriculture extension services.

| Use of ICT        | Frequency | %   |
|-------------------|-----------|-----|
| Use ICT           | 68        | 72.3|
| Did not use ICT   | 26        | 27.7|
| Total             | 94        | 100.0|

3.3. Kind of ICT used in the delivery of agriculture extension services

Table 3 showed that most of extension officers (34%, 53%, 35.1%, 33% and 27.7%) reported that they did not use computer, video, audio-visual aids, television and mobile respectively in the delivery of agriculture extension services to their audience. Some extension officers (34%, 10.6%, 51%, 57.5% and 63.8%) reported that they often used computer, radio, audio-visual aids, television and mobile respectively in the delivery of agriculture extension services to their audience. (22.3%, 7.4%, 9.6%, 7.4% and 6.4%) of extension officers reported that they used computer, video, audio-visual aids, television and mobile respectively some times in the delivery of agriculture extension services to their audience. (9.7%, 29%, 4.3%, 2.1% and 2.1%) of extension officers reported that they used computer,
video, audio-visual aids, television and mobile respectively rarely in the delivery of agriculture extension services to their audience.

The role of ICT in improving agricultural extension communication with beneficiaries to share information, skills, experiences and other purposes of communication was found to be the backbone of successful agricultural extension services that in turn will lead to the targeted agricultural development. [12] found that in Gezira State Sudan the majority of extension officers used radio, TV and mobile phone in their agricultural extension services. Gillwald [13] found that that despite the rapid growth of emerging ICTs, the more traditional ones such as radios and TVs remain popular in Africa, particularly in rural areas. Rahman and Hamid [6] reported that in the Gezira State, Sudan the majority of vegetable farmers still depend on the use of mobile phone and the traditional ICTs (radio and TV) only to obtain various agricultural extension services. Also a study carried out by [14] revealed that in South East Nigeria radio and television followed by phone were the most accessed and utilized ICT among the extension officers, however the extent of access and utilization of contemporary ICTs such as internet is still very low.

Table 3. Distribution of extension the officers according to kind of ICT used in the delivery of agriculture extension services.

| Kind of ICT used | Computer | Radio | Audiovisual aids | Television | mobile |
|------------------|----------|-------|------------------|------------|--------|
| Fr. %            | Fr. %    | Fr. % | Fr. %            | Fr. %      | Fr. %  |
| Not used         | 32       | 34    | 50               | 33         | 35.1   |
|                   | 31       | 33    | 26               | 27.7       |
| Often            | 32       | 34    | 10               | 48         | 51     |
|                   | 54       | 57.5  | 60               | 63.8       |
| Some times       | 21       | 22.3  | 7                | 9          | 9.6    |
|                   | 7        | 7.4   | 6                | 6.4        |
| Rarely           | 9        | 9.7   | 27               | 4          | 4.3    |
|                   | 2        | 2.1   | 2                | 2.1        |
| Total            | 94       | 100   | 94               | 100        | 94     |

3.4. Purposes for which ICTs were used

Table 4 indicated that (34%, 53%, 35.1%, 33% and 27.7%) of extension officers reported that they did not use computer, radio, audio-visual aids, television and mobile respectively in the delivery of agriculture extension services to their audience. (26.6%, 16%, 31.9%, 37.2% and 12.8%) of extension officers reported that they used computer, radio, audio-visual aids, television and mobile respectively in the delivery of agriculture extension services to their audience as extension methods. (6.4%, 5.3%, 2.1%, 1.1% and 6.4%) of extension officers reported that they used computer, radio, audio-visual aids, television and mobile respectively in the delivery of agriculture extension services to their audience as sources of agricultural information. (7.5%, 6.4%, 3.2%, 00.% and 5.3%) of extension officers reported that they used computer radio, audio-visual aids, television and mobile respectively in the delivery of agriculture extension services to their audience as sources of problem solving practices. (25.5%, 19.1%, 25.5%, 26.6% and 47.8%) of extension officers reported that they used computer, radio, audio-visual aids, television and mobile respectively in the delivery of agriculture extension services to their audience for multiple purposes.

The use of ICTs in the delivery of agriculture extension services to extension audience can have economic impact to their users because they can save time and money especially for those who do not prefer leaving their work sites and travel into near towns and cities to make their own purchases of agricultural inputs and other farm needs. Rahman and Fadol [12] found that in Gezira State Sudan the majority of extension officers used the available ICT as extension methods, sources of problem solving practices and other extension services.
Table 4. Distribution of the extension officers according to purposes for which ICTs were used.

| Purpose of use                  | Computer | Radio | Audiovisual aids | Television | mobile |
|--------------------------------|----------|-------|------------------|------------|--------|
|                                | Fr.      | %     | Fr.              | %          | Fr.    |
| Not used                       | 32       | 34    | 50               | 53.2       | 35.1   |
| extension methods              | 25       | 26.6  | 15               | 16         | 30     |
| sources of agricultural       | 6        | 6.4   | 5                | 5.3        | 2      |
| information                   | 7        | 7.5   | 6                | 6.4        | 3      |
| sources of problem            | 24       | 25.5  | 18               | 19.1       | 24     |
| solving practices             | 1        | 1.1   | 00               | 00         | 5      |
| Multiple purposes             | 94       | 100   | 94               | 100        | 94     |
| Total                          | 94       | 100   | 94               | 100        | 94     |

3.5. Constraints facing the use of ICT in the delivery of agriculture extension services

Table 5 revealed that (3.2%) of extension officers reported that they have no computer, video, audiovisual aids, television and mobile. (2.1%) of extension officers reported that they lack technical know-how which can help them to get more benefits from ICTs if they are trained in the proper use of them. (1.1%) of extension officers reported that ICT have high cost including their prices and usage. The majority of extension officers (93.6%) reported that they faced many constraints in their usage of ICT in the delivery of agriculture extension services.

Table 5. Distribution of the extension officers according to constraints facing their use of ICT in the delivery of agriculture extension services in Gedarif State.

| Constraints facing the use of ICTs       | Frequency | %  |
|-----------------------------------------|-----------|----|
| Lack of ICT                              | 3         | 3.2|
| Lack of technical know-how               | 2         | 2.1|
| High cost of using ICT                   | 1         | 1.1|
| Collective of constraints                | 88        | 93.6|
| Total                                    | 94        | 100|

3.6. Association between use ICTs and constraints facing the use of them:

Chi-square test was used to determine the association between the use of ICT and constraints facing use of them in agricultural extension services in Gedarif State. The results revealed that there was no significant association between lack of ICT and use of them in agricultural extension services in Gedarif State. There was no significant association between lack of technical know-how and use of them in agricultural extension services in Gedarif State. There was no significant association between the high cost of using ICTs and use of them in agricultural extension services in Gedarif State. There was no significant association between collective of constraints facing the use of ICT and use of them in agricultural extension services in Gedarif State.

Using depth interview with extension officers revealed that they have no smart mobile phones as a result of the high price and use of them in Sudan and/or lack of them in all agricultural extension complexes in the State. The State lacks internet centres affiliated to Ministry of Agriculture in the villages which can provide information services with reasonable prices for farmers. The State lacks internet cafes in the villages which can provide information services with commercial prices for
farmers. They have no personal computers (laptop device) because of high price of them in Sudan and/or lack of them in all agricultural extension complexes in the State.

Inadequate ICT basic infrastructure, high price and use of ICT, lack of technical know-how and lack of electricity power problems have been cited as some of the constraints facing the use of ICT in agricultural extension services [15-17].

Table 6. Chi-squire test for association between use of ICT and constraints facing the use of them in agricultural extension services in Gedarif State.

| constraints facing the use of ICTs | Use of ICTs | Total | Sig. |
|-----------------------------------|-------------|-------|------|
|                                   | yes | no |     |
| Lack of ICT                       | 2   | 1  | 3   |
| Lack of technical know-how        | 2   | 0  | 2   |
| High cost of using IC             | 1   | 0  | 1   |
| Collective of constraints         | 63  | 25 | 88  |
| Total                             | 68  | 26 | 94  |

Significance level 0.05 or less

4. Conclusion

From this study, we can conclude that a considerable number of agricultural extension officer of Gedarif State still depend on the use of traditional ICT such as Radio and Television. Thus the authors recommend that the extension officers and farmers should be trained in the use of ICT and the constraints facing the use of ICT in the agricultural extension services in the State should be solved in collaboration with all concerned stakeholders.

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