

Use of Information and Communication Technologies (ICTs) by Intermediaries in the Agriculture Sector

Insights from Ghana

FRR VOLUME
6 No 03

Authors

Omari R
Jumpah E.T
Arthur J. O
Asabo R
Hagan E

Mahama A
Ameyaw R.A
Frempong G
Baumuller H



MAY 2022

Citation: Omari R, Jumpah E.T, Arthur J. O, Asabo R, Hagan E, Mahama A, Ameyaw R.A, Frempong G. and Baumuller H (2022). Use of Information and Communication Technologies (ICTS) by Intermediaries in the Agriculture Sector: Insights from Ghana. FARA Research Report 6 (03): Pp 55

Corresponding Author

Omari Rose

ISSN:2550-3359

Editorials

Dr. Fatunbi A.O and Mr. Benjamin Abugri (babugri@faraafrica.org)

FARA encourages fair use of this material. Proper citation is requested

Forum for Agricultural Research in Africa (FARA)

12 Anmeda Street, Roman Ridge PMB CT 173, Accra, Ghana Tel: +233 302 772823 / 302 779421 Fax: +233 302 773676 Email: Website: www.faraafrica.org : www.faradatainforms.faraafrica.org

Join the network: <https://faraafrica.community/fara-net/join>

Register as an AR4D expert: <https://experts.faraafrica.org/>

Designed By: Samuel Oti Attakorah - FARA Knowledge Management, Learning & Communications Unit (publications@faraafrica.org)

About FARA

The Forum for Agricultural Research in Africa (FARA) is the apex continental organisation responsible for coordinating and advocating for agricultural research-for-development. (AR4D). It serves as the entry point for agricultural research initiatives designed to have a continental reach or a sub-continental reach spanning more than one sub-region.

FARA serves as the technical arm of the African Union Commission (AUC) on matters concerning agricultural science, technology and innovation. FARA has provided a continental forum for stakeholders in AR4D to shape the vision and agenda for the sub-sector and to mobilise themselves to respond to key continent-wide development frameworks, notably the Comprehensive Africa Agriculture Development Programme (CAADP).

FARA's vision is to "Reduced poverty in Africa as a result of sustainable broad-based agricultural growth and improved livelihoods, particularly of smallholder and pastoral enterprises" its mission is the "Creation of broad-based improvements in agricultural productivity, competitiveness and markets by strengthening the capacity for agricultural innovation at the continental-level"; its Value Proposition is the "Strengthening Africa's capacity for innovation and transformation by visioning its strategic direction, integrating its capacities for change and creating an enabling policy environment for implementation". FARA's strategic direction is derived from and aligned to the Science Agenda for Agriculture in Africa (S3A), which is in turn designed to support the realization of the CAADP vision.

Disclaimer

"The opinions expressed in this publication are those of the authors. They do not purport to reflect the opinions or views of FARA or its members. The designations employed in this publication and the presentation of material therein do not imply the expression of any opinion whatsoever on the part of FARA concerning the legal status of any country, area or territory or of its authorities, or concerning the delimitation of its frontiers".

Acknowledgement

This study was executed with the funding support of the German Federal Ministry of Economic Cooperation and Development (BMZ). We acknowledge the facilitation and coordination role played by the Forum for Agricultural Research in Africa (FARA) to ensure the successful execution of the study. We are grateful.

We would like to express our profound gratitude to Dr. Victor Agyeman, Director-General of the Council for Scientific and Industrial Research (CSIR) and Dr. Wilhemina Quaye, Director of CSIR-STEPRI for their great leadership and contribution to the completion of this study. We are also grateful to Dr. Heike Baumüller for her guidance on the design and implementation of this study. We acknowledge the invaluable contributions of the CSIR-STEPRI team that conducted this study, including data analysis and report writing. They are Dr. Rose Omari, Emmanuel Tetteh Jumpah, Johnny Owusu-Arthur, Sylvia Baah-Tuahene, Rankine Asabo, Elizabeth Hagan, Abdalla Mahama, Dr. Richard Ampadu-Ameyaw, and Godfred Frempong.

This study was developed in the context of the Program of Accompanying Research for Agricultural Innovation (PARI), supported by the Federal German Ministry for Economic Cooperation and Development (BMZ).



Summary

The use of information and communication technologies (ICTs) can propel economic development and improve living standard of a nation's citizens. ICTs are deployed in various facets of human endeavours. They have been widely used in commerce and industry to promote economic growth, particularly in developed countries. The development of nations like US, Germany and Japan can be attributed to the significant contribution and use of ICTs. The use of ICTs in the global south has been increasing in recent years, particularly in industry and services sector of the economy. In Ghana, access to broadband internet increased from 19% in 2014 to 53% in 2019. However, access to these technologies has largely been lacking in the agricultural sector. Within the limited use of ICT in the agricultural sector, not much is known by its use by intermediary value chain actors. This study therefore analysed the use of ICTs among intermediaries in the agricultural sector and examined the benefits therein, especially in uncharted times of the Covid-19 pandemic.

Further, the study examined the use of ICTs among intermediaries for professional activities, impact of ICT use on the reach, quality and profitability of service provision. Survey data of 303 respondents (82 agricultural extension agents, 139 agro-output dealers and 82 agro-input dealers) were collected by using multi-stage sampling procedure. The data was analysed using SPSS. Cross tabulations were done to analyse the data. The results were presented in statistical tables and charts and analysis was made accordingly. Analysis was done for three main intermediaries: agricultural extension agents (AEAs), agro-output and agro-input dealers separately; comparative analysis was done among the intermediaries. The findings suggested that the main type of ICT devices used for professional activities was mobile phone, even though they owned other ICT devices like radio, TV, computer and tablet. These devices, mobile phone, in particular were used on daily basis and mainly used to communicate business-related information with actors in the value chain. High cost and poor network connectivity were observed to be the main hindrances to the use of these tools. The level of digital skills or knowledge was considerably high (given that most of the communities were rural) among the three intermediaries, but this was more prominent among AEAs ($\geq 92\%$) than agro-output ($\geq 29.1\%$) and agro-input ($\geq 30.5\%$) dealers. The mode of business transactions had also transformed through reduction in regular face-to-face interaction, thereby reducing time and cost of business transaction particularly among agro-input dealers. Important benefits (speed of interaction and profitability) of ICTs use in businesses were observed for all three intermediaries. ICT use was more profitable to agro-input (87.1%) and agro-output (87.8%) dealers than AEAs (75.9%), although AEAs possessed most of the ICT tools and used them more frequently than agro-output and agro-input dealers. The period of Covid-19 pandemic witnessed an increase in the use of ICTs among the intermediaries, AEAs (77%), agro-output dealers (63%) and agro-input dealers (54%). Despite the important benefits associated with the use of ICTs in business or professional activities, their uses were hindered by certain factors. It is therefore crucial to initiate policies (e.g. tax incentives) that will promote lower cost of using ICTs in businesses, increase investment by telecommunication service providers to improve access and quality of services, and educate and develop the skills of intermediaries on the contemporary use of ICTs, such as internet business transactions.

Introduction

Information and Communication Technologies (ICTs) may be defined as “products that store, process, transmit, convert, duplicate, or receive electronic information” (Ayisi-Nyarko & Kozári, 2021). ICT tools include laptops, mobile phones, tablets, radio and television. Among these, mobile phones with internet connectivity, precisely smartphones, are the most widely used ICT device worldwide (Ayisi Nyarko & Kozári, 2021). These tools play key roles in every country's development. The application of ICTs in the agricultural sector is reported to be rising tremendously in the last few years (FAO, 2015; El Bilalia and Allahyari, 2018; Sennuga et al., 2020). The extensive and appropriate use of ICTs in the agricultural sector can result in the growth of a country's economy and consequently lead to poverty reduction; it can help identify and find solutions to some of the many problems in the agricultural sector.

In Ghana, both public and private institutions have supported initiatives aimed at developing, deploying and facilitating the adoption of ICTs to enhance agricultural productivity and a radical shift from the use of rudimentary technologies. A study conducted by Omari et al. (2020) showed that most ICT4Ag (information and communication technology for agriculture) services were established between 2000 and 2017 targeting farmers and other value chain actors. These ICT4Ag services provide digital solutions, including extension and market information, data capture, market linkage, financial and traceability services.

It is expected that AEAs, for example, will use ICT tools to collect field data from diverse farms and report any evolving challenge on farmers' fields for an immediate response (Ayisi Nyarko & Kozári, 2021). In pursuant of this requirement, some platforms have been designed and developed to facilitate the process. Ghana's Ministry of Food and Agriculture (MOFA) has implemented the e-Agriculture Programme (an ICT initiative through the West African Agriculture Productivity Programme-WAAPP), which has e-Farm Information, e-Field Extension and e-Learning and Resource Centre components.

The main objective of the e-Agriculture Programme is to provide affordable, prompt and efficient agricultural service delivery through the use of ICTs. Recently, the Council for Scientific and Industrial Research's Institute for Scientific and Technological Information (CSIR-INSTI) has designed four digital outputs to support and provide alternative methods of extension delivery, namely, CSIR technologies, CSIR space, Kuafo marketplace, and Agritech mobile advisor, designed to be hosted on the Digital Agriculture Innovation Hub (DAIH) of CSIR-INSTI.

The impacts of ICT4Ag services, from the perspectives of the service providers, include good database on farmers and increased access by farmers to information and markets. The major challenges faced by ICT4Ag service providers include low adoption of technologies by the targets, limited incentive system, which the companies can utilise to improve service delivery, limited resources to effectively scale-up, poor internet connectivity, and unwillingness of farmers and others to pay for the services. Omari et al. (2020) therefore recommended the need to introduce policies to support deployment, uptake and scaling up of ICT4Ag solutions, increase investment in advanced and emerging ICTs, such as sensors, drones, robotics; increase funding support for start-ups and promote informal ICT education for actors in the agricultural sector.

Despite increasing development of digital technologies and services in agriculture, the extent of adoption and impact on the sector have not been critically assessed in the country. It is important that research is conducted in this area to provide empirical evidence on Ghana's experience in the adoption of the digital technologies in agriculture. Such study would specifically examine ICTs' contribution to achieving economies of scale, boosting productivity, profitability and resilience to climate change, among others. Accordingly, this study was conducted to assess the use and impact of ICTs among agricultural intermediaries (AEAs, agro-output and agro-input dealers). The emergence of Covid-19 pandemic has generally increased the use of ICTs; hence, the study will assess the use and impacts of ICTs before and during the pandemic.

Role of Agricultural Intermediaries

Intermediaries play an important role in the African food and agriculture sector. Among the most prominent are the so-called 'middlemen', i.e. individuals, businesses or organisations that procure outputs from one actor in the chain to sell to another actor.



Other intermediaries, such as AEAs or researchers link value chain actors to information; while some others provide access to inputs, including agro-dealers or labour recruiters. Also, intermediaries can facilitate access to services, such as farm tools /equipment rentals, loans and insurance. In practice, intermediaries often have more than one function. This study, however, focused on three categories of intermediaries: agricultural extension agents, agro-output dealers and agro-input dealers. Agricultural extension agents (AEAs) play a key role in extension, which refers to 'systems that facilitate the access of farmers, their organizations and other market actors to knowledge, information and technologies. Extension also facilitates the interaction of these actors with partners in research, education, agribusiness, and other relevant institutions, and assist them to develop their own technical, organizational and management skills and practices' (FAO, 2010, cited in Danso-Abbeam et al., 2018:2). This facilitation is made possible through the work of AEAs. The role of AEAs goes beyond just the transfer of technology and improvement in productivity; it includes development in farmers' decision-making and technical skills through training, facilitation and education. They are also involved in professional activities such as providing technical support to farmers, connecting producers and agro-output /agro-input dealers, producers and government officials. In addition, they conduct group and individual on-farm training and assist producers to access farm credits from funding agencies. In Ghana, AEAs are either private or public. The private extension services are often supported by NGOs, development partners and community groups.

Agro-output dealers are those who deal with the final farm produce/output. They may be involved in activities such as buying outputs directly from producers (mostly at farm gates). Agro-output dealers are also involved in selling outputs to consumers and other agro-output dealers, transporting outputs from producers and other agro-output dealers, transporting outputs to consumers or agro-output dealers, packaging outputs, storing outputs, and processing outputs, among others. Agro-output dealers range from retailers, wholesalers, supermarkets, aggregators, selling agents, farmers organisations, including cooperatives, processors, exporters, institutions (e.g. NGOs, international organisations, faith-based organizations) and government-based organizations.

Agro-input dealers are those who sell, distribute or manufacture agro-inputs that farmers use in their operations, such as agrochemicals, fertilizers, animal feed, machinery, improved seeds, etc. Inputs are significant to agricultural innovation and productivity improvement. While 61% of agro-input dealers in Ghana sell improved seeds, only 3% sell animal feed. On the average, about 79% deal in fertilizers, while 91% are into chemicals (Krausova & Branoah Banful, 2009). The agro-input dealers range from market retailers/shops, market wholesalers, distributors, importers, agro-input companies (agrochemicals, seeds, etc), farmers' organisations (including cooperatives), institutions (e.g. NGOs, international organisations, faith-based organizations) and government-based organizations. Some agro-input dealers also provide agricultural extension and advisory services (EAS) to farmers (Alex, 2019). The density of agro-input dealers in a region or area may determine the farmer's access to agro-inputs. In the southern

part of Ghana, 84% of the agricultural input sellers are generally stockists, selling multiple types of agricultural inputs; the northern part of Ghana is equally divided among stockists, wholesalers and table-top dealers or retailers.

Research Questions

Much of the recent debates around digitalization in food and agriculture has focused on the adoption and use of dedicated ICT4Ag (information and communication technology for agriculture) services. Baumüller (2018), Malabo Montpellier Panel (2019) and Tsan et al. (2019) have shown that uptake of ICT4Ag services in African agriculture has to-date been limited and many of these initiatives remain small, disconnected and financially unsustainable. This research will contribute to the academic literature by taking a group of actors, the intermediaries, as a starting point, assessing their use of ICTs. It sought to address three overarching questions:

1. Does the literature on uptake of information and communication technology for agriculture (ICT4Ag) services underestimate the transformative impact of ICTs in the food and agriculture sector?
2. Are intermediaries the drivers of this transformation?
3. What are the enablers and constraints to the use and uptake of digital technologies by intermediaries?

Essentially, this research sought to answer the question: *How does the use of ICTs affect the ability of intermediaries in the agriculture sector to perform their professional activities?*

Methodology

Method of Data Collection Selection of Study sites

The study was conducted in three regions selected from the three agroecological zones of Ghana, namely, the southern, middle and northern belts, to give a wider coverage and fair representation of the population. In the southern belt, Greater Accra Region was selected; while Ashanti Region was selected for the middle belt, and Northern Region for the northern belt.

Greater Accra Region (GAR) has a total population of 5.4 million, representing 17.7% of Ghana's 30.8 million population. The region covers about 1.4% of Ghana's total land area of 238,533 km² (3,245 km²). GAR lies along the coastline of Ghana, about 200km; it makes fishing and tourism active economic activities in addition to crop production. GAR is the most densely populated region of

Ghana mainly because it has the nation's capital and therefore affected by rural-urban migration. The soils have low organic content, with shallow top soils, which limit the capacity for crop production; but it is one of the major centres of agro-inputs and agro-output trades. Within the Accra Metropolis, which houses the seat of government and central business centre, only 3.2% of the total households are involved in agricultural production, which is lower than the regional percentage of 5.4%. Of those engaged in agriculture, 77.7% are crop producers followed by livestock production (23.5%), tree planting (11.4%) and fish farming (0.7%). The main crops produced in the region are cassava, maize, tomato and watermelon, while the livestock are poultry, cattle, sheep, goats and pigs. Agricultural production in the region is less than what obtains in Ashanti and Northern regions.

Ashanti Region (AR) accounts for about 5,432,485 (17.6%) of Ghana's population. It covers an estimated 24,389km² of Ghana's landmass and possesses most of the country's agricultural and mineral resources, such as cocoa, timber and gold. The soils are rich in minerals and suitable for agricultural production, with two rainy seasons per year. Agricultural households account for about 30% of households in the Region. In the metropolitan areas of the region, for instance, Kumasi, agricultural households constitute not more than 16.4%, while in rural areas like Amansie Central, it constitutes about 85.3%. Averagely, in the rural areas, agricultural households constitute about 71.8%. Household farming activity revolved around cocoa production (22.1%) and food crops (53%), such as cassava, plantain and

maize. Other agricultural economic activities are livestock, fish and tree crop production.

Northern Region of Ghana has an estimated population of 2,310,943, accounting for 7.5% of the national population. Agricultural farm households constitute about 70.6% of total households. Proportionally, more households rely on agriculture for livelihood in Northern Region than in Greater Accra and Ashanti regions. The Northern Region, unlike GAR and AR, has a unimodal rainfall season per year. The climatic and geographical factors lie between the Sahel and the middle belt, with low annual rainfall and high temperature, compared to GA and Ashanti regions. Due to the vast arid land availability, animal production is more prevalent in Northern Region than in Greater Accra and Ashanti regions. The region is a major production centre for grains and legumes like maize, rice, groundnut and cowpea. Due to poor rainfall patterns, tree crops such as cocoa and rubber are uncultivated in exception shear tree (grown normally in the wild). The use of agro-input, particularly, chemical fertilizer, is common among crop farmers because of poor soil fertility. Like southern Ghana, the main livestock produced are poultry, cattle, sheep and goat. However, the intensity of animal production in Northern Region is higher than in GA and Ashanti regions.

Two districts each were purposively selected in each region based on availability of mobile phone and internet services, as well as the three target intermediaries; hence, in total, six (6) districts were selected (Table 1). From each district, two (2) communities were selected (one being the district capital and the other a nearby community), making a total of twelve (12) communities.

Sample Size and Sampling

The study population comprised intermediaries, namely, AEs, agro-output and agro-input dealers. Depending on the population of each category of respondents in each community, a proportion of the respondents was selected. However, some intermediaries, such as agro-input dealers, were so few in some communities that all of them were interviewed. In communities where there were adequate respondents, the study applied Yamane (1967) formula to determine the sample size, given below as:

$$n = N / 1 + N(e^2) \tag{1}$$

n= sample size
N=population
e= degree of precision (95%).

After the sample size was determined, agro-output and agro-input dealers were mostly randomly selected from market centres and shops, with a few contacted through snowball technique. The selection was based on the respondents that were willing to participate in the study. At Akomadan, in the Offinso Municipality, willing agro-output dealers were assembled at designated locations and interviewed with the help of the Association leader and AEs. The list of AEs in all the selected districts were obtained from the district agricultural offices; each was contacted by phone prior to the arrival of the research team at their office. Due to the low number of agro-output, all those who met the research team were interviewed. For instance, in the Mampong Municipal of Ashanti Region, there were seventeen (17) AEs, so applying equation 1, sixteen (16) of them should be randomly selected for the interview; but for various official reasons, only 15 of them were readily available at the time of the survey; hence, all the fifteen AEs available were interviewed. In total, 303 respondents were interviewed (Table 1).

Table 1: Number of respondents per intermediaries in each district and region

Regions	Districts	Agro-Input-Dealers	Agro-Output-Dealers	AEs
Northern Region	Savlugu	16	22	16
	Tamale	16	22	16
Ashanti Region	Offinso	15	20	15
	Asante Mampong	15	20	15
Greater Accra	Ablekuma	10	30	10
	Ga West	10	25	10
Total	6	82	139	82

Source: Field survey, 2021

Survey instrument

A structured questionnaire, prepared and formatted with the Survey CTO App installed on mobile phones and tablets, was used to collect data. The data covered demographics and socioeconomic characteristics, ICT tools used by the intermediaries, level of digital skills of intermediaries, limitations on the use of ICTs and impact of the Covid-19 pandemic on the use of ICT among intermediaries.



Method of data analysis

The data were cleaned and reviewed after collection to ensure that questions were satisfactorily answered. The data were analysed using SPSS version 22.0 and the results presented in the form of graphs, means, and pie charts.

Results and Discussion

Analyses in this section were done separately for the three (3) intermediaries: agricultural extension agents (AEAs), agro-output dealers and agro-input dealers.

Agricultural Extension Agents

Use of ICTs by AEA intermediary

Demographic and socioeconomic background of the agricultural extension agents (AEAs)

As outlined in Table 1, the survey questionnaire was administered to 82 AEAs, of which 59 (72%) were male. Reported in Table 2 are the districts from which data were collected and the number of respondents by gender.

Table 1: Number of respondents per intermediaries in each district and region

District	Gender of the respondent		
	Male	Female	Total
Asante Mampong Municipal	17	1	18
Offinso North District	10	4	14
Ga West Municipal	6	5	11
Ablekuma Central Municipal	5	3	8
Savelugu Municipal	12	4	16
Tamale Metropolitan	9	6	15
Total	59	23	82

Source: Field survey, 2021

The average age of the AEAs was 35 years for male and 34 years for female; the maximum age of both male and female respondents in the survey was 59 years. The minimum age of the male AEAs was 21 years and that of the female was 25 years. Similarly, average years of work experience, as observed for male AEAs was 6.6 and that of the female AEAs was 6.4. The maximum years of work experience for the male AEAs was 9 years more than that of the female (see Table 3).

Table 3: Age and working experience of respondents

	Gender	N	Mean	Standard deviation	Min	Max
Age	Female	23	33.9	8.6	25	59
	Male	59	35.0	7.8	21	59
Experience	Female	23	6.3	5.9	1	23
	Male	59	6.6	7.1	1	32

Source: Field survey, 2021;

N = Number of respondents

On the educational status of the AEAs and as mandated by employment requirements, all the AEAs were formally educated, with the majority having attained tertiary education (university and college education). Secondary and vocational levels of education recorded three (3) and two (2) respectively (Table 4a). Also, the data in Table 4a show that as the level of education increases, more male (42) than female (12) were in the agricultural extension work, proportionally.

This may be as a result of female of higher education not being interested in extension service profession or having to leave the service for other opportunities. However, this may also reflect the situation in public service, where more male than female personnel are witnessed. This needs to be remedied, especially as female population is more than that of the male in Ghana (<https://www.bbc.com/pidgin/58658816>).

Table 4a: Educational level of respondents

Level of education	Gender of the respondent		Mean
	Male	Female	
Secondary school	2	1	3
Vocational training	1	1	2
College	14	4	18
University	42	17	59
Total	59	23	82

Source: Field survey, 2021

Use of ICTs by agricultural extension agents

With regard to their roles and responsibilities, while the AEAs specified that they perform a wide range of services, the results showed that across all the districts, the AEAs generally provide information to producers (24%) and conduct group trainings (21%) and individual on-farm trainings (21%). The other services include performing intermediary roles, such as connecting producers to agro-input dealers (4%) and agro-output dealers (9%), such as bulk purchasing agents; connecting producers to government officials (5%) and sources of finance (5%), as well as other specified roles, such as animal disease surveillance and treatment (Figure 1).

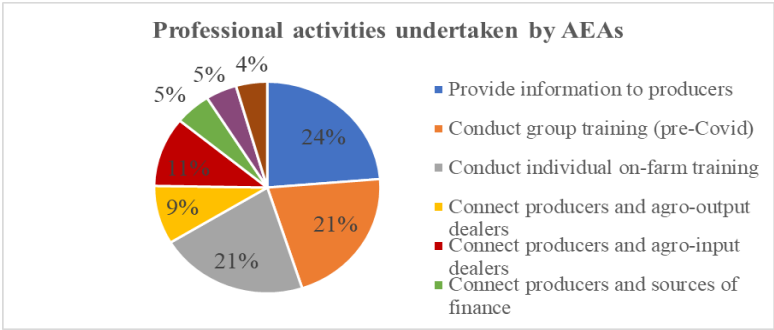


Figure 1: Professional role of AEAs
Source: Field survey, 2021

In the past one year, 73% of AEAs owned radio, 71% owned television and 68% had computer. Further, 28% had tablet, 28% had basic phone, 21% had feature phone, while 98% had smartphone. However, on the types of mobile phones, 99% of the AEAs interviewed used smart phone, either alone or in combination with basic or feature phone. For example, 8 AEAs used basic phones, of which 7 used the basic phone as complement to smart phone. Similarly, all the 4 AEAs who used feature phone explained that they used them as

complement to smart phone.

On the use of ICTs for professional activities, it was observed that 98% used smart phone, 49% used computer, 22% used radio, 12% used tablet, 11% used basic phone, 10% used television, and 4% used feature phone. The data also show that some AEAs used more than one ICT device for their professional activities; however, smartphone was most frequently used by 93.9%, followed by computer (2.4%) and basic phone, television and tablet, each with 1.2%.

The specific professional activities conducted by AEAs with ICT devices are shown in Table 4b. The data show that 76% used smartphone to provide information to producers, while only 1.2% used basic phone and tablet for the same activity.



Table 4b Professional activities undertaken by AEAs with the most frequently used ICT devices

Professional activity	Basic phone	Computer	Smartphone	Tablet	Television
Providing information to producers	1.2%	0.0%	75.6%	1.2%	0.0%
Conduct group training (pre-Covid)	1.2%	1.2%	50.0%	1.2%	1.2%
Conduct individual on-farm training	1.2%	0.0%	52.4%	1.2%	0.0%
Connect producers and agro-output dealers	0.0%	1.2%	20.7%	0.0%	0.0%
Connect producers and agro-input dealers	0.0%	0.0%	29.3%	0.0%	0.0%
Connect producers and sources of finance	0.0%	0.0%	7.3%	0.0%	0.0%
Connect producers and government officials	0.0%	0.0%	9.8%	0.0%	0.0%
Others (please specify)?	0.0%	0.0%	9.8%	0.0%	0.0%

Source: Field survey, 2021

Generally, mobile phone was used for voice call (98.7%), SMS (77.5%), mobile money (61.5%), internet service (94.7%), email (83.1%), GPS (72.7%), photo camera (92.4%), video camera (93.4%) and video call (55.0%). The mobile phone functions used for professional activities are shown in Table 4c, where 91.5% used the phone for voice calls and only 2.4% used it for digital agriculture services.

Table 4c: Phone functions used for professional activities

Phone function used for professional activities	% Respondents
Voice call	91.5
Photo camera	19.5
SMS	18.3
Internet	17.1
Social network platform	13.4
Text messaging App	8.5
Mobile payment	3.7
Video camera	2.4
GPS	2.4
Digital agriculture service	2.4
Video calls	1.2
Another App	1.2

Source: Field survey, 2021

On the activities that AEAs used their main ICTs tools for, about 78% used them to provide information to farmers; about 55% used them to provide group training (pre-Covid-19) and individual on-farm trainings. In serving as a link between other intermediaries, less than a quarter of the AEAs (22%) used ICTs to connect producers to agro-output dealers, 29% used them to help connect producers and agro-input dealers, while only 7% used ICT tools to connect producers and sources of finance. Moreover, about 10% used ICT tools to connect producers to government officials and other activities, such as conducting research.

The study further enquired about the type of information they used the ICT tools to receive or provide to the different value chain actors as part of their professional activities. Almost all (99%) answered that they used the tools to receive or provide information. About 83% used ICTs to contact value chain actors, 35% used ICTs to receive/make payments and 37% used ICTs to conduct/organise group activities to the different value chain actors. Only 4% used ICTs to obtain and disperse credit to the different value chain actors as part of their professional activities. In comparing the use of ICTs in the period before and after Covid-19, the AEAs answered that

the frequency of usage of ICTs for their professional activities increased during the Covid-19 pandemic. Almost a quarter (23%) affirmed that there had been no change. About 4.9% indicated that ICT usage had decreased a little, 1% noted that the frequency of use of ICTs for professional activities had decreased a lot, while 4% stated that they had not been conscious of change in the pattern of usage.

Also, 44% of AEs observed that the Covid-19 pandemic had substantially increased their use of ICTs for professional operations; 33% of the AEs observed that their use of ICTs increased a little because of the pandemic. About 15% observed no effect, while 5% and 2% observed that the pandemic had decreased a little, and significantly, respectively, their use of ICTs for professional activities. Only 1% of the respondents could not tell the effects of Covid-19 on their use of ICTs for professional activities (Table 5).

Table 5: How Covid-19 has affected the use of ICTs for professional activities

Level	N	%
Decreased a lot	2	2.4
Decreased a little	4	4.9
No effect	12	14.6
Increased a little	27	32.9
Increased a lot	36	43.9
Don't know	1	1.2
Total	82	100

Source: Field survey, 2021

AEs were asked to indicate the most important reasons for the increase in the frequency of use of ICTs for professional activities. Increased awareness of ICTs used for professional activities (41.8%), improvement of network connectivity (36.4%), and change in nature of professional activities (34.5%) and better access to ICTs by clients/customers (34.5%) were observed to be the main factors which led to the increased use of ICTs for professional activities (Table 6).

Table 6: Factors which promote use of main ICTs for professional activities

Factors promoting ICTs use	Yes	
	N	%
Improved network connectivity	20	36.4
Improve access to electricity	1	1.8
Cheaper devices	9	16.4

Factors promoting ICTs use	Yes	
	N	%
Cheaper variable cost (e.g. cost of SMS, data)	5	9.1
More functions for devices	4	7.3
Availability of useful apps/digital services	10	18.2
Increased awareness of ICTs uses for professional activities	23	41.8
Improved skills to use ICTs	12	21.8
Increased trust in ICTs use	3	5.5
Better access to CTs by clients/ customers	19	34.5
Change in nature of professional activities has which made use of ICTs necessary/useful	19	34.5
Others	4	7.3

Source: Field survey, 2021

Note: Tables constructed on multiple responses

Also, some AEAs indicated that they do not use some ICT tools for their professional activities due to various reasons as shown in Table 6. Out of the 82 AEAs interviewed, those who did not use ICT tools for their professional activities were 64 for radio, television (74), computer (42), tablet (72), basic phone (2), feature phone (2), Smartphone (2). Of the 64 AEAs who did not use radio, about 72% felt it was not necessary for their professional activities while 75% of non-TV users also gave the same reason. About 36% and 33% of non-computer and non-tablet users, respectively gave their reasons as high cost of device.

Table 7: Proportion of AEAs who did not use ICTs for their professional activities for various reasons

Reasons	Radio	Television	Computer	Tablet	Basic phone	Feature phone	Smart-phone
Too expensive to purchase	10.9	12.2	35.7	33.3			50.0
Too expensive to use			14.3	6.9			
Not necessary for professional activities	71.9	71.6	35.7	40.3	50.0	50.0	50.0

Reasons	Radio	Television	Computer	Tablet	Basic phone	Feature phone	Smart-phone
My clients/business partners don't have access				4.2			
Poor network connectivity	3.1	6.8		1.4			
Lack of electricity		1.4					
Don't know how to use			2.3				
Clients/business partners don't have access			4.7				
I don't trust it	6.3			1.4	50.0	50.0	
Other (please specify)	7.8	8.1	7.1	12.5			
Total %	100	100	100	100	100	100	100
Non-Users as % of total sample	78	90.2	51.2	87.5	2.4	2.4	2.4

Source: Field Survey, 2021

| Digital skills/ knowledge of the AEs

While 13% of AEs did not provide any response on this questionnaire item, all the 87% of AEs who responded indicated that they had skills in performing digital functions with their ICT tools.

In details, all the AEs answered that they were able to check the amount of credit left on their phones (100%), top-up credit on their phones (99%), make/receive phone call (99%), send/receive SMS (100%), access voice mail (90%) and send/receive money (98%). In addition, they were able to find GPS coordinates on their phones (83%), take a photo (98%), record a video (93%), connect to Wi-Fi (93%), open an app (95%), install an app (98%), access an email (95%), and open a file on the phone (96%). Further, they were able to search for information on the Internet (93%), fill an online form (93%), use a text messaging app (e.g. WhatsApp) (98%), participate in video call (99%), use social media networking platform (98%), use a digital agricultural service (40%) and use other specified apps (55%).

Impact of ICT Use among AEs

On the impact of ICT use among AEs, about two-thirds (67%) of the respondents confirmed that ICT changed the way they interacted with producers. Majority of the respondents confirmed that mobile phone use decreased the frequency of face-to-face interaction with producers and other intermediaries. About 65% agreed that mobile phone use decreased slightly the frequency of face-to-face communication, while 22% noted that the frequency of face-to-face communication decreased a lot. On the other hand, 9% and 3% of the AEs reported that face-to-face interactions 'increased a little' and 'increased a lot,' respectively, with other intermediaries despite the use of ICTs. The information that AEs preferred to exchange face-to-face, in order of preference, was on production methods/ technologies/ inputs (78.0%), on government programmes (33.3%), input prices (16.0%), output prices (9.8%), buyers (9.8%), sources of finance (6.2%), and weather (6.1%).

Also, about 62% and 66% of the AEs, respectively, agreed that the number of producers and frequencies of monthly interactions with producers changed as a result of increased use of mobile phone. On both frequency changes (Table 8), more than half of the AEs stated that the number of interactions and frequency of monthly interactions with producers increased a little. The results show that the interactives relatively increased than decreased (Table 8).

Table 8: Monthly interactions between AEs and intermediaries

Number of interactions			Frequency of interaction		
	N	%		N	%
Decreased a lot	3	5.9	Decreased a lot	3	5.6
Decreased a little	6	11.8	Decreased a little	10	18.5
Increased a little	28	54.9	Increased a little	29	53.7
Increased a lot	14	27.5	Increased a lot	12	22.2
Total	51	100	Total	54	100

Source: Field Survey, 2021

All the AEs indicated that ICTs improved their ability to assist crop and livestock producers at the production stage, while 77% answered that ICTs improved their ability to assist crop and livestock producers at the marketing stage. Moreover, about 31%, representing the largest proportion of the AEA respondents, noted that better access to information on crop/livestock production methods was the most important benefit of their services provided to farmers at the production stage through ICTs. About 12% of the respondents also noted that better access to timely information about on-farm operations (from producers) enabled them to give timely feedback; 10% others

said that it is easier to help farmers adopt new technologies/practices and help farmers to better understand field challenges through the use of ICTs. In addition, 9% indicated that ICT provided better access to weather update and less traveling time to farmers. Other benefits included providing more regular information to farmers (6%), easier demonstrations and training exercises (6%), better access to timely postharvest information (from producers) (4%) and faster assistance to producers (3%).

More so, the study explored the impacts of ICT at the marketing stage—which included better access to information on commodity prices (31%), reduced travel time (16%), better access to information on buyers (13%), higher linkages to buyers (13%), reduction of perishable crop/product losses (6%), and better market participation for remote farmers (4%), among others (Table 9).

Table 9: Impacts of ICT of extension services on producers (production and marketing)

	N	%
Benefits of ICT at the Production stage		
Better access to information about crop/livestock production methods	69	31.1
Better access to weather updates	20	9.0
Better access to timely information about on farm operations (from producers)	26	11.7
Better access to timely post-harvest information (from producers)	9	4.1
Better understanding of producers' problems	22	9.9
Easier demos and trainings to producers	13	5.9
More regular information provision to producers	14	6.0
Easier to help producers adopt new technologies/practices	22	9.9
Less travelling to assist producers	20	9.0
Faster speed of assisting producers	7	3.2
Total	222	100.
Benefits of ICT at the Marketing stage		
Better access to information about commodity prices	49	31.0

	N	%
Better access to information about buyers	21	13.3
Reduced travel time	25	15.8
Better access to more transportation options	4	2.5
Better linkages to more buyers	21	13.3
Enabling of collective negotiations between farmers and intermediaries	2	1.3
Better timing of output sale	6	3.8
Better market participation for remote farmers	7	4.4
Reduced perishable crop/product losses	10	6.3
Reduction in inter-market price dispersion/differences	3	1.9
Reduced information asymmetry between buyers and sellers	4	2.5
Improved diversification into high value crops	5	3.2
Other benefits	1	0.6
Total	158	100

Source: Field survey, 2021

The study analysed how ICTs facilitate collective action among value chain actors. On how ICTs benefit value chain group activities, about 35% noted that ICTs speed up group communication, while 16% stated that they reduce the cost of group communication. Further, 12% and 5% cited that value chain group interactions through ICT empower women and youth, respectively. Other benefits stated include facilitating payments to agro-input dealers (4%), increased networking between producers and agro-output dealers (2%), improved access to information for group members (2%), and improved exchange of information within the group (2%), among others (Table 10).

Table 10: Impacts of ICTs on value chain actors' activities

	N	%
How ICT benefit the activities of the group		
Speed up communication	20	35.1
Reduce the cost of communication	7	15.8
Increase incomes of producers	2	14.0
Empower women	1	12.3
Empower youth	1	5.3
Facilitate payments to agro-input dealers	1	3.5
Increase the network of producers and agro-output dealers	1	1.8
Improve access to information for group members	8	1.8
Improve exchange of information within the group	9	1.8
Improve dissemination of information outside of the group	3	1.8
Improve access to machinery	1	1.8
Reduce cost of using machinery	1	1.8
Improve quality of training	1	1.8
Improve frequency of training	1	1.8
Total	57	100

Source: Field survey, 2021

On the challenges encountered in implementing group activities using ICTs, only 13% answered that they faced difficulties. Of those who responded positively to this question, 33% each explained that ICTs limited participation of some group members and that it led to differential access to information. Also, the use of ICTs for group activities slow decision-making (17%) and reduced interest in group activities (17%). Nearly two-thirds (63%) of AEAs answered that the main channels of communication to implement the group's activities changed as a result of Covid-19.

Agro-Output Dealers

| Use of ICTs by Agro-Output Dealers

Demographic and socioeconomic characteristics of agro-output dealers:

This section focused mainly on key demographic characteristics in terms of gender composition, age, educational levels and years of experiences of respondents on their current professional activities. The respondents under this section are agro-output dealers.

Gender distribution of respondents: A total of 139 agro-output dealers were interviewed, 60% of whom were female and 40% male. This clearly shows the important role women play

in the production, marketing and processing of agriculture products in the country.

Level of education: With regard to the educational levels of the respondents, a considerable proportion (60%) of them had primary up to secondary school education. The result also indicates that a total 35% of them had no education at all and a few with basic Arabic education. University and college education constituted 2% each of the respondents respectively. The remaining 1% of the respondents had vocational training (Figure 2).

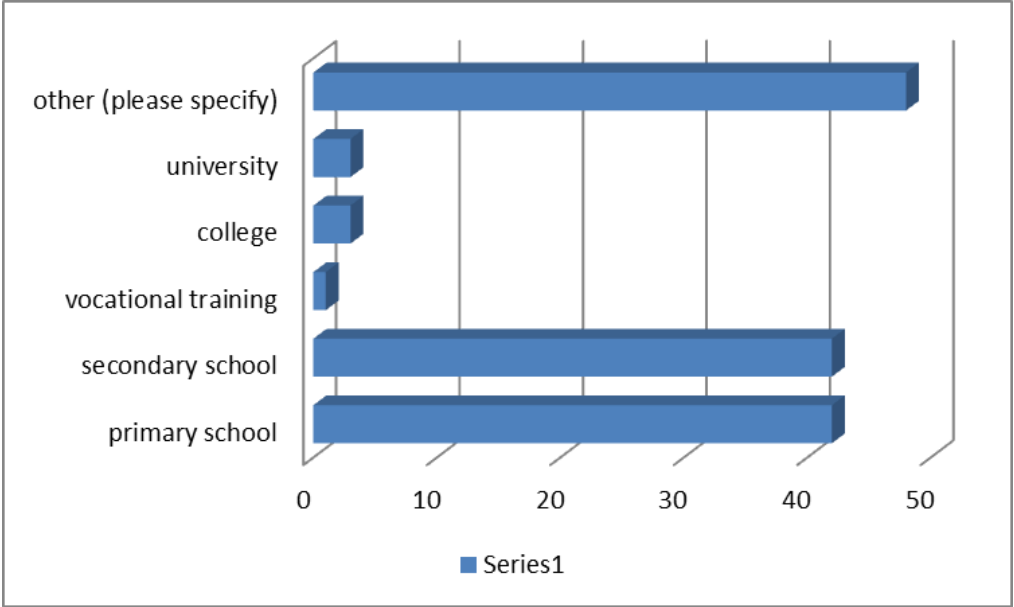


Figure 2: Level of education
Source: Field survey, 2021

Age distribution of respondents: Out of the 139 interviewed, majority of the agro-output dealers (46%) were within 18 to 39-year range. This was followed by those in the 40 – 49-year group (23%) and 50– 59 -year group (21%). The least age group (60 and above) constituted 10% of the respondents. Thus, the respondents within the ages of 40 years and above were about 54%. This implies that more than half of the respondents were outside the youth bracket, but were still active in their various economic activities

Table 11: Age and years of business years’ experience

	F	Min	Max	Mean	Standard Diviation
Age	139	18	65	40.87	11.780
Experience	139	1	53	14.22	11.047

Source: Field survey, 2021

Location, occupational experience of respondents: With regard to location of business, years of experience in business and categories of agro-output dealers in the survey, the results revealed that market retailers/shops constituted almost half of the respondents (49%), while market wholesalers accounted for 33%. Respondents within the aggregator/collector group accounted for 14%, compared to the 2% who were into processing of agricultural products. Respondents engaged in supermarket business and as producers’ selling agents accounted for 1% each (Figure 3). Data on the occupational experience of respondents indicate that most of the agro-output dealers were well experienced, with the mean year of experience being 14, and the maximum being 53 (Table 11)

The data further reveal that a majority of the agro-output dealers (87%) ran their businesses in small towns with less than 50,000 inhabitants, as against 7% in cities and 6% in villages. The data also indicate that a considerable number (79%) of the respondents have their businesses not registered, compared to 21% of those who registered their businesses with the local authorities

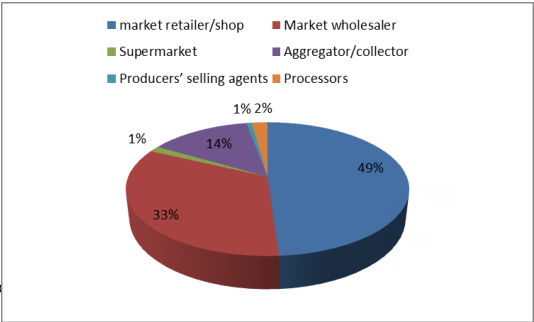


Figure 3: Categories of agro-output dealers
Source: Field survey, 2021

Type, frequency and operation-related use of ICTs

The results of the survey reveal that almost 45% of agro-output dealers frequently used basic phone in their professional activities, followed by those with smartphone (39%) and feature phone (12%). Also, 5% of the respondents used radio and television in their activities. The data further show that most of the respondents had basic mobile phone, whose use was limited to voice and SMS communication. The data show that majority (95%) of the agro-output dealers used some ICT devices on a daily basis, while the remaining 5% used them weekly.

Level of digital skills among agro-output dealers: With the advancement of the Internet technologies and applications, some types of mobile phones are not only used for making voice calls but also for accessing the internet, such as sending and receiving emails, chatting, sharing photos and documents, learning, video calls, commerce, SMS, playing games, and installation of apps. The results in

Table 12 imply that the level of advanced digital skills among agro-output dealers is moderate. The data show that, aside from being able to make and receive voice calls with their phones, majority of the respondents could take photos (84.9%), open applications (70.9%) and open files (75.6%) on their phones. Also, nearly half of them were able to use the mobile phone to make WhatsApp calls/send videos (46.5%), install applications (46.5%), and search for information on the internet (48.8%). There was also high level of basic digital knowledge among the agro-output dealers; they could check credit on their phones (77%), and they knew how to check credit (66.9%), make and receive calls (97.1%), and send and receive mobile money (55.4%). However, less than half of them knew how to send and receive SMS (46.0%) and access voice message (25.9%); and none could use digital agricultural services, although they were able to use some other applications and mobile phone services.

Table 12: Level of digital skills of respondents

Knowledge of digital technologies	Yes	No	Total
	%	%	%
Benefits of ICT at the Production stage			
Finding out the GPS coordinates of your current location	12.9	87.1	100
Take a photo	84.9	15.1	100
Participating in video calls (e.g. WhatsApp, Telegram, Zoom, Skype)	46.5	53.5	100
Connecting to Wi-Fi	30.2	69.8	100
Opening an app on your mobile phone	70.9	29.1	100

Knowledge of digital technologies	Yes	No	Total
	%	%	%
Installing an app on your mobile phone	46.5	53.5	100
Sending/receiving an email	32.6	67.4	100
Opening a file on your phone (e.g. photo, video, document)	75.6	24.4	100
Searching for information on the Internet	48.8	51.2	100
Completing an online form	29.1	70.9	100

Source: Field survey, 2021

Factors hindering and promoting desired use of ICTs: On what hinders the desired use of some ICT devices, such as radio, television, computer and tablet, the survey data in Figure 4 indicate that majority (over 90%) of the respondents did not use some ICT devices mainly because they were too expensive to purchase or not useful/necessary for their professional activities. Some respondents cited other reasons, including limited knowledge on how to use some of these ICT devices.

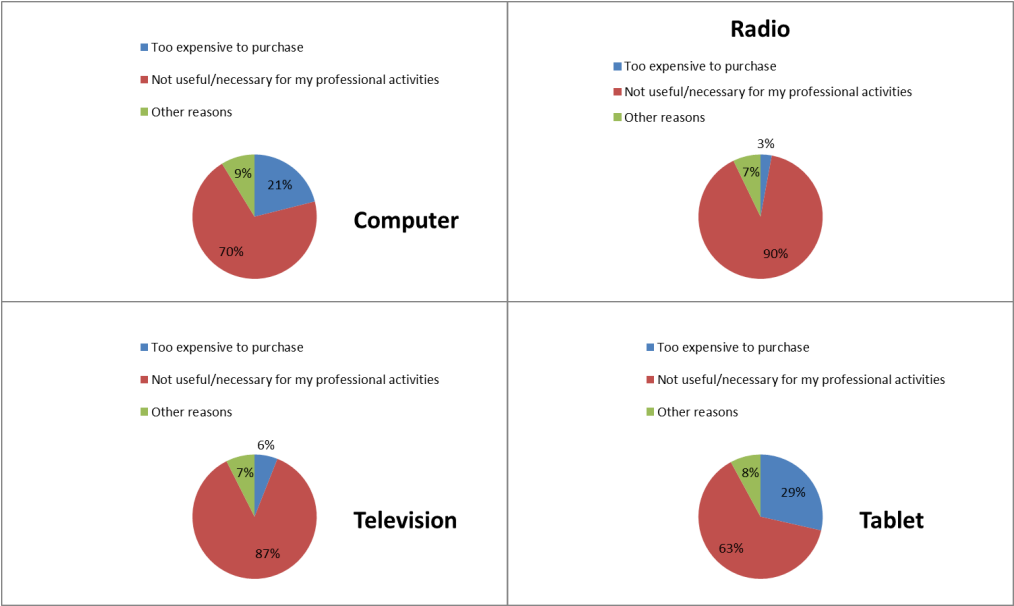


Figure 4: Hindrances to non-use of some ICT tools for business
Source: Field survey, 2021

The survey data also indicate that majority of the agro-output dealers did not use social network platforms (Facebook, Twitter and Instagram) in their activities. Only 10% of the respondents possessed some level of digital skills in these social media networks. Similarly, the data reveal that many of the respondents (57%) did not engage in mobile payment, as against 43% of those who used mobile payment facility (Figure 5).

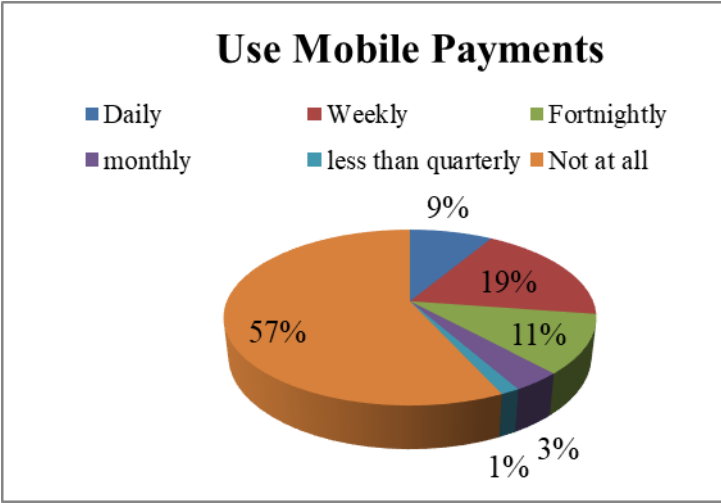


Figure 5: Frequency of use of mobile payment
Source: Field survey, 2021

Data in Figure 6 depict that 86% of agro-output dealers mainly used voice calls for operation-related purposes, such as buying outputs directly from producers (farm gate) and other intermediaries, selling outputs to consumers and to other agro-output dealers, and transporting outputs from producers and/or agro-output dealers. Although there were digital agriculture services (such as Esoko, Farmerline, MFarm, Qualitrace, and Farmforce) which provided agricultural marketing services in Ghana, a total of 97.7% of the agro-output dealers interviewed had no idea or knowledge of the existence of these services.

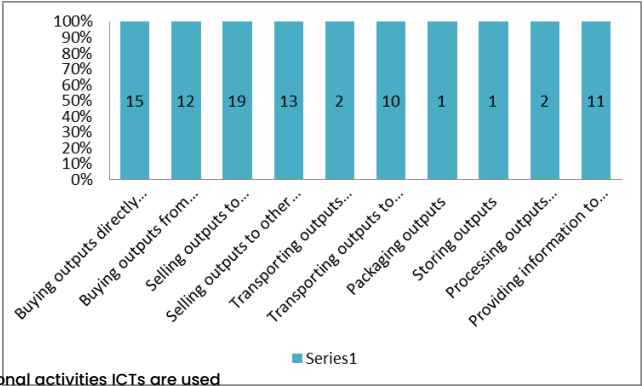


Figure 6: Main professional activities ICTs are used
Source: Field survey, 2021

Effect of Covid-19 pandemic on ICTs Use: Of the 139 agro-output dealers interviewed, only 25% had a change in their interaction with producers the five years prior to the Covid-19 pandemic (Figure 7). See Appendix for detailed information.

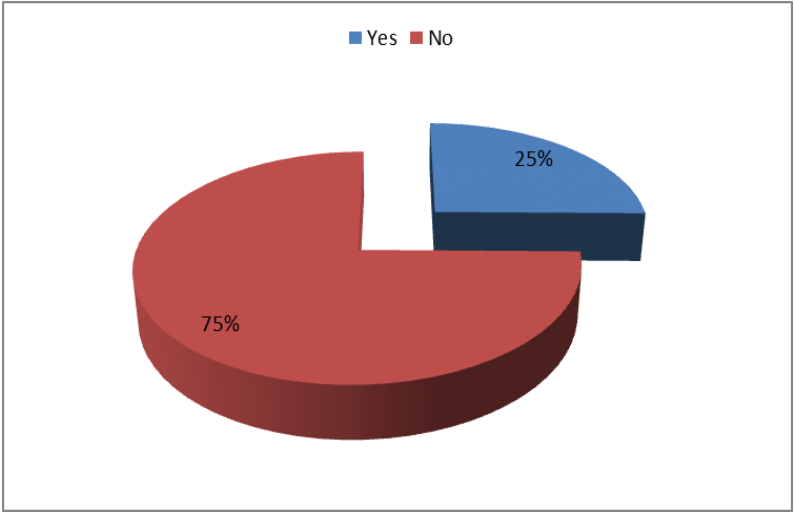


Figure 7: Level change in the use of ICTs pre Covid-19 pandemic
Source: Field survey, 2021

With regards to how the use of ICTs has changed in the presence of the pandemic, the data illustrate that about 49% of respondents had a little increase in the use of ICTs, as against 37% who observed great increase. About 11% of them experienced a little decrease, while 3% indicated great decrease. Most of the respondents (63%) experienced a change in their share of interaction with producers using mobile phone in a busy month during the pandemic, compared to 37% of those who experienced no change. It was also observed that most of the agro-output dealers interacted with producers weekly or monthly in a busy month during the Covid-19 pandemic. Before the Covid-19 pandemic, majority of the respondents (51%) frequently interacted with producers on a weekly basis; 20% interacted daily, while 14% interacted fortnightly with mobile phone.

Majority of the respondents (69.1%) noted that the frequency of face-to-face communication with producers did not change as a result of using mobile phone, as against 30.9% who stated that this has changed. About 56% of the respondents experienced little decrease in frequency change.

Impact of ICTs use among agro-output dealers

All the agro-output dealers possess in one form or the other an ICT device, particularly mobile phone to facilitate their business operations. However, the data indicate that, of the 139 respondents interviewed, 34% used ICTs to facilitate selling process between producers and agro-output dealers, while 25% used ICTs to help speed up communication (Figure 8). The remaining 41% of the respondents mentioned the following benefits of ICT use in their activities: Increase the network of producers and agro-output dealers; empower women, jointly develop innovations, and adapt innovations to the needs of group members.

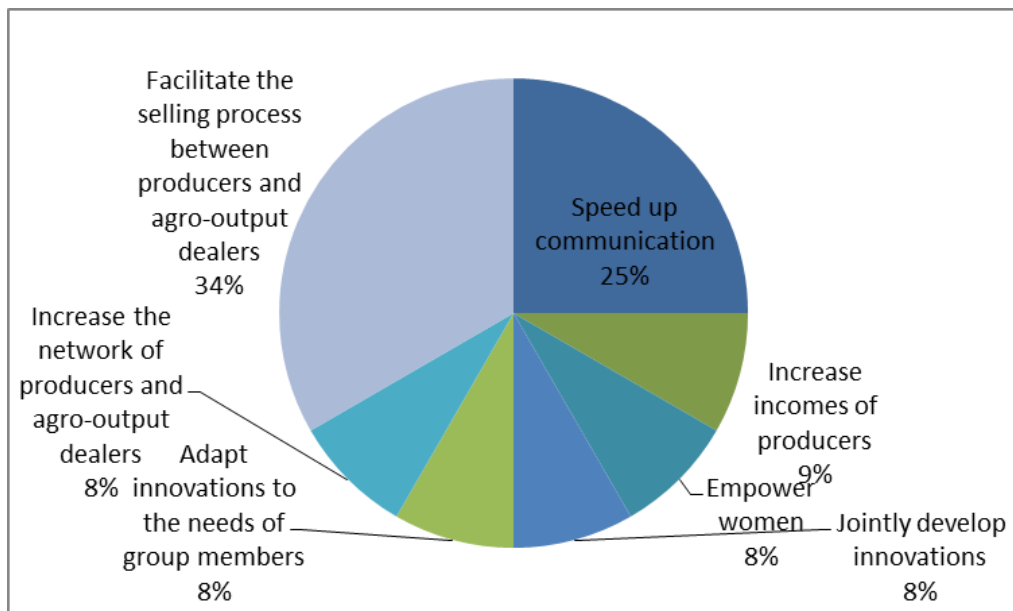


Figure 8: Change in use of ICTs with intermediary
Source: Field survey, 2021

With regard to how the use of ICTs improved the ability to interact with producers and buyers, majority of the respondents (88.49%) identified the following benefits of ICTs in their professional activities

- Better access to information about producers
- Better access to information about buyers
- Easier interactions with producers
- Easier interactions with buyers
- Linkages with more producers
- Linkages with more buyers
- Reduced travel time
- Better access to more transportation options

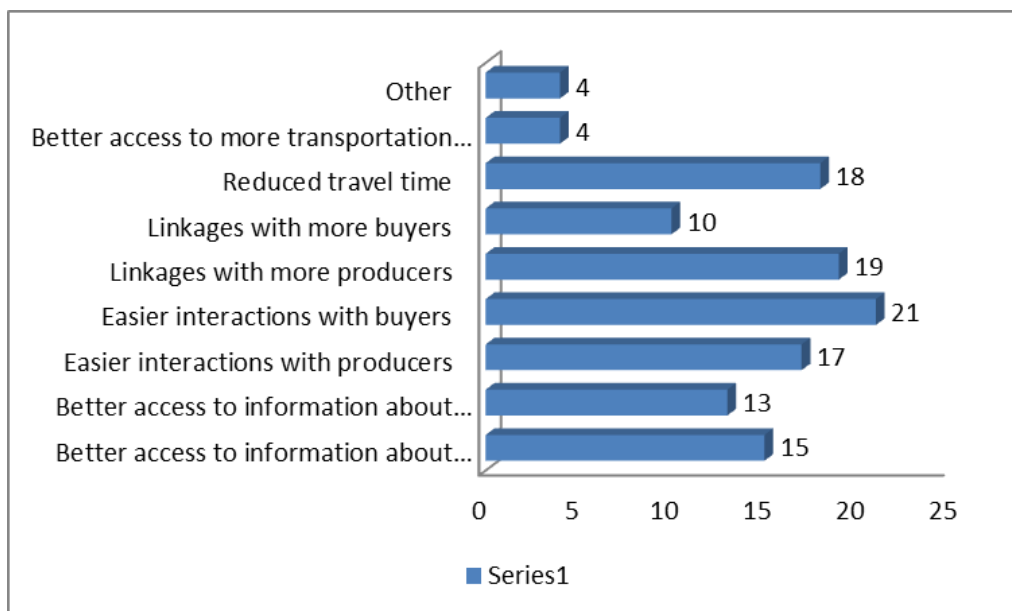


Figure 9: Advantages in using ICTs to run business

Source: Field survey, 2021

The data show that a considerable number of respondents (87.1%) acknowledged the importance of ICTs in making their businesses profitable. The main benefits identified were:

- Better access to information about commodity prices (55.4%)
- Better timing of output purchase and sale (24.0%)
- Reduced perishable crop/product losses (19.0%)
- Faster payments from customers (48.8%)
- Fewer non-payments from customers (5.0%)
- Better access to credit (0.0%)
- Better book-keeping about business activities (1.7%)
- Higher profits (11.6%)
- Better access to government programmes (0.0%)

Demographic and socioeconomic background: In this section, the analysis of data obtained from agro-input dealer respondents is presented. Agro-input dealers, however, is often used interchangeably with respondents, traders or dealers in the section.

Gender: The number of agro-input dealers involved in the study was 82. Almost all the dealers in the locations (see methodology) were involved in the study, particularly in the Ashanti and Northern regions. The respondents came from different demographic and socioeconomic backgrounds. The results show that more male (76%) than female (24%) were involved in the agro-input trade in the study area. The low number of female respondents in the trade could be as a result of the capital-intensive nature of the trade. In addition, in developing and patriarchal societies like Ghana, female are at a disadvantage, as the male have the upper hand in the possession of investment and production resources. The low level of female participation could also be due to the hazardous nature of the trade.

Educational level: The data on educational level of traders (Table 14) reveal that all the respondents had some level of education, the highest being secondary (34.1%) and university (28.0%), and the least being college (3.7%). On the other hand, it is important to note that college is a tertiary institution, just like university. The high number of literate people involved in the trade may be attributed to the skills and knowledge required to teach, educate, and guide farmers in the application of agro-inputs to achieve positive health outcomes.

Table 14: Educational level of respondents

Educational level	Frequency	Percent
Primary School	17	20.7
Secondary School	28	34.1
College	3	3.7
University	23	28.0
Other (...)	11	13.4
Total	82	100.0

Source: Field survey, 2021

Age: The data on ages of the respondents show that youth (24-35 years) were largely involved in the trade. The mean age of the respondents was less than 40 years (38.04), while 20 years and 66 years were the minimum and maximum ages, respectively (Table 15). The mean age of the respondents was encouraging, as compared to producers or farmers whose mean age was 55 years (MOFA, 2018). The youthful outlook of the respondents could also mean that the venture was profitable— high profit being a motivation for youth participation.

Table 15: Age, distance and experience of respondents

	Number of respondents	Minimum	Maximum	Mean	Standard. Deviation
Age	82	20	66	38.04	12.49
Experience	82	1	42	8.68	8.20
Distance	82	0	791	220.0	87.5

Source: Field survey, 2021

Location, occupation and experience of respondents: The businesses were located in the main communities that owners resided or adjoining communities that were relatively developed; this means there were relatively easy means of transport. However, it was observed in Akumadan that some of the business owners resided in Techiman and Kumasi but had shop managers at Akumadan. Intermittently, they checked on the businesses and supplied the agro-inputs from their bases in Techiman and Kumasi for sale. About 86% of the respondents classified trading in agro-input as the work on which they spent most of their daily work time. However, some respondents with bigger and several shops employed others to support the work. The data show that most of the agro-input dealers were well experienced, as the mean years of being in the trade was about 9 and the maximum was 42 (Table 15).

Years of experience have the potential to help the respondents navigate through challenges when they come. But it is observed that, while most of these agro-input dealers were in the rural and peri-urban areas, their suppliers were located in cosmopolitan areas, which are very far from their business locations. As can be observed in Table 15, the average distance from the suppliers to the dealers was 220km and the maximum was 791km. Although this study stopped short of establishing whether the agro-input dealers were the ones who bore the transport cost, (even if it were to be them) the high fare paid by dealers could lead to high prices for the farmers, since the fare burden would be transferred to the farmers. Should this be so, then it would be incumbent on the producers of agrochemicals to bring the production centres closer to areas where they are needed most (rural and peri-urban areas).

Type, frequency and operation-related use of ICTs: Varied ICT tools were used by the agro-input dealers in their professional activities. Table 16 presents data on the main ICT tools used by respondents for their work. The most widely used ICT tool was the feature phone (92.7%), followed

by basic phone (63.4%) and TV (63.4%); smartphone (30.5%) and tablet (13.4%) were the least used.

Table 16: Type of ICT agro-input dealers’ use

	Feature phone		Smart-phone		Basic phone		Tablet		TV		Radio		Computer	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%
Yes	76	92.7	25	30.5	52	63.4	11	13.4	52	63.4	51	62.2	21	25.6
No	6	7.3	57	69.5	30	36.6	71	86.6	30	36.6	31	37.8	61	74.4
Total	82	100	72	100	82	100	82	100	82	100	82	100	82	100

Source: Field survey, 2021

The low use of smartphone and tablet could be as a result of the high cost of these gadgets. In areas where energy challenge was prominent, the use of basic and feature phones became a necessity, because they have longer battery life than the smartphone. The tools were used almost on daily basis (96%) or weekly basis (4%). The need to frequently communicate with or receive information from customers and suppliers thus mad these tools critical to the growth and sustenance of the business. Despite the frequent use of ICT gadgets for professional works, no respondent borrowed an ICT gadget to enable them transact business.

Table 17: Use of ICT tools for business activities

	Importing inputs		Buying inputs from agro input suppliers		Selling inputs directly to customers		Selling inputs to other agro-input dealers		Transporting inputs from other agro-input dealers		Transporting inputs to customers and/ or other agro-input dealers	
	N	%	N	%	N	%	N	%	N	%	N	%
No	77	93.9	29	35.4	11	13.4	56	68.3	78	95.1	77	93.9
Yes	5	6.1	53	64.6	71	86.6	26	31.7	4	4.9	5	6.1
Total	82	100	82	100	82	100	82	100	82	100	82	100

Source: Field survey, 2021

The data in Tables 17 and 18 show the business-related purposes for which ICT tools were procured and used. From Table 17, it is observed that the main purpose of using mobile phone for business was to communicate with farmers and agro-input suppliers to sell inputs (86.6%) and to deliver inputs to shops (64.6%). This is because most of the farmers were located in communities that were a little distant from the sales outlets of the agro-input traders.

ICT tools were used for other purposes, such as importing agro-inputs (6.1%), selling agro-inputs to other agro-input dealers (31.7%), communicating to transport inputs from other agro-input dealers

(4.9%), communicating to transport inputs to customers and/or other agro-input dealers (6.1%), providing non-business-related information to producers (6.1%), and providing credit support information to producers (1.2%) (Tables 17 and 18); but these were not the major purposes for the purchase and use of ICT tools, as not more than 32% of respondents acknowledged each of these uses.

Table 18: Uses of ICT tools for business activities (cont. Table 17)

	Packaging inputs		Providing information to producers		Providing credit to producers		Producing Inputs	
	N	%	N	%	N	%	N	%
No	82	100	77	93.9	81	98.8	82	100
Yes	0	0	5	6.1	1	1.2	0	0
Total	82	100	82	100	82	100	82	100

Source: Field survey, 2021

Factors hindering and promoting desired use of ICTs

In the course of this study, it was observed that there were some challenges to accessibility and effective use of ICT gadgets, which, when resolved, can promote the use of ICT tools in the business. The data show that 6 (7.2%) respondents had challenges on accessibility and effective use of ICT tools. Of these 6 respondents, 4 (66.7%) reported poor network connectivity as the main hindrance. It was difficult to get mobile network connectivity in some of the communities visited, a situation that delayed information sharing for the respondents—which could have adversely affected input delivery and, therefore, the profitability of the enterprise. Other constraints to the effective use of ICTs were high-cost of tools (60.4%); although the smartphone made it possible to perform additional functions than basic phone, the price of a smartphone was considered exorbitant by the respondents. Thus, price became a disincentive for patronage despite the usefulness.

Respondents also reported high maintenance cost when ICT tools broke down and had to be repaired. In addition, the cost of maintaining some of these tools was a cause for concern and tended to negatively impacted on business profit margins. There were also reports on high cost of phone credit and data charges, sundry/ unexplained charges by telecommunication service providers, and unsolicited messages. Furthermore, while the importance of ICTs cannot be overemphasised, respondents reported that they sometimes could not use some of the features on ICT tools, especially mobile phone; hence, the need for skills building and sensitisation to improve user knowledge. One other important observation was the challenge related to lack of or unstable energy supply, as the tools are energy-dependent. The respondents believe that if these constraints are addressed, there will be increased use of ICT tools for business, both in the

cosmopolitan and rural areas.

Level of digital skills among agro-input dealers: All respondents who reported having basic phone (63.4%), feature phone (92.7%), smartphone (30.5%) and tablet (13.4%) were able to make and receive call. Also, 91% of them all were able to receive and send text message, while about 88% were able to send and receive mobile money by themselves. Those unable to send and receive text message and mobile money could be the few with low level of education, with limited ability to effectively read and write and, so, relied on others to use such facilities.

Further, about 32% reported to effectively use social media applications, such as WhatsApp, Facebook, YouTube, Twitter and Instagram. These respondents were able to send emails too. It is likely these were respondents with secondary and tertiary education and also had smartphone. Moreover, all respondents who reported to owning television (63.3%), radio (62.2%) and computer (25.6%) were able to effectively use them. The level of knowledge and skills in ICT tool usage among respondents appeared to be high, considering the fact that some of the communities were in the hinterland and confronted with energy and network connectivity challenges. But the scenario could be attributed to the high educational level reported among respondents. Indeed, as could be observed in Table 13, all the respondents had some level of education, with no less than 79.3% attaining at least secondary school education. Nonetheless, the data also show that only 4.9% of agro-input dealers knew how to use digital agricultural services, although they were able to use other applications and digital services.

Effect of Covid-19 pandemic on ICTs use: Figure 10 presents data on the frequency of use of ICT tools (mobile phone) before and after the pandemic. The comparison data in Figure 15 show that 50% and 3.7% respondents believed the use of mobile phone for business activities decreased a little and had no effect, respectively; also, 15.9%, 25.6% and 4.9% of respondents reported little increase, a lot increase and 'do not know,' respectively, with regard to mobile phone use before Covid-19 pandemic.

On the other hand, 2.4%, 4.9% and 37.8% reported that the use of ICT tools for professional activities decreased a lot, decreased a little and had no effect, respectively, while 34.1%, 19.5% and 1.2% reported 'increased a little', 'increased a lot', and 'do not know,' respectively, after Covid-19. It is interesting to note that more respondents (37.8%) reported 'no effect' for the use of ICT tools after the pandemic than before the pandemic (3.7%). Moreover, more (50%) respondents reported 'a little decrease' in the use of ICT tools pre-Covid-19 than post-Covid-19 (4.9%). Also, 34.1% reported 'a little increase' in the use of mobile phone for business activities after Covid-19, compared to 15.9% before Covid-19.

Frequency of Use of ICT (Mobile Phone) Before and After Covid-19 (%)

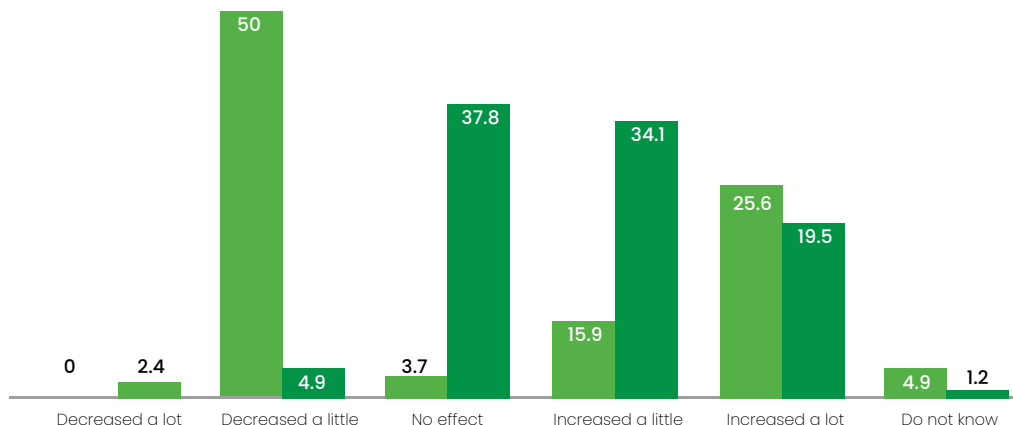


Figure 10: Frequency of ICT tools use pre and post Covid-19
Source: Field survey, 2021

It is also instructive to note that, cumulatively, 71.9% reported 'a little increase' after Covid-19, compared to 'a lot of increase' 41.5% before Covid-19. In general, the Covid-19 period witnessed an increase in the use of ICT tools, particularly mobile phone, among agro-input dealers. This may be because of the Covid-19 protocols, one of which restricted businesses operations and individuals from travelling or congregating. Moreover, suppliers might have discouraged dealers from going to their premises to purchase products; hence, the increased use ICTs in line Covid-19 protocols. In as much as the result suggested that Covid-19 period witnessed the increased use of ICT tools, particularly mobile phone by agro-input dealers, this increase can be attributed to the respondents' need for interaction with stakeholders in the agro-input value chain—whether this was with one or more actors within the value chain.

Changes in Provision of Intermediary Services: In this section we will look at how the use of ICTs has changed the way intermediary services are provided. Among the value chain actors within the agro-input trade, it was observed that prior to the introduction of ICT tools, for example mobile phones, business transactions were done mainly through physical contacts. Meaning if a customer wants to buy agro-input from an agro-input dealer, who may be some distance away from the customer/farmer (who is in some remote community), he or she will have to move from his or her community to the shopping outlet of the dealer. However, with the introduction and use of ICT tools coupled with innovation in the financial system, a customer can make a phone call to the agro-input dealer and place an order for products he or she needs. Later these agro-inputs are delivered through third party vehicle arrangement to the customer without his or her physical presence at the shop. This saves time, reduces stress and speeds up production. This may also reduce cost to the farmer since he or she is spared the human transportation cost. The study found that ICTs use for professional activities cumulatively increased a little and increased a lot

by 41.5%. The increased use of ICTs for professional activities do not necessarily mean decreased in face-to-face interaction because about 53.7% (before the Covid-19 pandemic) reported no effect on face-to-face interaction as a result of the ICTs evolution. It appears the ICT tools are used as complements with personal interaction rather substitute for professional activities by the agro-input dealers.

Dealers revealed that this arrangement is also made with the suppliers. As stated earlier, there is an average distance of about 220.0 km (Table 14) between suppliers and dealers, but dealers mostly do not go to the suppliers' outlets to take delivery of the products. Some dealers are able to take pictures of products they need with the mobile phones and later forward them in addition with the quantities of the products needed to the suppliers. This is exemplified by the statement by one of the dealers in Mampong-Ashanti:

With my smart phone or tablet [ICT tools] I can do all the business transactions from the comfort of my office. Even as you [interviewer] can see I am just sending a message to my business partners that is why you [interviewer] at some points have to hold on the interview. Even I have business partners outside Ghana, but I hardly travel there to transact business. The technologies [ICT tools] have really transform the concept of business practices.

Another respondent reported using ICT tools to check product prices being offered by competitors.

You [interviewer] know this business is very competitive, so we [dealers] have to always know what others [competitors] are doing so that one can compete. If not, you will be left out [get poor sales] in the business. You can also not be travelling and or moving from one shop to another to find out prices of competitors; that will be tiring and costly, especially as our profit margins are small. But with phones, computers and internet services you can easily find these information - Agro-input dealer at Okorase

The use of ICT tools in the agro-input business has increased thereby and this may be modifying the way actors in the industry conduct businesses.

Impact of ICTs among Agro-Input Dealers

This section discusses the impacts of the use ICTs on transaction costs, reach, quality, and profitability of services. The results as can be observed in Figure 11, shows there are significant benefits of ICT to agro-input dealers in business transaction, such as interaction between suppliers and customers. Seventy-six (76) of agro-input dealers (93%) believe it helps to improve business transactions or interactions. Also, seventy-two (72) agro-input dealers (almost 87%) agreed the use of ICT improves business profitability.

Benefits of ICTs

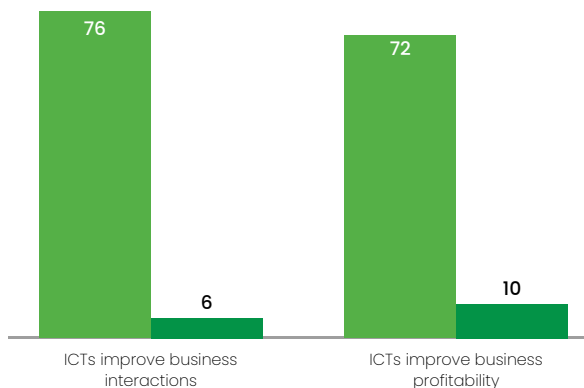


Figure 11: Main benefit of ICT
Source: Field survey, 2021

These are two broad benefits or impacts associated with the utilisation of ICTs. However, there are specific major impacts of ICT usage by agro-input dealers that culminated into improvement in interactions and profitability of their businesses (see Tables 19 and 20).

Table 19: Specific benefits of ICTs usage

	Interaction with customers		Better information about availability of different types of agro-inputs		Better access to information on how to apply agro-inputs		Better access to information on where to source agro-inputs		Better access to information about customers		Better timing of agro-input purchase and sales	
	N	%	N	%	N	%	N	%	N	%	N	%
Yes	76	92.7	42	55.3	25	32.9	13	17.1	7	9.2	11	14.5
No	8	7.3	34	44.7	51	67.3	63	82.9	69	90.8	65	85.5
Total	82	100	76	100	76	100	76	100	76	100	76	100
	Interaction with customers		Better information about availability of different types of agro-inputs		Better access to information on how to apply agro-inputs		Better access to information on where to source agro-inputs		Better access to information about customers		Better timing of agro-input purchase and sales	
	N	%	N	%	N	%	N	%	N	%	N	%
Yes	23	30.3	71	93.4	61	80.2	65	85.5	28	36.9	75	98.7
No	53	66.7	5	6.6	15	19.8	11	14.5	48	63.1	1	1.3
Total	76	100	76	100	76	100	76	100	76	100	76	100

While there are several benefits observed to be derived from the use of ICT tools by respondents, the two most important benefits agro-input dealers derive from the use of ICT tools are; easier interactions with customers, and better access to information about availability of different types of agro-inputs on the market and from agro-input suppliers.

Table 20: Specific benefits under ICT use that improve business profitability

	Higher profits		Better access to information about prices		Better timing of agro-input purchase and sales		Faster payment from customers	
	N	%	N	%	N	%	N	%
Yes	5	6.9	52	72.2	30	41.7	43	59.7
No	67	93.1	20	27.8	42	58.3	29	40.3
Total	72	100	72	100	72	100	72	100
	Fewer non-payment from costumers		Better access to credit		Better storage of business information		Better access to government programmes	
	N	%	N	%	N	%	N	%
Yes	2	2.7%	0	0	2	2.7	5	6.9
No	70	97.3	72	100	70	97.3	67	93.1
Total	72	100	72	100	72	100	72	100

Source: Field survey, 2021

In general, agro-input dealers reported significant and positive impact of the use of ICT to run their business (Figure 16). However, only 'better access to information about prices' (72.2%) and 'faster payment from customers' (59.7%) are observed to be specific major benefits in the use of ICT to run their businesses (Table 20). For instance, respondents do not believe that the use of ICT leads to higher profit margin (6.9%). This is likely so because although the use of ICT can speed interactions between suppliers and customers (Figure 16), it can also add significant cost to the business and hence the belief that it does not lead to improvement in profit, ceteris paribus (Table 20). Similar scenarios are observed for the remaining specific major benefits such as better timing of agro-input purchase and sales (41.7%), fewer default among costumers (2.7%), better access to credit (0.0%), better storage of business information (2.7%) and better access to government programmes (6.9%)

Use ICTs to Facilitate Collective Action among Value Chain Actors: The information relative to collaboration and sharing of information among value chain actors revealed that actors largely (84.1%) rely on ICT tools to receive product and market information from colleagues in the value chain. Importantly, it was also observed that about 67.1% of the agro-input dealers rely on ICT

tools to make and receive payment for services rendered within the value chain (Table 21). So, it is possible for members of the value chain to transfer cash to one another, using for instance, mobile money services for products and services rendered without the need to meet each other physically. This reduces time and stress associated with physical business transactions. Ironically, none of the value chain actors reported using ICT tools for organising or attending group meeting. This is because as was observed, none of the agro-input dealers reported to be a member of any group as they operate individually due to the competitive nature of their enterprises.

Table 21: Benefits of ICT use for the agro-input value chain

	Receive and provide market information		Make/receive pay-ments		Organize / conduct group activities?		Other (...)	
	N	%	N	%	N	%	N	%
No	13	15.9	27	32.9	82	100	82	100
Yes	69	84.1	55	67.1	0	0	0	0
Total	82	100.0	82	100	82	100	82	100

Source: Field survey, 2021

Only six (7.2%) of respondents reported challenges with the use of ICTs. These challenges are “Very poor or bad” network connection (66.7%) from service providers, and “High cost” of internet data and phone credit cards (33.3%). From respondents these tend to increase the cost of doing business since they have to frequently purchase data or credit to either do internet transactions or make phone calls to their clients and suppliers.

Effect Covid-19 Pandemic: The results, Figure 12 shows the level of use of ICT tools among agro-input dealers in the pre Covid-19 era. About half (50%) of the respondents reported no change in the level of use of ICT tools in their business operations.

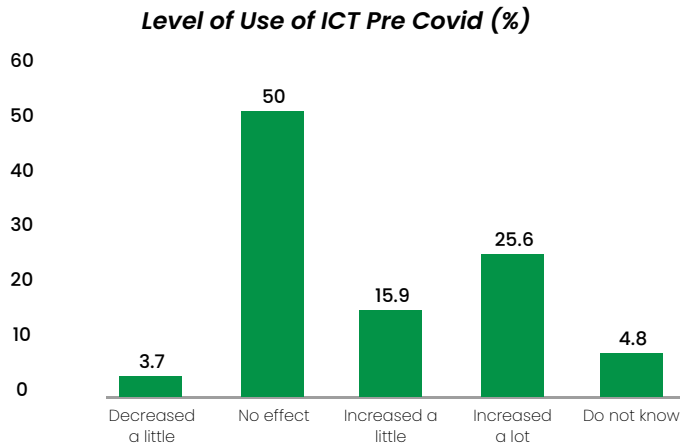


Figure 12: Level of use of ICT pre-Covid-19
Source: Field survey, 2021

A little over a quarter (25.6%) reported a lot of increase in the use of ICTs pre-Covid-19; only 3.7% reported a little decrease, while 15.9% reported a little increase and 4.8% respondents could not determine whether there was an increase or decrease in the use of ICT pre-Covid-19. Considering the fact that 50% reported no change in the level of use of ICT tools in the pre Covid-19 period, there might have been a lot of physical interactions or transactions among actors. However, as could be observed in Figure 13, more than half (54%) reported an increase in the use of ICTs to undertake business operations in the post-Covid-19 period.

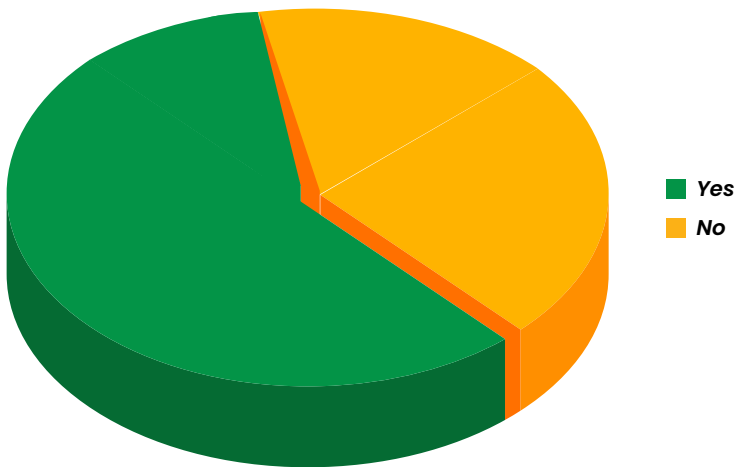


Figure 13: Respondents opinion on ICT use after Covid-19
Source: Field survey, 2021

Comparative Outcomes of All Three Intermediaries

Use of ICTs by AEA, Agro-Output and Agro-Input Intermediaries

Table 22 presents basic information about the intermediaries. The data show that, for AEAs and agro-input dealers, there were more male than female in the subsectors. It is noteworthy that these occupations involve high level of education and investment capital, respectively, which the female tends to be disadvantaged. The social and monetary benefits of such professions may also be much; hence, being a motivation to young people to take up the professions. The data in Table 22 show that the mean ages of AEAs (34.5 years) and agro-input dealers (38.0 years) were lower than that of agro-output traders (almost 40 years). Also, agro-inputs dealers travelled an average of 220km to purchase goods from their suppliers, which probably attracted additional cost to the final products.

Table 22: Basic information of the three intermediaries

	Gender		Education		Age	Experience	Distance
	Male (%)	Female (%)	Tertiary (%)	Below Tertiary (%)	Mean (Years)	Mean(- Years)	Mean (Km)
AEAs	72.0	28.0	95.1	4.9	34.5	6.5	-
Agro-Output Dealers	40.0	60.0	2.0	98.0	40.9	14.2	-
Agro-Input Dealers	76.0	24.0	31.7	68.3	38.0	8.7	220.0

Source: Field survey, 2021

The data in Table 23 show that AEAs and agro-input dealers, unlike the agro-output dealers, had all ICT tools listed in the study. Smartphone was more common among AEAs (98.0%) than agro-output dealers (38.8%) and agro-input dealers (31.5%). On the other hand, basic phone was common among agro-output dealers (92.0%), compared to AEAs and agro-input dealers. While tablet and computer were unreported for agro-output dealers, majority of AEAs (68.0%) had tablet and computer. Also, more AEAs and agro-input dealers had TV and radio than agro-output dealers (Table 23).

Table 23: Type of ICTs use among intermediaries

	Feature Phone (%)	Smart Phone (%)	Basic phone (%)	Tablet (%)	TV (%)	Radio (%)	Computer (%)
AEAs	21.0	98.0	28.0	28.0	71.0	73.0	68.0
Agro-Output Dealers	11.5	38.8	44.6	-		5.1	-
Agro-Input Dealers	92.0	31.5	63.4	13.4	63.4	62.2	25.6

Source: Field survey, 2021

Mobile phones (99%) were widely used among the intermediaries, especially AEAs, to receive and/or send information to other value chain actors, including farmers, who are their main clients. A similar scenario was observed for agro-output and agro-input dealers. The information so shared largely related to farming practices, payments, cost of agro-inputs and outputs, etc.

Frequency of Use of ICTs for Professional Activities among intermediaries

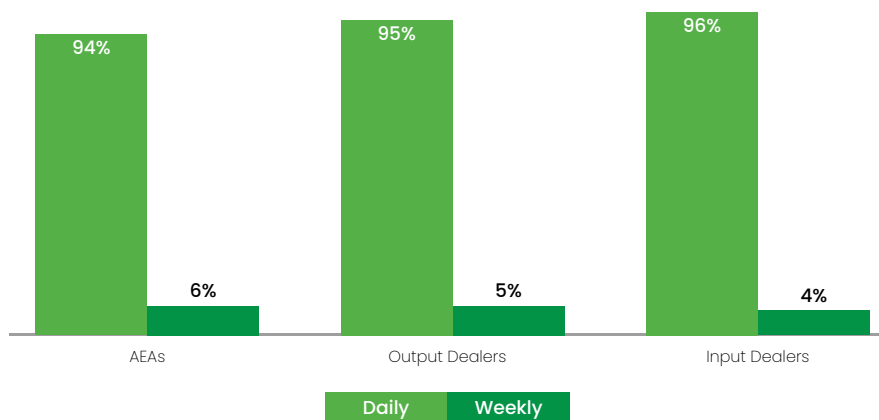


Figure 14: Frequency of use of ICTs among intermediaries

Source: Field survey, 2021

The frequency of use of ICT tools was very high for all three intermediaries. Figure 14 shows data on the daily and weekly use of ICTs for professional activities. It appears that the frequent use of ICTs led to increased profitability of the businesses, as there was daily use of ICTs among agro-input dealers (96%), compared to AEAs (94%) and agro-output dealers (95%). This also reflected in the profitability of their businesses, as 87.8% of agro-input dealers reported improved profitability, compared to AEAs (75.9%) and agro-output dealers (87.1%) (see Figure 20)

Digital skills/knowledge: Digital skill/knowledge was observed to be high among AEAs than agro-output and agro-input dealers. Not surprisingly, AEAs had more modern ICTs, like tablet, smartphone and computer than agro-output and agro-input dealers (see Table 23). While the ICT tools possessed by AEAs and agro-input dealers were well utilized because of their level of skills/ knowledge, same could not be said for those of agro-output dealers. Not less than 92.9% of AEAs could use internet services and applications, compared with 30.5% and 29.1% of agro-input and agro-output dealers, respectively. It appears that educational level and age (youthfulness) correlated positively with digital skills or knowledge of the intermediaries. As could be observed in Table 22, educational level was higher for AEAs and agro-input dealers than for agro-output dealers. Similarly, the mean ages of the AEAs and input dealers were lower than that of the agro-output dealers.

Table 24: Factors hindering use of ICTs among intermediaries

Factor	AEAs (%)	Agro-Output Dealers (%)	Agro-Input Dealers (%)
High cost of ICT gadgets	21.0	29.0	60.4
Not critical to professional activities	56.6	-	-
Lack or poor network connectivity	-	-	66.7
Lack or poor energy supply	3.9	-	-
Others	-	15.1	5

Source: Field survey, 2021

The main hindrance to the use of ICT tools among all three intermediaries was the cost of purchase and maintenance of these tools. Among agro-input dealers, 60.4% reported high cost of purchase as a challenge, while AEAs and agro-output dealers reported 21.0% and 29.0%, respectively. While agro-output dealers reported no hindrance related to poor network connectivity, 3.9% and 66.7% of AEAs and agro-input dealers, respectively, observed poor network connectivity. Ironically, AEAs possessed most of the modern ICT tools (see Table 23), but 56.6% of them reported their use as incidental in their professional activities. Limited knowledge in the use of ICT tools was reported for agro-output and agro-input dealers as a constraint.

Impact of ICTs use among AEAs, agro-output and agro-input dealers

There are several identified benefits of ICT use in professional activities among all three intermediaries (Table 25). In each of the general benefits of ICTs use (improve business interaction and profitability), it was observed that no less than 75% of the three intermediaries reported improved benefits. Ironically, although AEAs possessed most of the ICT tools, they reported the least benefits; they also reported that ICT use was not critical to their professional activities (Table 7).

It is important, therefore, that further investigation is conducted in this regard. Why is it that AEAs, who are more educated and should rely heavily on ICT tools for research and dissemination of findings or information to their clients (producers), reported less reliance on these tools? However, this may be due to the fact that these AEAs were mostly public sector employees, whose performance was not driven by monetary or profit intent, unlike agro-output and agro-input dealers, who were of the private sector.

Table 25: Impact of ICTs use among intermediaries

		AEAs		Agro-Output dealers		Agro-Output dealers Agro-Input dealers	
		Assist producers at production stage (%)	Assist producers at marketing stage (%)	Interact with producers and buyers (%)	Improve ability to run business (%)	Interact with agro- input suppliers and buyers (%)	Improve ability to run business (%)
Age	Below 25	100	100	84.6	84.6	100	92.3
	25-35	100	73.2	93.5	93.5	85.2	81.5
	36-45	100	88.2	95.6	88.9	93.8	87.5
	46-55	100	100	81.8	78.8	94.7	89.5
	Above 55	100	50	88.5	88.2	100	87.9
Education	Primary	-	-	28.3	76.2	94.1	88.2
	Sec- ondary	100	100	92.9	95.2	89.3	78.6
	Voca- tional	100	100	100	100	-	-
	College	100	100	100	100	100	100
	Univer- sity	100	100	100	100	91.3	91.3
	Others	-	-	87.5	87.5	100	100
Intermediary type		100	76.8	88.5	87.1	92.7	87.8
Phone type	Basic	9.8	11.1	87.1	87.1	90.0	86.7
	Feature	4.9	50.0	95.2	95.2	100	100
	Smart	98.8	76.5	88.1	85.1	93.0	87.7

		AEAs		Agro-Output dealers		Agro-Output dealers Agro-Input dealers	
		Assist producers at production stage (%)	Assist producers at marketing stage (%)	Interact with producers and buyers (%)	Improve ability to run business (%)	Interact with agro- input suppliers and buyers (%)	Improve ability to run business (%)
Type of agro-output dealer	Retailer	-	-	83.8	82.4	-	-
	Whole- saler	-	-	91.3	95.7	-	-
	super- market	-	-	100	100	-	-
	Aggre- gator	-	-	94.7	94.7	-	-
	Pro- ducers' selling agent	-	-	100	100	-	-
	Proces- sors	-	-	100	100	-	-

Source: Field survey, 2021

ICT tool use in professional activities during the Covid-19 pandemic was observed to increase or relate positively for all three intermediaries. For the three categories, more than half of the respondents observed had increase in the use ICTs during the Covid-19 pandemic. The data in Figure 15, show that 77.0% of AEAs had increase in ICT use, 63.0% for agro-output dealers and 53.6% for agro-input dealers.

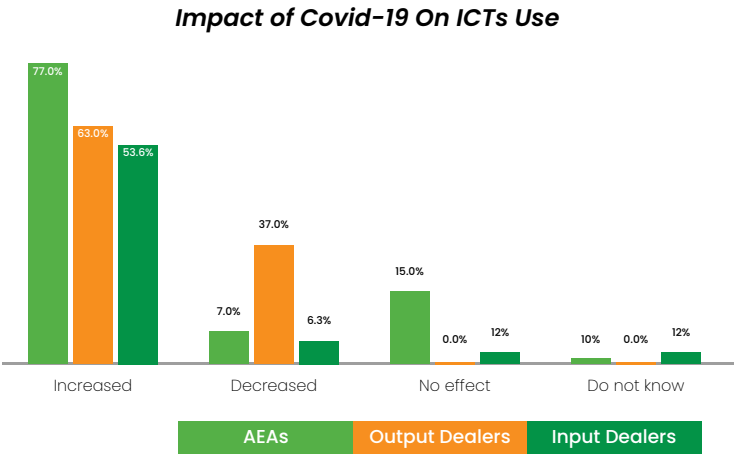


Figure 15: Effect of Covid-19 on ICTs Use among intermediaries
Source: Field survey, 2021

Although, there has been increased use of ICTs across the three intermediaries, usage was more pronounced among AEs, who incidentally attained high educational level and possessed most of the ICT tools (Tables 22 & 23). The AEs reported an increase in the use of ICTs in the Covid-19 period. However, the majority had indicated earlier that usage was not critical to their professional activities (Table 6). Therefore, it is possible that Covid-19 restrictions compelled them to use ICT tools more for their professional activities.

Conclusion and Policy Implications

The use of ICTs for business transaction is expected to improve transactions and promote business growth. This study analysed the use of ICTs by intermediaries in the agricultural sector in Ghana with the view to understanding how the use of ICTs affected the ability of intermediaries in the sector to perform their professional activities and improve their businesses.

Among others, the study observed that the most used ICT tool by the intermediaries was mobile phone, as compared to computer, tablet, television and radio. The study found that the use of smart phone was more common among AEAs and agro-input dealers than agro-output dealers. The mean age was lower and education level was higher for AEAs and agro-input dealers than agro-output dealers. These two factors, lower mean age (youthfulness) and relatively higher educational level might have led to the high level of use of smart phone among AEAs and agro-input dealers.

The phone usage was found to be on daily basis; it was used for voice communication and other business-related matters. Among agro-input dealers, it was used to call customers, while AEAs used it to contact farmers. However, mobile phone usage for business-related transactions was more pronounced among AEAs and agro-input dealers. Moreover, its use for internet and social media access was common among AEAs and agro-input dealers than agro-output dealers. The main constraints to ICT use were high cost of ICT gadgets and poor network connectivity.

The level of digital knowledge was also found to be higher among AEAs and agro-input dealers than agro-output dealers. Specifically, AEAs could perform several activities with mobile phone, and they had additional ICT gadgets like computer and tablet.

Generally, across the three intermediaries it was observed that the level of use of ICTs for professional activities increased marginally in the Covid-19 pandemic era. This may be so in order to observe the Covid-19 protocols (one of which is social distancing). This outcome may also be caused by improved access to ICT gadgets and network connectivity.

Findings from the survey also showed that ICTs improved business interaction and profitability; but this also had some cost implications, depending on the level of usage. They helped AEAs to provide better services to farmers in terms of access to research findings on field problems; they helped agro-input dealers to connect with more customers and access better market information

on availability of different types of inputs; while they provided for agro-output dealers greater access to information on producers and buyers. Across the three intermediaries, increased ICT use (particularly mobile phone) had positive effects on the quality of respondents' interactions, reducing stress and time hitherto required for physical business transaction.

Finally, increased ICT use improved business interactions and profitability. Therefore, policies (e.g. tax incentives) that will promote lower cost and tariffs in the use of ICTs for businesses should be encouraged and promoted. There should be increased investment in telecommunication service provision to improve the quality of services. There is also the need to educate the study intermediaries on contemporary uses of ICTs in agricultural businesses and skills development.

References

- Alex, G. (2019). Understanding the complicated role of input suppliers in agricultural extension and advisory services. Available at <https://agrilinks.org/post/input-supplier-roles-agricultural-extension-and-advisory-services> (Retrieved 20 April, 2021)
- Ayisi Nyarko, D. & Kozári, J. (2021). Information and Communication Technologies (ICTs) usage among agricultural extension officers and its impact on extension delivery in Ghana. *Journal of the Saudi Society of Agricultural Sciences*, 20(3):164–172. <https://doi.org/10.1016/J.JSSAS.2021.01.002>
- Baumüller, H. (2018). The little we know: an exploratory literature review on the utility of mobile phone-enabled services for smallholder farmers. *Journal of International Development*, 30: 134–154.
- BBC (2021). Ghana 2021 population census figures: Ghana new census show population hit 30.8 million. Retrieved from <https://www.bbc.com/pidgin/58658816> (accessed 10 October 2021)
- Danso Abbeam, G, Ehiakpor, D. S. & Aidoo, R. (2018). Agricultural extension and its effects on farm productivity and income: insight from Northern Ghana. *Agriculture & Food Security*, 7 (74): 1–10. Available at <https://doi.org/10.1186/s40066-018-0225-x>
- El Bilalia, H. & Allahyari, M. S. (2018). Transition towards sustainability in agriculture and food systems: Role of information and communication technologies. *Information Processing in Agriculture*, 5 (4): 456–464.
- FAO. (2015). E-agriculture 10 year review report: implementation of the World Summit on the Information Society (WSIS) Action Line C7. ICT Applications: e-agriculture, by Kolshus, K, Pastore, A, Treinen, S. & der Elstraeten, V. Rome, Italy
- Krausova, M. & Banful, B. A. (2009). Overview of the agricultural input dealer sector in Ghana. IFPRI, Draft Paper, US: Washington DC. Available at <https://www.csir.org.gh/index.php/multimedia/news/item/505-csir-institute-designs-digital-apps-to-support-agricultural-productivity-dissemination>. (Retrieved 19 August 2021)
- Malabo Montpellier Panel (2019). Byte by Byte: policy innovation for transforming Africa's food system with digital technologies. Malabo Montpellier Panel, Dakar.
- MOFA (2018). Youth in agriculture. Available at <https://mofa.gov.gh/site/programmes/youth-in-agriculture> (Accessed 01 November 2021)
- Omari R, Frempong G, Tetteh E.K, Adams, A, Baah-Tuahene, S, Karbo, R. & Ampadu-Ameyaw R. (2020). Status and readiness for ICTs in Ghana's agriculture. *FARA Research Report*, 5(8), 1–94
- Sennuga, S. O, Conway, J. S. & Sennuga, M. A. (2020). Impact of information and Communication Technologies (ICTs) on agricultural productivity among smallholder farmers: evidence from sub-Saharan African communities. *International Journal of Agricultural Extension and Rural Development Studies*, 7 (1): 27–43.
- Tsan, M., Totapally, S., Hailu, M. & Addom, B.A. (2019). The digitalisation of African agriculture report launch. CTA, Wageningen.
- Yamane, T. (1967). *Elementary sampling theory* prentice. Inc. Englewood Cliffs. NS, USA

APPENDIX

		AEAs						Agro-Output Dealers								Agro-Input Dealers							
Before Covid-19	A		Min-6	Ave-359	Max-7000			Min-1	Ave-111	Max-500					Min-5	Ave-283	Max-2500						
	D	62.2						25.2								40.2							
	E	Di	DL	li	IL			Di	DL	li	IL				Di	Di	li	IL					
		5.9	11.8	54.9	27.5			2.9	11.4	48.6	37.1				3.0	9.1	48.5	39.4					
	H	Hardly any	A few	Many	Most	All		Hardly any	A few	Many	Most	All			Hardly any	A few	Many	Most	All				
		6.3	42.9	27.0	19.0	4.8		11.8	37.3	33.3	17.6				5.6	33.3	30.6	30.6					
	K	Daily	Weekly	Fort-nightly	Month-ly	Quar-terly	>quar-terly	Daily	Weekly	Fort-nightly	Month-ly	Quar-terly	>quar-terly		Daily	Weekly	Fort-night-ly	Month-ly	Quar-terly	-	>quar-terly		
		52.1	25.0	8.3	6.3	4.2	4.2	20.0	51.4	14.3	8.6	5.7	-		62.5	25.0	4.2	4.2	4.2		-		
	L	65.9						28.1							39.0								
	M	Di	DL	li	IL			Di	Di	li	IL				Di	DL	li	IL					
		5.6	18.5	53.7	22.2			12.8	15.4	41.0	30.8				-	6.3	59.4	34.4					
	N	67.1						30.9								39.0							
	N	Di	DL	li	IL			Di	DL	li	IL				Di	DL	li	IL					
	21.8	65.5	9.1	3.6			16.3	55.8	20.9	7.0				31.3	56.3	6.3	6.3						

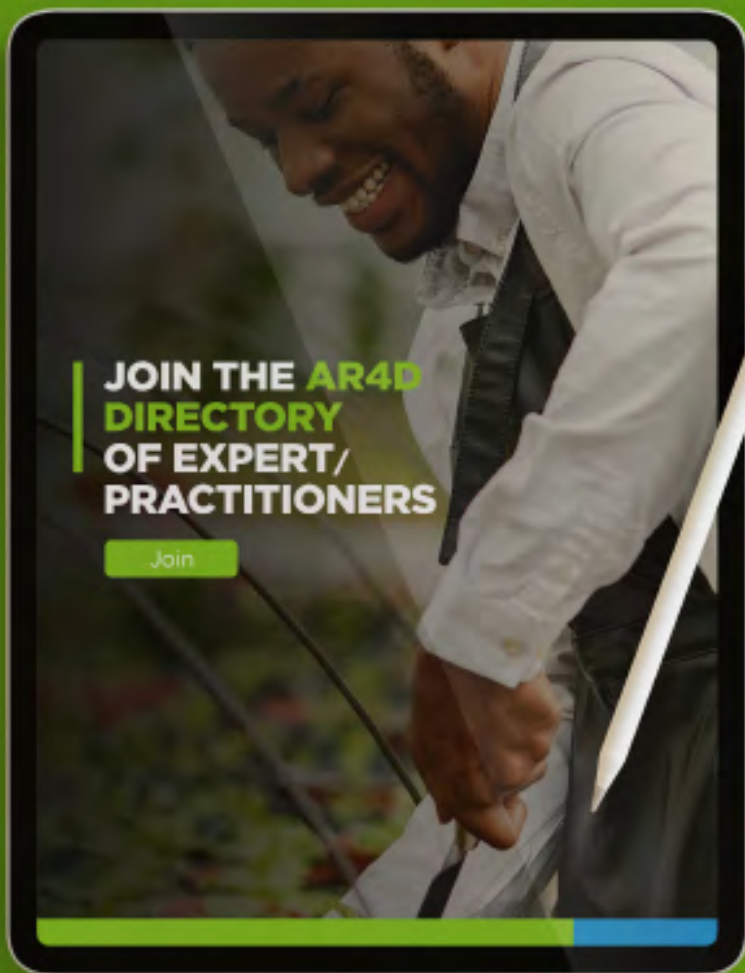
		AEAs						Agro-Output Dealers							Agro-Input Dealers						
During Covid-19	B		Min-5	Ave-271	Max-10000			Min-0	Ave-39	Max-300					Min-0	Ave-144	Max-1500				
	C	75.6						45.3							62.2						
	F	Hardly any	A few	Many	Most	All		Hardly any	A few	Many	Most	All			Hardly any	A few	Many	Most	All		
		18.3	22.0	40.2	18.3	1.2		38.8	37.7	17.3	8.6	3.6			30.5	31.5	30.5	7.5	-		
	G	76.8						36.7							43.9						
		Daily	Weekly	Fort-nightly	Monthly			Daily	Weekly	Fort-nightly	Monthly	Quarterly			Daily	Weekly	Fort-nightly	Monthly	Quarterly		Never
	I	27.0	42.9	12.7	17.5			19.6	35.3	5.9	35.3	3.9			25.0	36.1	5.6	25.0	5.6		2.8
	J	76.2						68.6							66.7						
	P	Daily	Weekly	Fort-nightly	Monthly	Quarterly	Less than quarterly	Daily	Weekly	Fort-nightly	Monthly	Quarterly	Less than quarterly	Never	Daily	Weekly	Fort-nightly	Monthly	Quarterly	Less than quarterly	Never
		37.8	43.9	8.5	7.3	1.2	1.2	25.9	29.5	9.4	23.0	2.9	0.7	8.6	36.6	31.7	8.5	17.1	2.4	1.2	2.4
	Q	56.1						37.4							40.2						
	P	Daily	Weekly	Fort-nightly	Monthly	Quarterly	Less than quarterly	Daily	Weekly	Fort-nightly	Monthly	Quarterly	Less than quarterly	Never	Daily	Weekly	Fort-nightly	Monthly	Quarterly	Less than quarterly	Never
		47.8	28.3	6.5	6.5	4.3	6.5	11.5	50.0	26.9	21.2	1.9	-	-	51.5	30.3	6.1	6.1	1.9		

Di, DL, li, IL are 'decreased a little', 'decreased a lot', 'increased a little', and 'increased a lot' respectively

A	Number of producers/customers interacted with in a busy month before the Covid-19 pandemic.
B	Number of producers/clients interacted with in a busy month during the Covid-19 pandemic?
C	How Covid-19 pandemic changed A
D	Change in number of producers/clients interacted, five years prior to the Covid-19 pandemic as the result of using mobile phone
E	How D changed
F	Share of producers/clients interacted with using mobile phone in a busy month during the Covid-19 pandemic

How Covid-19 pandemic changed F

H	Share of producers interacted with using mobile phone in a busy month before the Covid-19 pandemic
I	Frequency of interaction with producers in a busy month during the Covid-19 pandemic
J	Effect of Covid-19 pandemic I
K	Frequency of interaction with producers/clients in a busy month before the Covid-19 pandemic
L	Change in frequency of interaction with clients/producers, five years prior to the Covid-19 pandemic, as result of using mobile phone
M	How L changed
N	Change in frequency of face-to-face communication with producers/clients as a result of using your mobile phone
O	How N changed
P	Frequency of interaction with producers using your mobile phone in a busy month during the last year
Q	Effects of Covid-19 pandemic on P
R	Frequency in a busy month before the Covid-19 pandemic



Are you an AR4D expert
and want to be part of
the continental pool of
Agricultural experts ?

CLICK HERE TO
REGISTER





Forum For Agricultural Research In Africa

Headquarters 12 Anmeda Street, Roman Ridge

PMB CT 173, Accra, Ghana

Tel +233 (0) 302 772823 / 779421

Fax +233 (0) 302 773676

Email info@faraafrica.org

www.faraafrica.org



ISSN: 2590-9657